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Weather and Landscape in Eighteenth-Century Cumbria: Towards Inhabited Perspectives on Climate Change

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Abstract

This thesis asks whether there is a role for weather in archaeological narratives. It reviews how other disciplines have developed a sense of climate that is embedded in the human experience of landscape. Then, through the case study of late eighteenth-century Mosser – a small township on the edge of the Cumbrian fells – the thesis examines how and whether experiential perspectives can be incorporated into studies of past climate-society interactions by focussing on weather. This is achieved through the production and comparison of three narratives of change: environmental, landscape and experiential.

Existing palaeoclimate studies are examined and critically evaluated in the context of Mosser. An environmental model is constructed for Mosser using Martin Parry's method for identifying climate-caused abandonment on the Lammermuir Hills.

A range of secondary sources are used to place eighteenth-century Mosser in historical context. Results from hedge, boundary and upland walkover surveys are analysed, and a combination of primary map and documentary sources are used to examine the Mosser landscape.

An experiential narrative is developed from the diaries of Isaac Fletcher and Elihu Robinson, spanning 1756-1805. Qualitative statements on weather are translated into numerical records and compared with instrumental series. The diary entries are analysed to give insights on attitudes to weather in the early modern period.

When the narratives are compared, sparsity of data and poor chronological resolution prevent close correlation of trends and events; causality cannot be established. Narratives only become united when interpretation moves away from cause and effect to describe how people's relationships with climate were transformed as part of a wider transition into modernity.

The thesis concludes by reflecting on the wider implications of the case study, and it relates the experiences of the eighteenth-century diarists with current approaches to climate within archaeology. Overall, the thesis demonstrates that weather is a material condition of landscape – something as much open to archaeological investigation as any other aspect of the past.

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Chapter 1: Introduction

> *For me, a landscape does not exist in its own right, since its appearance changes at every moment; but the surrounding atmosphere brings it to life – the light and the air which vary continually. For me, it is only the surrounding atmosphere which gives subjects their true value.*
>
> Claude Monet

Weather and Climate

It is popularly thought that the British obsession with the weather stems partly from its functionality as a useful topic for impersonal yet polite conversation (Harley 2003), but it could also be suggested that it stems from the way in which it permeates multiple facets of day-to-day living. Even when spending most of our time in buildings and vehicles designed to control and mitigate the effects of weather, we have never quite managed to gain mastery over it. Engagement with the weather is part of the reality of our existence and of past people's existence, but it is something that is rarely explored within archaeology.

There are some exceptions. At the beginning of his essay on approaches to perception in landscape archaeology, Robert Johnston (1998: 54) contrasts two versions of the same scene: a small group of prehistoric roundhouses located high on a mountainside in north-east England. On one hand, the houses can be perceived in a "hostile landscape"; on the other, they are nestled in "a comfortable and agreeable landscape". The difference in interpretation is simple: the first scene is observed on a cold, foggy winter's morning, and the second in the warmth of a clear summer afternoon (Johnston 1998: 54). Christopher Tilley notes a similar effect when responding to Tim Ingold's (2005: 128) comments on *The Materiality of Stone*, stating that "weather alters the landscape so people perceive these landscapes differently." In these examples, however, the weather is merely the backdrop to human action – something that acts on the land, that contextualises experience and archaeological observations, but does not require investigation. Even when Tilley (Ingold 2005: 128; 2008: 272) suggests that an archaeology of weather might be developed, the weather is conceived as a separate sphere of research, isolated from the rest of the landscape.

In contrast to weather, climate has received growing attention within archaeology over the last two decades. Concerns about global environmental change have galvanised support for research initiatives that address the relationship between social and environmental processes. In some cases, the experiences of past societies have been seen to offer parallels for dealing with contemporary environmental change (Crumley 1994c; Diamond 2005). The view commonly espoused is that archaeology is uniquely positioned to explore the effects of climate change, because its historical perspective affords the ability to examine large scale, long term human and environmental processes (Mitchell 2008; Van de Noort 2011; Rowland 2010). This agenda has been supported by the discovery of a wide array of proxies for palaeoclimate reconstruction that are, for the most part, poorly suited to high resolution studies of weather (Bell and Walker 2005). Consequently, climate, defined by Lamb (1972: 5) as “the sum total of the weather experienced at a place in the course of a year and over the years,” is how weather is currently expressed within archaeology. A review of the index of the recently published *Handbook of Landscape Archaeology* reveals 20 references for 'climate', with many more for associated topics such as climate reconstruction, climate change and climatic impacts on human populations (David and Thomas 2010b). Looking up 'weather', one is greeted by numerous references to weathering, but none for weather itself.

Although researchers have long been interested in identifying and characterising relationships between climate and social history, they have often struggled to do so (Crate and Nuttall 2009; Lamb 1982; McIntosh et al. 2000b; Rothberg and Rabb 1981; Strauss and Orlove 2003b; Wigley et al. 1981). This is understandable given the difficulties in integrating data sets that are produced from a variety of different methods and scales of analysis. In archaeology, these have reflected the wider paradigmatic split between processual and interpretive archaeologies. Nevertheless, recent conceptualisations of 'climate change archaeology' have downplayed theoretical and methodological differences. Robert Van de Noort (2011: 1046–7) has stated that “different theoretical strands in archaeology are not in opposition when it comes to explaining the diverse connections between climate, environment, landscape and people”. Problematically, however, with so much emphasis on land and sea, few examples of climate change archaeology appear to be focussed on climate, and much less on the lived experience of climate – the weather.

In response to these issues, this project aims to explore the interfaces between subjective, embodied experience of weather and the scientifically reconstructed climate. It aims to achieve this by studying the 'weather history' of an upland parish in Cumbria, where there are both good climatic reconstructions and a day-by-day account of weather, farming and landscape change in the late eighteenth-century. The research investigates ways of integrating three different archaeological narratives – environmental, landscape, experiential – during a study of the human experience of weather and climate in the past. Importantly, through the study of two historical diaries, it provides local, inhabited perspectives on interactions with weather and climatic change, helping overcome the predilection for generalisation inherent in traditional interpretations and methods of investigation. This approach is then evaluated to provide insights on how issues of climate and climate change might be better addressed in archaeological research. In exploring these issues, the project touches on issues of scale, the role of modelling in archaeology, and the pervasive influence of modernity in both the case study and contemporary investigations of weather and climate.

The Case Study

The project focuses on a single case study area, Mosser, during the late eighteenth century. Mosser is a small upland former township on the north-west edge of the Lake District National Park, Cumbria. Its landscape can roughly be divided into three zones: the parliamentary enclosure on the upper hill slopes, the improved fields used for stockgrazing and arable, and the wet lowlands at the valley bottoms. Although sheep and cattle farming form the predominant agricultural activity in the present day, relict cultivation ridges indicate the prevalence of crop farming in the past (Figure 1). With such diversity of landscape occurring over a relatively small area and on the edge of the marginal uplands, Mosser was chosen in part for its likely sensitivity to climate change. In addition, two historical diaries from the nearby area span the period from 1756 to 1805. Within each, the diarists – Isaac Fletcher (Winchester 1994) and Elihu Robinson (RSF RSS Box R3) – have left a detailed record of weather that can be set against first-person perspectives on rural life in Cumbria during the late eighteenth century. By focussing on this period, it is also possible to draw instrumental weather records into the analysis, as well as explore the turbulent years at the end of the eighteenth century, when war, weather and social unrest threatened the stability of the nation.

Figure 1: The Mosser landscape. Looking east towards Mockerkin How.

Thesis Structure

The following two chapters place the thesis in wider context, they demonstrate the validity of the research questions and outline the theoretical approach. A literature review (Chapter 2) first examines the many ways in which past climate has been conceptualised and mobilised in studies of human societies. The review is then extended (Chapter 3) to consider how socially embedded perspectives on the past have found ground in archaeology, but have not yet been employed effectively in studies of links between climate and society. This is despite a growing body of anthropological literature that describes how perceptions and interactions with the weather are inherently cultural phenomena (Crate and Nuttall 2009; Ingold 2011; Strauss and Orlove 2003b).

Analysis of Mosser then progresses through three different narratives. The first, the environmental narrative (Chapters 5 and 6), contrasts regional palaeoecological syntheses with more targeted studies. It examines how climatic changes have been correlated with changes in land use, and how technical developments have improved research. A second aspect of this narrative draws on the work of Martin Parry (e.g. 1975, 1978; Parry & Carter 1985). Parry's method for linking climate changes to post-medieval settlement abandonment in the Lammermuir Hills has been influential in studies of upland Britain (e.g. Lamb 1982; Evans 2003). Here, the method is evaluated as it is applied to Mosser, resulting in an environmental model that uses instrumental weather records to 'retrodict' landscape changes as climatic thresholds to cultivation move up and down slope over time.

The second narrative (Chapters 7, 8 and 9) combines published histories of Cumbria with archaeological survey and archival research. It first discusses the main themes of historical debate concerning eighteenth-century Cumbria, before results from the archaeological survey and archival research are used to paint a detailed picture of society, economy and farming in Mosser during the eighteenth century. Efforts are made to identify how periods and processes of social and economic change were constituted by changes in the landscape. These findings are then placed within the wider historical context.

The third narrative (Chapter 11) focuses on the experiences of two eighteenth-century diarists. In the first instance, this involves using methods from historical climatology to translate comments about the weather into numerical data that can be used to reconstruct a 'weather-history' of Mosser. Also examined are specific comments and themes arising from the diaries, exploring how the diarists' interactions with the weather were integral to the work on their farms and going about their daily lives. The final aspect of this narrative involves looking beyond the text of the diaries to investigate how writing about the weather reveals insights into the diarists' attitudes and perceptions of weather, and how these relate to their personal cosmologies and world-views.

Two comparison chapters (Chapters 10 and 12) assesses the degree of correlation between the three narratives, and explore the difficulties entailed in comparing results produced at different scales and using different methods of analysis. The aim is to integrate each narrative within a holistic landscape history, one that better understands the relationship between climate, socio-economic processes and wider social history. A final discussion (Chapter 10) evaluates this approach and asks whether embodied experiences of *weather* can be reconciled with scientific reconstructions of *climate.* It questions whether the three types of investigation can indeed be integrated as part of detailed landscape approach, which links individual experience with the long term, broad scale inferences of archaeological research. Throughout the discussion, the project draws on and develops theories about the interaction of past peoples with the environment, and re-opens debate on the role of climate within social archaeology.

Chapter 2: Studying Climate and Human History

Introduction

Any discussion of the role of climate in archaeological interpretation must acknowledge nearly 100 years of debate on the relationship between climate and society. This chapter explores some of the main themes of this debate, from environmental determinism, to catastrophism, historical ecology and complex modelling. It looks at how the subject has been tackled from different perspectives in different disciplines, spanning the humanities and natural sciences. The chapter also assesses how the wider paradigmatic debates in archaeology have impacted on how archaeologists approach the idea of climate, and how contemporary concerns of global environmental change have fed into recent conceptualisations of "climate change archaeology" (Van de Noort 2011). Throughout the analysis, it is possible to detect a shift away from defining relationships between climate and human history in formalist economic terms, towards more socially-embedded understandings of human-environment relations. Whereas this chapter focuses on applied research, the following chapter explores the philosophical and theoretical background to some of the major changes in thinking. Combined, these chapters identify flaws in existing archaeological approaches to climate, before suggesting ways in which they might addressed within new research – thereby guiding the approach employed within the case study (Chapters 4–12).

A Changing Climate

In *Climate, History and the Modern World,* H.H. Lamb (1982), one of the most prominent historical climatologists of the past century, summarises scholars' changing attitudes towards climate. He notes that before the advent of detailed meteorological records, people had no simple means of identifying climate trends. Consequently, climate, like race, was considered static and immobile, with only sporadic deviations from accepted norms (Lamb 1982: 9–10). Of course, such deviations were seen to have localised disruptive impacts, but the frequency of such events was not considered to have changed radically across the years. Climate, in this sense, was part of the fabric of the landscape. Immutable and unchanging, "Aristotle had described the 'natural character' of men respectively in the cold, warm and middle zones of the Earth, and so arrived at a basis for believing in the superior quality of the Greeks of his time" (Lamb 1982: 9). Similarly, Baron Montesquieu's 1748 *De l'Esprit des Lois* was an attempt to formulate laws of human reason and behaviour. These laws were based on a multitude of factors including, perhaps most importantly, "the nature of the terrain" (Jones 1992: 746). Continuing this line of reasoning, with a Darwinian twist, the economic geographer Ellsworth Huntington argued in 1924, firstly, that "the general distribution of civilization and progress depends largely upon climate" and, secondly, that racial character is determined through "natural selection arising most frequently under the stress of over-population and migration" (Huntington 1924b: vii). One key aspect of Huntington's work that distinguishes him from his forbears is his adoption of a climate change hypothesis. Termed the "Pulsatory Hypothesis", Huntington's work is based on the premise that climate has changed over time, primarily with the "location, number, and intensity of cyclonic storms as the main factor in climatic pulsations" (Huntington 1924a: 335). *Civilization and Climate* was printed in multiple editions, spanning at least 20 years, during which the Pulsatory Hypothesis changed quite markedly. Despite this, the notion of climate changes remained vital to Huntington's conclusions.

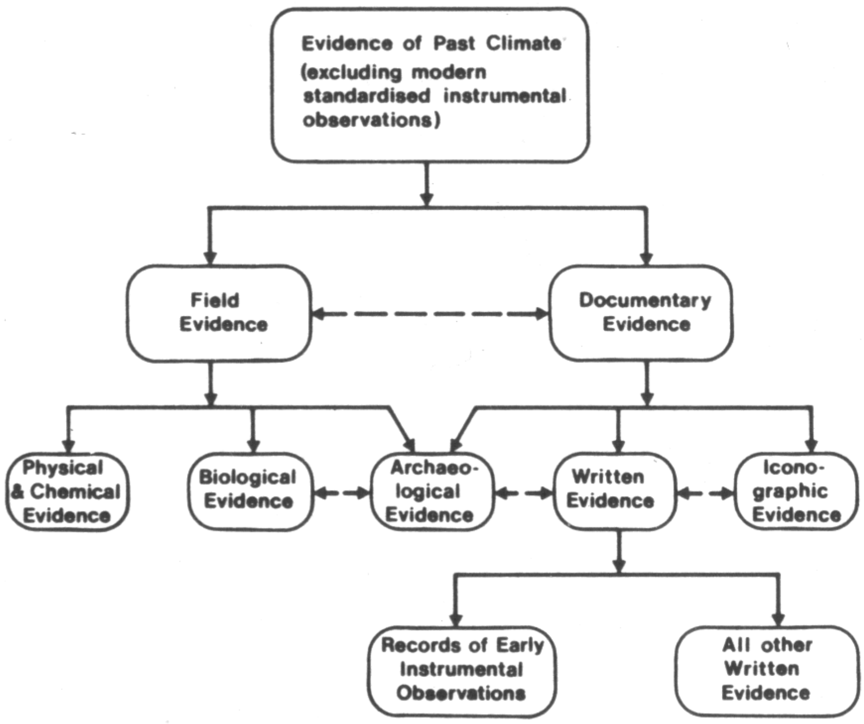

Figure 2: Evidence of Past Climate. Source: Ingram et al. 1981b: 181

Set out in the 1920s, Huntington's views were in part dependent upon the growth of the geological sciences during the nineteenth century, and the realisation that the past climate may have been more radically different than had previously been imagined (Lowe and Walker 1997). Certainly, subsequent work on the links between climate and human history cannot be divorced from the development of more refined understandings of past climates. In the decades since Huntington published *Civilization and Climate*, a wide range of palaeoclimatic proxies have been discovered, from which the characteristics of past climates can be deduced (Figure 2). This has shed light on the extraordinary dynamism of the climate throughout the ages. Crucially, "the discovery of millennial scale variability in climate is considered to be among the 'top ten' discoveries of the [twentieth] century" (Charles 1998; Rowland 2010: 387). It is this discovery that has challenged scholars to consider how such changes might have affected human history (Butzer 1982; Hulme and Barrow 1997; Lamb 1982; McIntosh et al. 2000b; Raikes 1967; Wigley et al. 1981).

Climate in Human Affairs

In the 1940s, Fernand Braudel, the prominent *Annales* School historian, divided the temporal rhythm into the slow moving *longue durée* of geographical time, medium-term deep historical structures of human history, and rapidly changing histories of events. In 1949, he claimed that the "roots of the social crisis caused by the food shortage that dominated the end of the [sixteenth] century may have lain in an alteration, even a very slight one, in the atmospheric conditions" (Braudel 1972 in De Vries 1980: 622). De Vries (1980: 623) points out that comments like this tended to be poorly substantiated, for Braudel and others at the time who held similar views, such as Lopez and Davis, were "not themselves historians of climate, and able only to offer illustrative evidence." Nevertheless, these three historians were fascinated by the notion that climate could have a persistent, underlying impact on the history of humanity. They each anticipated a "historiographical breakthrough that [would] give climate change a more central position in historical explanation" (De Vries 1980: 623). Gustav Utterstrom's (1955) study of 'Climatic Fluctuations and Population Problems in Early Modern Europe' epitomises this mid-twentieth century sentiment. Utterstrom denied that the social and political instability witnessed across Europe during the first half the seventeenth-century was due to a Malthusian population crisis (De Vries 1980: 622). Instead, Utterstrom invoked the Little Ice Age and a long period of climatic deterioration as the predominant factor in the economic stagnation of the early modern era (Le Roy Ladurie 1972: 8–9).

Utterstrom's theories were supported with what Emmanuel Le Roy Ladurie (1972: 8) described as “many but somewhat motley facts”. These, he argued, were primarily concerned with linking chronologies of economic hardship with chronologies of meteorological fluctuation. The links are not supported by rigorous statistical analysis, however, and Le Roy Ladurie (1972: 10) lamented that the result “is as if a historian or an economist were to try to demonstrate a lasting rise in prices by taking a few periodic peaks of a graph while taking not account of its general curve.” Through his attack on Utterstrom's work, Le Roy Ladurie revealed his own opinion, lambasting the 'anthropocentrism' within historical interpretations of climate where the pursuit of climatic periodicities and regularities were a prevailing theme. To Le Roy Ladurie (1972: 11), for every climatic explanation it was “easy to adduce a purely human and immediate consideration which is both adequate and intelligible.” In his eyes there was no need to supply a deeper climatic emphasis on human history when more immediate social, political and economic explanations were readily available. The approach that Le Roy Ladurie took paralleled developments in the climatic sciences, and it was one which became highly influential. He focussed his efforts on reconstructing past climates through the methods of historical research. Banished from this approach was any form of anthropocentrism – the impact on humanity was only to be considered once a climatic history could confidently be asserted. It led Le Roy Ladurie (1972: 119) to eschew grand claims of a climatically influenced human history, saying that “in the long term the human consequences of climate seem to be slight, perhaps negligible, and certainly difficult to detect.”

Le Roy Ladurie's (1972) *Times of Feast, Times of Famine* sits alongside the work of Hubert Lamb (1972, 1977, 1982), Christian Pfister (1981), and Gordon Manley's (1974) painstaking construction of the Central England Temperature series, at the root of modern historical climatology. Early work in historical climatology was primarily concerned with using the methods of the historian to reconstruct past weather and climates. Beyond these aims, however, there was no agreement on how their results could be related to human histories. For example, Lamb's (1982: 4) assertion that "there is no doubt that … the accumulating consequences of some tendency of the climate of previous years, has dictated human action" diverges markedly from the limited conclusions of Le Roy Ladurie. Whereas Le Roy Ladurie argued, with some justification, that there are cases where unusual weather events and extreme climates have influenced action, he sees no reason to suppose that such factors have any deep impact upon human history. For Lamb, the cumulative effect of such scenarios must engender some sort of long-term influence on human affairs. In both cases, however, the onus is placed on reconstructing climatic trends and events, conceptualisation of human response is a secondary issue.

Archaeology, with its broad scale and long term focus, provided a means by which Lamb and Le Roy Ladurie's theories could be tested, but there were a number of other influences guiding archaeological thought. Away from the focus on documents and economic history, the paucity of environmental and climatic data was partly responsible for archaeologists developing fairly deterministic characterisations of climate's impact on human societies. In the narratives constructed during the early to mid-twentieth century, climate helped to determine the environmental backdrop of human action. In this role, it constrained or enabled societies and their cultural development (Butzer 1972; Childe 1925, 1958; Clark 1969). Karl Butzer's (1972) *Environment and Archaeology* framed the deep prehistory of human development as a function of interactions with the environment. Thus in discussion of the origins of agriculture and the subsequent dispersals out of the fertile crescent, Butzer (1972) characterised the creation of new cultural groups as adaptations to new environmental circumstances, including climate. In this respect, the adoption of new techniques from the environmental sciences was helping to contextualise archaeological interpretations, "but there was not really a difference between how environmental archaeologists and cultural archaeologists thought" (Evans 2003: 2).

By the 1950s, 60s and 70s, climate change had been mobilised to help (partially) explain a wide range of archaeological phenomena, including mesolithic settlement patterns (e.g. Clark 1969; Mellars 1974), the origins of agriculture (e.g. Higgs and Jarman 1969, but see Flannery 1973), Bronze Age militarisation (e.g. Burgess 1974) and the collapse of complex societies (e.g. Sanders 1973; Bryson et al. 1974), amongst others. Within the emerging paradigm of New Archaeology, systems theory came to provide the over-riding mechanism of cultural change, in which behavioural ecology and sociobiology helped define the rules (Clarke 1968; Doran 1970; Friedman and Rowlands 1978; Sherratt 1982). Friedman and Rowlands (1977: 203) characterised the evolution of social systems as a set of processes organised within a "hierarchy of constraints", the ultimate constraint being the environment or ecosystem. Within their model, social structures were responsible for reproducing and transforming productive relations within societies, but only within bounds of possibilities determined by ecological context. Elsewhere, a more reductionist mode of thought described material culture as an "extra-somatic means of adaptation" (Binford 1972: 205). Here, evolutionary theory and optimal foraging theory (through site catchment analyses) could be combined to suggest that humans, like animals, coped with the natural environment in an economically rational manner (Foley 1985; Vita-Finzi and Higgs 1970). Thus when faced with changing climates, human adaptation was thought to involve the generation of new technologies and cultural norms to mitigate against environmental stress and rebalance the system towards equilibrium.

Amongst archaeologists, the environment came to be understood variously as the over-riding force operating on the cultural system, the driver behind adaptation, or, by utilising environmental archaeology, the evidence of climatic impact. Building on his earlier work, Butzer (1982) attempted to place systems theory in a wholly ecological setting. This had two core aims: firstly, to determine the characteristics of past environments and environmental processes, and secondly, to understand how human action is defined by systemic interaction with the environment (Butzer 1982: 6–7). Within this framework, Butzer (1982: 7–8) outlined a number of key concepts central to his programme of archaeological research: space, scale, complexity, interaction and stability. This approach placed great emphasis on methods that help define both environmental context and relations between social and environmental processes. Integral to this was rapidly advancing technology from within the environmental sciences, and the scientific methodology was complemented by interpretations framed in terms of energy flows, feedback loops and equilibrium. Although systems approaches were common at this time, Butzer (1982: 319) concluded that "civilizations behave as adaptive systems", operating in a dialectic relationship with the environment. It was, therefore, an approach that found middle ground between the more socially focussed and reductionist evolutionary models, but it was one where the environment retained a dominant role in the historical narrative.

In summary, in studies of the past during the mid-twentieth century, a number of developments placed climate at the centre of scholarly investigation. The growth of historical climatology as a discipline came in response to historians' limited understandings of past climates. The intention was to instead create an empirical framework for producing a history of climate. In archaeology, climate was subsumed within a wider appreciation of the environment as a constraining or enabling force in the development of human societies. With systems theory, these ideas were placed within mechanical descriptions of inter-related processes. Advances in the natural sciences prompted researchers such as Karl Butzer to develop approaches that required a greater focus on environmental reconstruction, and resulted in more people-focussed ecologies. Nevertheless, in both history and archaeology, the links between climate and human action remained under-explored and tended to be characterised by a 'soft' determinism. Here, climate – itself a determinant of the environment – was the ultimate influence on forms of economic activity or cultural expression (Coombes and Barber 2005; Evans 2003; De Vries 1980).

Response to Determinism

Responses to the modernist determinism of the 1960s and 70s came from slightly different angles within history and archaeology. In Anglo-American archaeology, the postprocessual critique of processual archaeology fought vigorously against a reductionism that described the products of human action and not the action itself (Barrett 1999; Hodder 1991; Shanks and Tilley 1987, 1992). Whereas New Archaeology had sought to define the laws of human behaviour, the post-structuralist critique focussed on questions of identity, representation, interpretation, power and politics, where "archaeologists conceptualise their material evidence, not as an external trace or record of a type of society, but as a medium of social practice" (Barrett 1994: 35). In the processual paradigm, "structure" was the thermodynamic system that deterministically ordered human societies through space and time. As a consequence of introducing Bourdieu's (1977) Theory of Practice and Giddens' (1986) Theory of Structuration into archaeological interpretation, "structure" has come to represent "'pre-understandings' which orientate the human subject, enabling that subject to act knowledgeably and effectively" (Barrett 1994: 36). Questions of social action are answered with reference to orientating structures which are produced and reproduced through knowledgeable human action: humans are afforded agency. In this we can see the influence of Émile Durkheim (1950), who asserted that social phenomena must be the result of social, rather than biological or psychological, processes. As a result, the complex strand of approaches that constitute the "post-processual condition" have downplayed (but not ignored altogether) the role of external agencies in social change (Preucel 1995). Although post-processual archaeologists have maintained an interest in environmental context, and do not explicitly seek to deny the influence of past climatic changes on human populations, "their work renders its role effectively invisible" (Van de Noort 2011: 1042–3).

Beyond the relatively confined sphere of post-processual archaeology, historians and historical climatologists maintained a keen interest in exploring the relationship between climate and human history. In fact, de Vries (1980: 624) argued that people "are psychologically ready, even eager, for the rise of climatic change as a vehicle of long term historical explanation, but do not possess the means of distinguishing its impact from among the many other variables at work on human society." The resulting discourse is worth considering in detail because it outlines many problems that are still relevant today when exploring the relationship between people and climates. At this time, there was a great deal of respect afforded to the "extraordinary ingenuity of the scientists … who … manipulated their physical findings to produce detailed information about weather and climate across centuries" (1980: 631). From this arose an insistent desire to better "integrate the new revelations with the familiar political, economic, and social landmarks" (Rabb 1980: 631) of traditional history.

Defining the Problems

Combined with this forward-looking optimism was a critique of past approaches to the subject. These ranged from issues surrounding the integration of new scientific data with more traditional historical processes, to debates about the kinds of case studies amenable to climate history research. The principal concern was that earlier studies had applied a simple form of determinism, when, as Anderson (1981: 339) argued, the "response of a social group to the challenge of climatic deterioration is unpredictable." Climates and climate change may have had an effect on human history, yet it is questioned "whether the effects can be isolated analytically in a study of long run economic change, and can convincingly be shown to have been an important determinant in the course of European history" (Anderson 1981: 339). In support, Robert McGhee (1981: 163) warned against the "facile" assumption that because two events occurred at approximately the same time, they should be related. Yet Ingram et al. (1981: 19) observed that this kind of approach, which uses a definition of proof based on a correlation of events and assumption of influence, "recurs again and again in the literature."

It was recognised that, in part, the problem lay in the various time-scales implicated in climate change studies (Rabb 1980: 252). Often, conclusions from climatology regarding long-term multi-decadal trends fail to address social, historical questions, where "only detailed local climate information will suffice for rigorous analysis of climate-society links" (Ingram et al. 1981: 11). Parry (1981: 321) highlights misunderstandings between climatologists and historians that contribute to the problem. Historical explanation is the product of a deductive approach based on *probable* causes and conditions. This approach has an "uneliminable subjective component, and is not open to analysis in the strictly deductive form which is most familiar to the climatologist" or scientist (Parry 1981: 321). Coupled with this is an assumption that technological progression "has enabled human societies to buffer the influence of weather with notable success" (Post 1980: 719). The humans of the more ancient past were, therefore, due to their lack of progression in terms of technological evolution, conceived to have been more susceptible to the elements. Braudel (1973: 18) once noted that "the rhythm, quality, and deficiency of harvests ordered all material life" in the preindustrial economy. The assumption was that it was through this agrarian economy that climate bent the path of human history (De Vries 1980: 601–2).

The implication for many historians is that synchronicity of climatic and socio-economic events, combined with the agrarian simplicity of past economies, is enough to attribute 'probable cause' to climate. Conversely, climatologists, harbouring limited knowledge of social, economic and philosophical theory relating to history, either defer to the their colleagues in history, or assume linkages based on simplistic notions of cause and effect. Le Roy Ladurie's (1972: 244) assertion that a long term 1°C temperature fluctuation is “slight, almost intangible” is highlighted by Parry (1981: 320) as indicative of a lack of scientific understanding amongst historians, and he goes on to instead argue that “in areas of marginal farming under a maritime regime, such changes would have produced a pronounced effect on the length of the growing season.” In response to this problem, David Fischer (1980: 822) called for a “synthesising venture”, where research is designed to cut across disciplinary boundaries. Theodore Rabb (1980: 831) supported this sentiment, claiming that “the danger of fragmentation is all too real, with separate sub-disciplines, indifferent to the preoccupations of their next door neighbours, multiplying the confusion rather than the coherence of our understanding of the past.” To emphasise this point, Lamb (1981: 294) warned that insularity can result in circular arguments: “the accusation has been heard of inventing climatic change to explain events in human history which are then held to prove the occurrence of a change in climate.”

As well as the problems entailed in formulating an interdisciplinary approach, there was a recognition that the general scarcity of information regarding past climates, and people's attitudes to them, was inhibiting interpretation (Ingram et al. 1981: 20). Despite widespread delight at the ingenuity of new methods in reconstructing climatological history, if one examines these methods in detail, a certain degree of caution becomes apparent. Lamb's (1977) second volume of *Climate: Present, Past and Future* contains, for example, a detailed guide to the methods most commonly employed, and yet he cautions that there is often an array of uncertainties associated with each: “These uncertainties include the margins of error of the physical measurements used, and of any dates, or values of the climatic variables derived therefrom by the methods described” (Lamb 1977: 21). It cannot be denied, however, that the understanding of past climates was progressively being improved. Instead of simply being expressed as multi-decadal trends of increasing or decreasing warmth or wetness, it was realised that climate change could involve changes of inter-annual variability and long runs of unusual weather. Hermann Flohn (1981: 317) observed that "extreme events often occur in groups of consecutive years", and it was thought that such episodes would likely have a greater human impact than long-term variations. For some, this information imbued a desire to examine cyclic regularities within climate and link these to human affairs (see Lamb 1982: 5). This, however, was derided by others as wishful thinking – the inability to link climatic cause with societal effects proving too great a barrier to regard cyclic histories seriously (Le Roy Ladurie 1972).

New Approaches to Studying Climate and History

Historians and historical climatologists went on to develop a range of approaches that aimed to satisfy the cogent critique of the late 1970s and 1980s. A first step was to lay out some priorities for research. A common call was to focus not on bridging across climatic and social chronologies using ever more complicated models of causation and ever more refined concepts of 'harm', but to explore the range of possibilities of human response, and how these vary in relation to the human experience of weather (Rabb 1980; De Vries 1980). For Rabb (1980: 837) this meant avoiding "blanket generalisations that make climate sound either decisive or insignificant in human affairs." Yet Rabb was united with Fischer (1980: 823) in wanting to work at broad scales that do not focus solely on localised empirical findings or abstract theoretical statements. Fischer (1980) argued that there should then be a progression through three stages: the empirical description of past climates, the exploration of the links between climate and culture, and an analysis of "middle range problems". This final stage is explicitly conceived to involve an examination of determinism, asking to what extent we can expect climate to control human action, and under what circumstances climate becomes less important in the historical narrative. In this respect, Theodore Rabb (1980: 837) did not expect to find simple causal relationships. Instead, "researchers could strive to establish the *range* within which these two mutual influences (climatic change and human action) operate." Importantly, that range might change according to the particular historical situation. For example, the relationships between climate and social history from 8000 BC to AD 1200 are likely to be markedly different from those seen in the early modern period, which are different from those that prevail today (Fischer

1980: 825–8).

These ideas and others are put into action in a number of case studies. Jan de Vries (1980), for example, employed a “probabilistic approach” that abandoned attempting to characterise the direct impact of changing climate patterns on crop yields. Instead, using an agricultural example, he demonstrated that the variability of human response can be seen in the changing crop mix. He went on to argue that this analysis can be formalised in a study of risk management strategies. Such models could then be used to predict under what circumstances disasters would have occurred, and the changes people could have made to avoid such situations. Contemporary human perception of the climate is foregrounded, as adaptability acts as a function of knowledge of the conditions and the resultant choices made. The probabilist aspect of the approach shies away from questions of harm done and modes of causality, aiming to avoid the pitfalls of deterministic thinking and, necessarily, opens up a range of hypotheses, generating research questions in the process. But Anderson (1981: 340) pointed out the sheer number of possible affecting factors “complicate to the point of impossibility the task of isolating analytically the climatic component of long-run historical change.” The solution developed by Anderson was an approach based on the idea that we should not assume climate change is a factor in social change unless we have explored every other possibility. His study of subsistence crises in the sixteenth and seventeenth centuries showed that social factors, such as disease, war, technology and economy, were dominant causes of change. Anderson (1981: 351) did, however, recognise that “local, and even regional, histories could well have been very different in the absence of changes in climate.” Therefore, the most fruitful lines of enquiry for someone wishing to examine the relationship between climate and history would centre on short-term impact analyses and shocks to the food procurement system.

An alternative is to try and model in advance the links between climate and society. This is the approach Pfister (1981) took when examining agricultural production in Switzerland during the Little Ice Age. Where such analysis becomes impossible due to the limitations of the dataset, “the case studies take on a more impressionistic character” (Ingram et al. 1981: 26). Martin Parry (1981) formalised this approach within a 'retrodictive' strategy (see also Chapter 6). This involves formulating an expected causal relationship between climate and society, which is then tested against the historical actuality (Figure 3). “If the retrodiction is refuted, then the model requires re-examining; if it is confirmed, then this evidence can be compared with data from independent sources. If there is a convergence of evidence to support the conclusion then the hypothesis can be said to be confirmed” (Parry 1981: 323). When applied in practice this approach allows the testing of a number of competing hypotheses and causal processes, provided enough information is available to make a viable retrodiction. At the core of Parry's approach is a distinction between brief climatic fluctuations, and long-term changes: short-term events are considered to increase in significance as long-term change alters the environmental resource base: “The degree to which agriculture and settlement were responsive [to brief fluctuations] depended, in part, upon their marginality” (Parry 1981: 331). In Parry's case study in Southern Scotland, the hypothesis was that climate change created an increasingly marginal environment, and should therefore be correlated with the most common occurrences of farmland abandonment. Successful correlation was observed in testing and a causal relationship was therefore presumed, albeit with a note of caution concerning the danger of circular arguments (Parry 1981: 333–4).

Much of the work reviewed thus far has predominantly been concerned with identifying incidences where climate change has impacted upon human society, whether in short episodes, or over longer stretches in time. During the early 1980s, there were also the beginnings of discussions on how these processes might be perceived by the people caught up in them. Did people identify and react to climate change on a conscious level, or was the change occurring without human knowledge? Moreover, in what ways were human reactions to clearly devastating events conditioned by existing socio-economic structures? Mooley and Pant (1981) discussed this particular question in reference to droughts in India over the past 200 years, while MacKay (1981) looked at people's religious responses to climatic calamities in fifteenth-century Castile. In the case of Mooley and Plant, it was argued that indeed “the extent of human suffering and mortality occasioned by drought in India [was], to a large degree, conditioned by inflexible and exploitative systems of social and economic organisation” (Ingram et al. 1981: 37). MacKay's (1981: 373) conclusion argued that “what to modern scholars may appear to be totally irrational and irrelevant explanations of weather phenomena, can turn out to be essential elements of the belief systems of those who had to account for the events of the world in which they lived." Both these studies, and this sort of approach in general, remind us that the human experience of climate is not necessarily limited to physical processes associated with the subsistence economy. People's understandings and reactions to climatic events were conditioned by their preconceptions and attitudes, and these were subject to change over time.

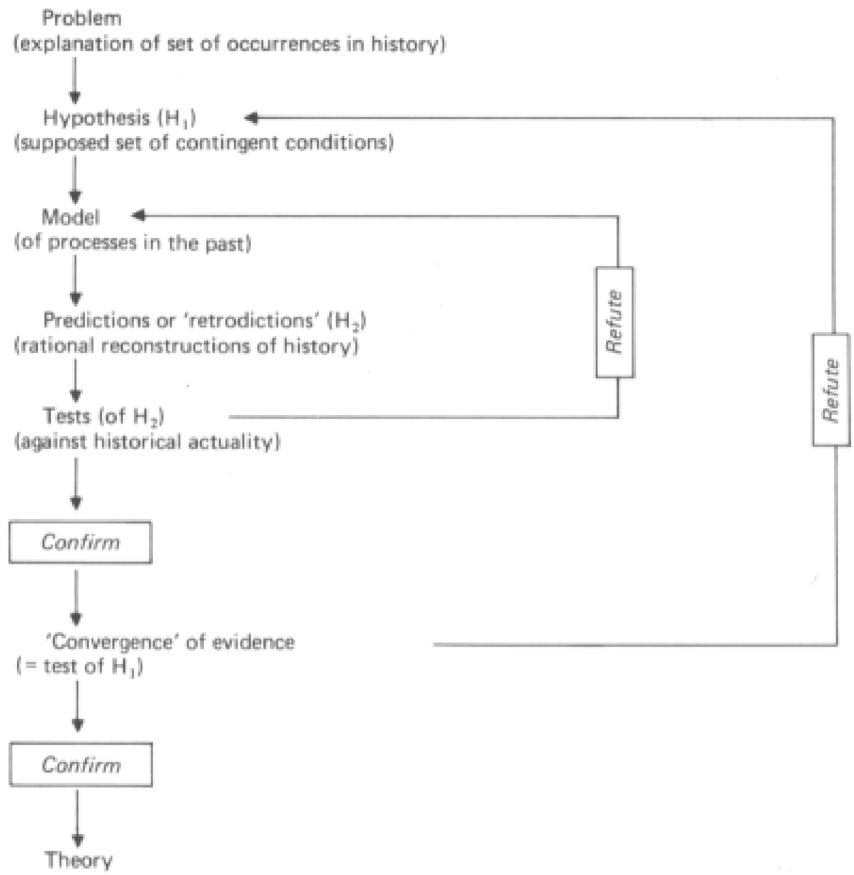

Figure 3: Martin Parry's 'retrodictive' strategy. Source: Parry 1981: 323

Summary

In response to the 'soft' determinism of the systems theory, Anglo-American post-processual archaeologists relegated climate to the margins of archaeological narratives. It was still considered important to reconstruct past environments, but climate was no longer seen as a prime mover in social transformations. Meanwhile, in contrast, the historical researchers of the late 1970s and 1980s were involved in a detailed critique of how past approaches had characterised the relationship between climate and human history. It was recognised that simplistic economic interpretations had employed a deterministic reasoning that, with advances in historical climatology, was increasingly lacking credibility. Anderson's (1981: 339) incisive observation that “'explanation' on the basis of correlation is simply rationalisation” is especially pertinent. There was a vibrant discussion of how quality research was impeded by barriers of understanding between the natural sciences and humanities, yet it was not forgotten that their knowledge of past climates was always likely to remain limited. Despite this consensus regarding the problems and, to a certain extent, how these then generated new priorities for research, a wide array of different approaches were produced to address the various issues. These ranged from the Occam's razor-style approach of Anderson, to Parry's more regimented hypotheses testing. Perhaps emblematic of the complexity of the issues involved, it was remarked of Parry's study that “it is sobering to realise that even in a marginal situation … the effects of long-term change cannot be identified with absolute certainty” (Ingram et al. 1981: 36). Yet importantly, this is also the time at which more people-focussed studies also started to appear. The work of Mackay (1981) and Mooley and Plant (1981) demonstrated an interest in how people's attitudes to, and experiences of, climate were directly related to their social context. This is a point that foreshadows much later work in archaeology and anthropology that will be discussed later.

Growing Concerns

The 1990s saw an increasing interest in global environmental change and how it might impact upon societies across the world. As a result of successive IPCC (1988-) reports over the last twenty years, climate change has become a politically charged issue. In archaeology, these concerns were met with range of studies that implicated climatic change in human affairs. A number of researchers have cited climate as the principal driver behind rapid technological or cultural change (Bogucki 1996; Bonsall et al. 2002; Gill 2001; Hodell et al. 1995; Peiser 1998; Sherratt 1997; Wells and Noller 1999). The growing recognition that climate could rapidly change has prompted some to consider how climate might affect people within a few generations or less (Rowland 2010; Straus 1996). The late 1980s witnessed a growing interest in the dynamics of societal collapse (Yoffee and Cowgill 1988; Tainter 1990; and more recently Brunk 2002; Diamond

2006). Significantly, an extensive group of researchers linked these developing theories with climatic events (Coombes and Barber 2005; e.g. Yoffee and Cowgill 1988; Peiser et al. 1998). This group includes, but is not limited to, studies of the Maya (Curtis et al. 1996; Haug et al. 2003; Hodell et al. 1995, 2001), the Tiwanaku of South America (Ortloff and Kolata 1993; Williams 2002), and the Norse in Greenland (Barlow et al. 1997; McGovern 1994).

The Akkadian Collapse

One of the most well-known and influential examples is the collapse of the Akkadian Empire. At Tell Leilan, an Akkadian site in northern Syria, a period of hiatus at the site correlates well with an aridificiation event observed in a number of palaeoclimatic proxy records from various locations in the Near East at around 4200 BP (Weiss 2000; Weiss et al. 1993). This hiatus, as well as similar abandonments at sites across the Habur and Assyrian Plains, is considered part of a widespread social upheaval which is represented by imperial collapse, habitat-tracking, changes in subsistence strategy and unusual population movements (Weiss 2000: 91). This notion of state collapse is built upon the climate caused breakdown of intensive, centralised agricultural production that Weiss et al. (1993) describe as one of the defining traits of Akkadian imperial control. A reanalysis of the dating by Marie-Agnes Courty (1998) threw doubt on this correlation, yet rather than attempting to better elucidate this chain of causation with more evidence and improved chronological control, the thrust of argument moved away from interpreting the archaeology to proving the existence of the climate change event. Thus while a range of paper from researchers in the environmental sciences (Arz et al. 2006; Cullen et al. 2000; Drysdale et al. 2006; Riehl 1999; Weiss 2000) examined the climate, the assumption of equivalence of correlation and causation prevalent in the original interpretation remained the basis for the entire collapse hypothesis. Furthermore, this research has been so influential that environmental and Quaternary scientists frequently cite the Akkadian collapse when they wish contextualise their results in relation to events of human history. Indeed, recent years have seen the focus of research widen from proving the existence of the climatic event, to identifying the global mechanisms responsible for it (Staubwasser and Weiss 2006).

The Akkadian example makes manifest many of the problems that historical researchers in the 1980s had grown so frustrated with. With limited chronological control and imperfections in the proxy datasets, spatial and temporal resolution remains low, requiring a broad scale of analysis. As such, although Tell Leilan is the focus of interpretation, it is the Akkadian society as a whole that takes precedence in the historical narrative. One consequence of this is that a detailed examination of people's interactions with the changing climate was not undertaken, and instead a simplistic formulation of climatic cause and social effect was assumed. To reiterate the observation of Ingram et al. (1981: 19), this approach “recurs again and again in the literature.” The way in which researchers with scientific backgrounds propagated the climate change hypothesis for the Akkadian collapse is representative of a problem of inter-disciplinary dialogue, where scholars fail to fully understand the fragilities in the interpretations and datasets of other disciplines. One of the main flaws in the body of literature surrounding this issue stems from the poor understanding of how the archaeological interpretation linked climate change with social change. So whilst considerable effort has been invested proving the incidence of a climatic change c. 4200 BP, and thereby avoiding Lamb's (1981: 294) accusation that climatic change is invented “to explain events in human history which are then held to prove the occurrence of a change in climate”, a simplistic and fairly tenuous notion of causation is nevertheless assumed.

Historical Ecology

As well as seeing a reignition of interest in climate amongst archaeologists, the 1990s heralded the beginnings of historical ecology, a discipline that combines ecological theory with an examination of human history (Balée 1998; Crumley 1994c). Its first proponents were directly influenced by the growing politicisation of climate research throughout the 1990s, and they called for “research and management options that draw on the lessons from the human past to guide and promote a sustainable quality of life” (Crumley 1994c: 243). Following the earlier work of historians and historical climatologists, historical ecology explicitly sets out to tackle the problems of paucity of evidence, correlation and causality, and attempts to link across social and scientific narratives of change as well as spatial and temporal resolutions. Seemingly responding to the 1980s calls for “synthesising ventures” (Fischer 1980: 822), historical ecology incorporates “globally relevant archaeology, ethnohistory, ethnography, and related disciplines” (Crumley 1994a: 7) under a rubric which emphasises diversity, heterarchy and complex spatial analysis. Although ecological issues of adaptation, resilience and ecosystem thresholds come to the fore, a people-centred perspective is maintained: ecological concepts are only used with the caveat that neo-Malthusian approaches, and the Expansionist critiques that followed, can explore only socially unmediated relations between humans and nature (Patterson 1994: 226–7).

In the search for a scale of study that enables the integration of social and ecological concepts, the historical ecologists define *landscapes* as “the material manifestation of the relation between humans and the environment” (Crumley 1994a: 6). This is reminiscent of the view held by the geographer Carl Sauer (1925), who saw culture as the agent, the natural environment as the medium, and the landscape as the result of their interaction (Darvill 2001). Underlying the ecological view is the concept of *heterarchy*. Crumley (1994a: 13) laments that one of the main problems with archaeology and ecology is that “researchers uncritically 'nest' levels of analysis, confusing scalar with control hierarchies and leading to the misinterpretation of chains of causation”. Global-regional-local climate is given as an example of scalar hierarchy in which interactions occur in a heterarchical manner; that is, any level can affect any other. This is a valuable concept when considering human-environment relations. Whilst some links may be hierarchical, with simple chains of causation, others may be heterarchical, with their importance changing in relation to myriad other factors. Key to understanding these complex relationships is an examination of the historicity of change, and its contextual framework. As a result, examples tend to take a broad scale perspective: Joel Gunn (1994) focuses on global and regional modelling, Crumley (1994b) offers a regional analysis of late Iron Age Europe, and Hassan (1994) provides a population ecology perspective on the relative influence of climate and the power of centralised government on human well-being in Egypt since the Neolithic. Only occasionally do researchers present more narrowly defined case studies. For example, Schmidt (1994) and McGovern (1994) look at how local resource management can change in relation to climatically induced scarcity, but not necessarily for the better.

Despite historical ecology's expressed aims to move away from mechanistic and deterministic interpretations of the past, Neil Whitehead (1998: 35) points out that "the most cogent interpretation that can be given to the contributors' intent … is that some *processual* form of ecology should be favoured over a systemic or functionalist kind." This, he argues, does little to advance debates that have already been held in anthropology between strands of evolutionism and functionalism. Whitehead's (1998: 36) suggestion was to abandon the invention of a new theoretical paradigm and to focus instead on historical ecology as a method that makes "human decision-making, and the consciousness that drives it, the independent variable in our analysis of environmental dynamics". He argues that landscapes have a human dimension, and that "simply to chart changes in the landscape through time once again places phenomena, rather than persons, at the centre of explanation" (Whitehead 1998: 36).

Recent Approaches

Research over the past two decades has seen the various approaches to exploring climate-society relationships become more closely aligned. The (re)introduction of ecological concepts into studies of past people has encouraged a generation of archaeologists to reconsider how societies relate to the natural environment. In part, this has been supported by the utilisation of non-linear dynamics and complex systems theory to create a mathematical basis for neo-Marxist social theory (that underpins much post-processual archaeology) (Beekman and Baden 2005; Kohler and van der Leeuw 2007; van der Leeuw and McGlade 1997). It means that, although Whitehead's (1998) criticisms imply that historical ecology is at odds with the post-processual approaches that distance themselves from broad, descriptive analyses of the past, processual approaches can now incorporate post-processual perspectives on the structure of societies and human agency. Even where modelling has not been undertaken, attempts to unite interpretative social theory and descriptive processual analyses have become increasingly common.

Complex Modelling

Within complex models, mathematics is used to describe how instability within a system can produce structures, and how multiple agents acting intelligently upon unforeseen events can result in the *"spontaneous structuring of social order*" (McGlade and van der Leeuw 1997: 9 original emphasis). The dynamic relationships within the models are non-linear. This completely undermines the older Aristotelian model of cause and effect, and explicitly recognises the existence of unforeseen events and actions with unintended consequences (McGlade and van der Leeuw 1997: 9). Therefore, rather than thinking of the past as an orderly unfolding of events from defined origins and innovations, complex modelling suggests that societal restructuring, or social change, is dependent on inherent instability, and is a continuous process: "Issues such as social change cannot be successfully constituted on the sole preserve of reflexive social action, but rather as a dynamic interaction in which social agency, decision making and societal organisation are seen to be embedded in the natural world" (McGlade and van der Leeuw 1997: 21). Human-environment relations are thus conceived as a constant interplay between deterministic and stochastic (random) processes that have a direct effect on the structure of society. As James McGlade and Sander E. van der Leeuw (1997: 20) point out, in this conception of the past "what needs to be 'explained' is stability rather than change." Chains of causation are reconstituted as dialogues between macro- and micro-processes. Notions of optimality (as perhaps produced through Darwinian natural selection) are embedded in an emphasis on the adaptability of individuals and social structures they produce and reproduce. This idea of multiple non-linear interactions defining a range of aspects within human-environment relationships is reminiscent of the anarchic or heterachical relations outlined by historical ecologists. To its proponents, complex modelling provides a means by which these relationships may be studied and understood as part of a holistic, multi-scalar approach to the human past (Beekman and Baden 2005).

According to McGlade and van der Leeuw (1997: 22), complex modelling is a means of elucidating non-linear interactions. Complex models that combine ecological theory with the study of past peoples are an attractive proposition for archaeologists who struggle with integrating social and environmental processes at a variety of scales: "The encoding of … human/environment relations as formal mathematical models may provide us with a set of explanatory tools that allow us to grasp the qualitative dynamics which may be said to form the 'deep structure' of any non-linear system" (McGlade and van der Leeuw 1997: 23). Although most archaeologists are not well equipped to handle the mathematics involved in complex modelling, the close alignment of some of the principles with social theory means that they can be readily adopted into conceptual models of the past (Kohler and van der Leeuw 2007). The types of study employing such understandings can range from asking big questions at broad scales to focussing in on specific places at specific times. For example, King and Lindh (1997) and Reynolds (1997) use complex modelling to look at how cultural change is different from biological change, and how they are both related to environmental change. Their results indicate that cultural evolution can accelerate biological evolution, and that cultural evolution occurs more quickly under variable environmental conditions. Patrick Kirch's (2007) study of 'human ecodynamics' in Hawaii from 1200 to 200 BP stresses the non-linear relationships between climatic variation and agricultural yields, and their effects on surplus extraction and the cohesion of social groupings. Alternatively, looking at the small Bronze Age communities in Mesopotamia, Wilkinson et al.'s (2007) extremely detailed, agent-based approach models how individual responses to a range of stresses, including climate change, resulted in different regional field and settlement patterns.

Complex systems, and the models that describe them, have two important qualities: (1) they are irreducible – the product is more than the sum of its parts; (2) at any one point within the temporal operation of the system, its future actions are inherently unpredictable. For these reasons a complex system's potential interactions – its “possibility space” – can only be incompletely modelled (Allen 1997: 43–44). So whilst modelling at a high level of abstraction can be used to describe and explain long term dynamical processes, modelling can never describe reality accurately: “the real world is too complex to be modelled” (McGlade and van der Leeuw 1997: 22). Modelling is therefore typically used for identifying dynamics, and not for describing particular elements of history in minute detail. In archaeology, the main point is that the close relationship of non-linear dynamics and post-processual theory provides researchers with a mathematical basis for integrating complex processual (or ecological) modelling with informed social interpretation (Beekman and Baden 2005). Whilst the detailed application of mathematical modelling may not be possible, or indeed useful, a knowledge of complex systems does provide a means of visualising where and how microscopic changes can have macroscopic impacts, and, as a consequence, how causation can be multi-dimensional (Dugmore et al. 2007).

Palaeoecology

The application of ecological concepts in combination with a knowledge of non-linear dynamics and complex systems has helped archaeologists move away from the focus on catastrophic collapse, and has led to better understandings of causation (McAnany and Yoffee 2009; McGovern et al. 2007; Redman and Kinzig 2003; Rosen 2007). Although trends towards new forms of (eco)systems modelling have had less of an impact in Britain, palaeoecologists are increasingly showing signs of dissatisfaction with more traditional approaches to interpretation, where climate either played too large or too little a role (Catto and Catto 2004; Coombes and Barber 2005; Evans 2003; Jones et al. 2001a; Tipping 2002). For example, Amy Bogaard and Nicki Whitehouse (2010: 109) state that the debate in archaeology between 'processualists' and 'post-processualists', which "promoted accounts of the origins and early development of agriculture that emphasised the explanatory role of climate *versus* social factors," has now receded.

With the recession of the paradigmatic debates of the 1980s and 90s, palaeoecologists have been free to engage with some of the issues outlined by researchers in the 1970s and 80s. Rick Schulting (2010: 167), for example, shows a detailed awareness of the problems engendered in linking correlation with causation, arguing that "until 'abrupt' climatic events and their environmental consequences can be dated with sufficient precision, attempts to link them with cultural changes – which will similarly needed to be dated more precisely – will be speculative at best." Schulting (2010: 167–8) also highlights the importance of geographical scale; a change in one location may reflect an opposite change in another, or no corresponding change at all. This raises the question: can proxy records from a limited number of locations be used to infer the climate of an entire region? Looking at grazing-woodland interactions at a wooded shieling (seasonal pasture site) near Loch Awe in the Western Highlands of Scotland, Althea Davies and Fiona Watson (2007) address some of the difficulties with integrating different types of dataset. Utilising archaeological, palaeoenvironmental and historical sources, they acknowledge the difficulties that arise from differences in "spatial specificity and scale, and in temporal coverage or continuity" (Davies and Watson 2007: 1785). Unlike the

Akkadian case study mentioned above, the response to these issues is to avoid seeking known events in environmental records, and instead they work to treat each source independently and thereby test hypotheses that relate to processes of change and causality. Through this process, they generate a number of new insights into the relationship between woodland dynamics and grazing. Importantly, they observe that “if only one source had been used, the nature and drivers of ecological change would have been misinterpreted on numerous occasions” (Davies and Watson 2007: 1787–1788).

One environmental scientist for whom these problems are clear is Richard Tipping. Tipping (2002: 10) has been vocal in resisting what he describes as “the recent trend to explain socio-economic change throughout the world by new forms of environmental catastrophism”. In support of this view, Tipping (2002: 11) dedicates himself to questioning “one of the keystones of the deterministic paradigm, that of the susceptibility to climatic deterioration of the farming communities in upland regions of Britain, notably in northern Britain.” This susceptibility has been assumed in a range of studies extending from the Bronze Age to the Little Ice Age (Barber 1998; Burgess 1989; Parry 1975, 1976b). However, using pollen evidence from a range of local palaeoecological studies, Tipping (1998, 1999, 2002, 2004) is able to reject these generalising interpretations. He criticises 'confirmatory' approaches to palaeoecological data, in which evidence that supports existing narratives is given higher priority over that which challenges orthodoxy, and where, as a result, “the palaeoecological data are not able to speak for themselves” (Tipping 2004: 19). In contrast to models of climate-caused abandonment, Tipping suggests that people in these areas exhibited a degree of resilience afforded by economic links with the lowlands. Such trading relationships would ensure that subsistence strategies need not rely on high altitude cereal cultivation.

These examples demonstrate how spatially specific, temporally well-defined palaeoecological case studies can contribute to examinations of the climate-society dynamic. This is particularly true when such studies involve detailed investigation of hypothesised links between climatic cause and observed socio-economic effects. By targeting palaeoecological studies on specific elements of the human-environment relationship, some of the problems of generalisation are overcome. Whereas in the Akkadian study a wealth of palaeoclimatological evidence was mobilised to support the hypothesis of widespread climatic change, Tipping's palaeoecological approach focuses more directly on the human aspect of the relationship, albeit by proxy of pollen records. This targeted and often small-scale approach, can reveal how regional composite records tend to present “a poor reflection of landscape diversity” (Davies and Tipping 2004: 242). As such, palaeoecological case studies are now beginning to produce histories characterised by spatio-temporal diversity, rather than homogeneity. This localised approach can also be combined with detailed dating techniques to great effect. Jörg Schibler and Stefanie Jacomet (2010) use dendrochronology, for example, to produce a high resolution study into how resource procurement is affected by short-term climatic fluctuations. Interestingly, over longer time-scales, climate changes are argued to have had a biological effect on hunted animal species, possibly driving technological change (Schibler and Jacomet 2010: 181). Although it is correlation between palaeoclimatic and archaeological datasets that forms the basis of Schibler and Jacomet's interpretations, the economic chain of causality is not simply assumed: there is a detailed analysis of how climate changes might have impacted upon the resource base, and the decisions made in response.

Climate Change Archaeology

Elements of complex modelling, palaeoecology, historical ecology and post-structuralist social theory have all been used in recent research on climate change in the past. Such studies deal with a range of issues, including the multi-scalar and multi-disciplinary nature of the research, the material characteristics of archaeological datasets, and problems of causality. Increasingly, archaeological research on past climate change is designed to inform environmental policy in the present.

Emerging from ecology and applications of systems modelling, resilience theory has had a growing influence in studies of human-environment relations (see also van der Leeuw 2000; Nelson et al. 2010; Redman and Kinzig 2003). From the 1990s onwards, it has played an important role, whether used in responses to catastrophism, by historical ecologists, or within non-linear models of adaptation. More recently, resilience theory has been proffered as a concept that enables cross-scale and cross-discipline analyses of change within archaeology (Redman and Kinzig 2003). Although change is regarded as inevitable and episodic, conceptions of vulnerability, robustness and flexibility describe how that change can be managed, ensuring continuity of certain societal characteristics whilst discarding others (Nelson et al. 2010; Redman and Kinzig 2003). In this respect, societal stability and continuity are considered part of the same mechanisms governing societal change, thereby presenting an attractive prospect for those seeking to inform future environmental management strategies (van der Leeuw 2000).

When applying resilience theory, interpretation need not focus on whole ecosystems: adaptations of the theory can be used to focus on specific aspects of human-environment relationships. For example, in their comparison of irrigation-dependent societies in pre-Hispanic North America, Nelson et al. (2010) focus on how social systems respond to different types of environmental shock, including climate changes. Despite this ability to address narrowly defined questions, Redman and Kinzig (2003) recognise that, applied uncritically, a resilience model is potentially unsettling: "it suggests an underlying uniformity to cultural history." Moreover, existing applications of resilience theory have tended to focus primarily on economy and population dynamics: Nelson et al. (2010) produce a predominantly functionalist assessment of the economic processes that result from interplay between society and environment. Combined, these problems mean that there is a danger that some applications of resilience theory could become exposed to the well-known, convincing critiques of systems theory and processual archaeology (e.g. Hodder 1991; Barrett 2001). Nevertheless, this has not stopped archaeologists suggesting that ideas of resilience could be united with more socially-embedded perspectives to form an integrated approach to climate change in archaeology (Cooper forthcoming; Davies forthcoming).

Jago Cooper's (Cooper and Peros 2010) research in the Caribbean takes a slightly different approach. Here the research is designed to directly inform mitigation strategies that are being developed in response to contemporary climate change. This is achieved by employing a multi-scalar approach to the data, moving focus from regional, to national, and then to local and site specific issues. Perhaps in response to the problems outlined in the 1980s, causal relationships are not established, with socially embedded perspectives regarded as more useful. Interpretation centres on how settlement patterns, material culture, food procurement and household architecture – all identifiable in the archaeological record – would have affected vulnerability to various climatic impacts. Ideas of social memory, resilience and traditional ecological knowledge are are then united to describe how some socio-cultural changes can be described as deliberate adaptations to changing environmental circumstances, and how a greater time-depth of engagement results in better decision making (Cooper forthcoming).

Also reacting to concerns of contemporary environmental change, Robert Van de Noort's (2011) recent conceptualisation of 'climate change archaeology' around the North Sea attempts to draw together existing research to focus on the climate changes of the past. In producing this synthesis, Van de Noort describes how studies of palaeoecology, historical ecology and complex modelling might be combined. The limitations of climate-focussed archaeological studies are recognised, but opportunities are acknowledged too. Van de Noort cites studies where there is an emphasis on human agency to inform and update more scientific understandings. Thus, "climate change archaeology explains the operation of certain feedback mechanisms that have gone largely unnoticed in climate change science" (Van de Noort 2011: 1046). Then, similarly, scientific understandings of change can be tied into social narratives: for example, in how national identities or religious ideologies might have been influenced by the changing physical environment (Van de Noort 2011: 1045). Here, qualitative and quantitative assessments of human-environment interactions are seen to work side by side, with each adding something to the other. The focus, however, is very much on the terrestrial environment: the land and its relationship with the sea. This frame of working is linked to the trajectory of thought outlined above, in which landscapes are defined as "the material manifestation of the relation between humans and the environment" (Crumley 1994b: 6; see also Darvill 2001; Sauer 1925; Schama 1995). By exploring relationships to land, interpretive emphasis naturally gravitates towards land use and economy – areas that are particularly suited to processual modelling. Nevertheless, the growing interest in social and cultural dimensions of human responses has led Van de Noort (2011: 1046–7) to make his statement outlined in the introduction: that "the different theoretical strands in archaeology are not in opposition when it comes to explaining the diverse connections between climate, environment, landscape and people".

In summary, recent approaches to climate in archaeology can be seen as the result of 40 years of debate. There is a continuity of thought linking the critiques of the 1970s and 80s with the research being undertaken today. Major themes include causality, cross-disciplinary dialogue, spatio-temporal scales of analysis and embedding social responses within processual descriptions of change. Through resilience theory, Jago Cooper's research in the Caribbean, and Robert Van der Noort's climate change archaeology, these themes have coalesced. There remain problems, however. Resilience theory describes systemic action, and its applications have been primarily functionalist. Cooper's research attempts to avoid issues of causality altogether, but then becomes distanced from examining knowledgeable interactions with weather and climate. Van de Noort sees different theoretical approaches united in the study of past climates, but only when the interpretative emphasis is already gravitating towards questions of land use and economy. More generally, these approaches have only managed to accommodate very limited insights from anthropology, and, although Cooper does begin to characterise experiences of climate, it is not clear whether this approach can be developed into a truly experiential archaeology (see next chapter). There are certainly strong elements to each of these approaches, but there are also areas for improvement, modification and clarification.

Conclusion

This chapter has aimed to show how research on the relationships between past people and climates has developed over the course of the twentieth and early twenty-first centuries. Initially, it was advances in the geological and climate sciences that helped prove climate has not gone unchanged through the ages, and which led to interest in how climate affected human societies. Early discussions directly linked human characteristics to environmental contexts, but environmental determinism was found many forms: in laws of human nature, in systems theory, and in the assumption of causation where climatic and social events coincided. The various responses to environmental determinism have set the tone of academic research since the late 1970s. They helped identify many of the core issues in linking social and climatic processes: the problems moving between different datasets and scales of analysis, the difficulties involved with researchers working across disciplinary boundaries, and the general availability of information about past climates. Although there have been number of suggestions to help overcome these issues, for the most part, these problems remain relevant today, despite significant advances in palaeoclimatology and palaeoecology.

Concerns about global environmental change from the late 1980s onwards served to reinvigorate archaeologists' interest in the role of climate. A significant amount of research went into defining how climate changes could have been involved in the catastrophic collapse of past societies, but links between climate and social processes were often rendered in simplistic, economic terms. The combination of ecological concepts with a knowledge of non-linear dynamics and theoretically informed complex modelling addressed this problem. The resultant models explore the relationships between climatic and social processes, but do not assume the primacy of either. Moreover, agent-based modelling techniques can explore how individual responses to different scenarios result in wider landscape changes. Perhaps as a result of continuing mistrust of systemic modelling, such approaches remain fairly rare in Britain. However, palaeoecologists have begun to consider how improvements in sampling and dating can be used to relate changes in the environment to human activity. They have found that generalising interpretations tend to effectively confirm archaeological or historical narratives, while downplaying inferences from environmental datasets. In contrast, selective, highly focussed studies on elements of climate-society interactions have been successful in highlighting diversity in the past, as well as providing new insights on the range of responses engendered by changing climates.

Throughout this review, there has been clear progression towards more socially aware theory and methods. As the scalar focus has narrowed, primarily through advances in dating, there has been a move away from predominantly mechanistic conceptions of human nature towards emphasising agency and social perspectives on change. Recently Robert Van de Noort's (2011) conceptualisation of 'climate change archaeology' has brought together many of these different approaches while placing climate change at the centre of archaeological investigations. Yet, despite emphasis on climate change, very little research appears to be focussed on people's interactions with the climate itself. Relationships are primarily conceived as operating through the proxies of land use and economy, rather than as direct engagements with changing weather. Resilience theory links together periods of stability and change, and long and short term processes, but this has been applied in archaeology principally in terms of population dynamics and settlement patterns. Although Van de Noort stated that the different theoretical strands of archaeology are not in opposition, archaeologists have struggled to accommodate insights from anthropology and ethnography within their narratives of change. Moreover, there is a large body of theory developed within landscape archaeology that uses the philosophy of phenomenology and ideas of inhabited perspectives to concentrate on the experiences of past people. For the most part, these experiential perspectives have yet to be incorporated into studies of past climates and climate changes. The following chapter explores this point in more detail by charting the development of socially-embedded perspectives on human-environment relations, and considers how a new theoretical perspective based on experience might aid studies of climate-society interactions in the past.

Chapter 3: Towards Socially Embedded Perspectives

Introduction

The previous chapter reviewed how research into the relationships between climate and past societies developed over the last century. Initial interest in the subject arose from the discovery that the climates of the past were radically different from those in the present. Then, in the late 1970s and early 1980s, a vigorous critique of environmental determinism laid the foundations for a more in-depth examination of climate-society interactions. Growing concerns about global environmental change have stimulated further research into past climate changes, where approaches have ranged from employing the simplistic mechanics of catastrophism, to more refined conceptions of non-linear relationships in historical ecology and complex modelling. As dating techniques have improved, the scalar focus has narrowed and causality has been better addressed. Social theory has been integrated into systemic and processual descriptions of change, and Robert Van de Noort (2011) has stated that different theoretical approaches are now united in climate-society studies.

This chapter examines the philosophical and theoretical background to these developments. It begins by charting how dichotomous conceptions of nature and culture have been extremely influential in Western academic thought. The chapter goes on to show how a critique of the dichotomy has resulted in socially-embedded perspectives on human-environment relations becoming prominent in archaeological studies of past landscapes, and it identifies areas where these have been employed within research on past climate changes. The concept of social memory has, for example, been mobilised to explain how long-term climate changes can be responded to on human time-scales, but there remain difficulties in applying this, and other insights from anthropology, within archaeological research and interpretation. Phenomenological and experiential perspectives have been suggested as means by which these problems can be addressed, but these have garnered sustained critique from a number of archaeologists. Despite this, there are elements of experiential approaches that could impact positively on studies of climate. Supported by research in anthropology, it is possible to outline a new theoretical approach to climate-society relationships that centres on the human experience of climate, through weather.

Nature and Culture

Ellsworth Huntington's early work on the Pulsatory Hypothesis was strongly tinged with the racialist sentiments of the early twentieth century, but his work has inspired much in relation to the study of climate and history. A few lines in Huntington's (1924a: 4–5) introduction to the 1924 edition of *Civilization and Climate* still bear remarkable relevance to academic discourse today:

> We recognize two great sets of facts which are apparently contradictory. We are conscious of being stimulated or depressed by climatic conditions, and we know that as one goes northward or southward, the distribution of civilization is generally in harmony with what we should expect on the basis of our own climatic experiences. Nevertheless, even in our own day, regions which lie in the same latitude and apparently have equally stimulating climates differ greatly in their degree of civilization. When we compare the past with the present, we find the same contradiction still more distinctly marked. Hence our confusion. From personal experience we know that the direct effects of climate are of tremendous importance. Yet many facts seem to indicate that this importance is less than our observation would lead us to anticipate.

Weather is seen, anecdotally at least, to have set forms of impact upon people's daily actions. When extrapolated out, it seems impossible that the human animal should not be as subject to nature's whims as other organisms are. Huntington, however, observes something else: he notes that human action is not constrained within the bounds exacted by such a simplistic model. The picture is more complex. The comments refer to a dichotomy between nature and culture, illustrating the persistent problem of "representing the seemingly transcendent aspect of our humanity within a mechanical universe" (Malik 2000: 53).

The distinction between nature and culture has been immensely powerful in the development of Western philosophical thought. In the seventeenth century, René Descartes, after reflecting on the nature of being, famously concluded that the thinking mind was separate and distinct from the space-occupying body. In an age of exploration, this concept was drawn into the heart of the emerging field of anthropology. A comparison between the civilised European world and the peoples discovered at the "uttermost ends of the earth" (Gamble 1992: 710) seemed to be a perfect representation of the Cartesian dualism – whilst the European culture was dominated by the mind and rational thought, the 'savages' of the southern hemisphere were controlled by animalistic bodily urges, constituent rather than transcendent of nature. Baron Montesquieu's 1748 *De l'Esprit des Lois* attempted to crystallise these ideas into fundamental laws of human nature, defined in part by geography. Humanity was thus split into ethnic groups and categorised on a scale of complexity which foregrounded subsistence strategy and environmental context (Jones 1992: 746). Other thinkers, such as Turgot, placed this scale of complexity in a chronological context, seemingly demonstrating the ascent of humanity from its natural roots to its cultural flowering. Alternatively, those with a more negative conception of the contemporary world, such as Rousseau, saw 'progress' not as an ascent, but as a descent from the ideal of the 'noble savage': "a fall into misery and tyranny from an original state of happiness" (Jones 1992: 748). Whether human progress was conceived positively or negatively, in an age of colonialism increasing contact with the New World came to be viewed as the physical embodiment of a nature-culture divide. European culture appropriated, dominated and controlled the newly discovered, 'pristine', natural world (cf. Croll & Parkin 1992: 17). Importantly, however, it was also recognised that culture emerged from the natural world; once part of it, now transcending it.

By dividing nature and culture and situating them within an evolutionary context, the scholars of the Enlightenment had inadvertently both instigated a schism, and yet because a relationship was still maintained through the medium of 'progress' (or regress), they had also provided a means of unification. Where an ever greater pace of technological advancement represented mastery over nature, culture was considered directly derivative of natural context. So although nature was divorced from culture, they remained fundamentally linked, tied together with a length of time, along which nature *became* culture. Whether such time is conceived as the millennia of evolutionary change, or the life cycle of a single person, in both cases nature represents the precondition of existence; the precursor to culture (Strathern 1980: 195–6). Unfortunately, because Uniformitarian assumptions underlay conceptions of nature and culture, the ultra-nationalists of the early twentieth century were able to seize upon the notion that social and environmental inequalities could be both projected from the past and back into it. This consequently enabled a form of racism which was environmentally determined (Kohl and Fawcett 1995). This mode of thought helped constitute some of the travesties of early to mid twentieth-century conflicts, thereby transforming positive notions of social progress into that “of the Fall of Man back into beastliness” (Malik 2000: 22). In Descarte's philosophy, “the possession of reason allowed humans to understand the world. But it also separated them from that world, making them distinct from animals” (Malik 2000: 12). The fall back into beastliness represented a more chaotic and uncivilised conception of human nature, one which less obviously distinguished humans from the rest of the animal kingdom.

Influencing Archaeology

In archaeology, this backdrop of negativity towards human endeavour formed the basis of the modernist, processual paradigm: humans were a constituent part of the environment and their actions were interpretable as beasts'. This enabled archaeologists to draw on ecology and systems theory to model human behaviour mechanistically. In the last chapter, I outlined how this meant that human adaptation to environmental stresses was often conceived as the principal means by which social and technological changes occurred (Butzer 1972; Foley 1985; Vita-Finzi and Higgs 1970). Because human-environment relationships could be conceptualised as operating within a thermodynamic system of which climate was the external driver, climate was rendered as a prime mover in social change (Binford 1972; Clarke 1968; Friedman and Rowlands 1978). Whereas the archaeological post-processual critique focussed on 'depopulated' worlds of processual models and the deterministic qualities of systemic structures (Barrett 1994, 2001; Hodder 1991; Shanks and Tilley 1987, 1992), anthropologists initiated another strand of critique that reflected on the way in which Darwin's theories had been applied to social transformation.

In optimal foraging theory, for example, humans are thought to behave as animals in employing foraging strategies that become increasingly efficient over time, thereby demonstrating ever greater degrees of successful adaptation (Foley 1985). The problem with this, argues Tim Ingold (1996: 32), is that the theory's proponents “are trying to have it both ways, taking their cue, as it suits them, from neo-Darwinian evolutionary biology or from neo-classical economics.” Either the diversity of human culture inhibits natural evolutionary efficiency, but enables humans to act rationally in their exploitation of the environment, or human culture is the natural extension of biological evolution, and humans are the unthinking subject of natural selection. When extrapolated from small hunter-gatherer societies to entire civilisations, this confusion between cultural, transcendent humanity and natural, mechanistic humanity is replicated on a larger scale. In the 1970s, James Faris (1975: 243) argued that “any consideration of the relationships between social organisation and population dynamics of *Homo sapiens* and that of other animal species must be based on a clear understanding of social evolution.” Ingold (2000: 33) observes, however, that the understanding of social (rather than biological) evolution has been rendered insignificant: all too often the “appeal to human intentionality and rational choice … reveals only *proximate* causes of behaviour, while the *ultimate* cause lies in those selective forces that have furnished individuals both with the fundamental motivations underwriting their choices and with cognitive mechanisms that allow them to be made.” Behaviour is thus stripped back and reduced down to the principles of natural selection and Darwinian evolution.

This awkward confluence between evolutionary, ecological and economic theory was visible in the archaeology of the 1980s and 90s (Balée 1998; Butzer 1982; Crumley 1994c; Crumley and Marquardt 1987; Halstead and O’Shea 1989). There were, however, attempts to couch natural, animal behaviour in terms of social processes. Following the highly influential works of population geography, particularly Malthus (2006) and Boserup (1965), and the recognition that “it is the ability of human society to produce subsistence, rather than control population in order to subsist, that discriminates human from animal society” (Faris 1975: 236), the utilisation of economic and demographic geography was seen as a means of achieving this (Brunk 2002; Coombes and Barber 2005; Dumond 1972; Halstead and O’Shea 1989; Tainter 1990; Wood 1998). In the case of the Akkadian collapse and other 'catastrophe' examples, preconceived notions of social organisation, ideology and power relations were linked to levels of economic productivity. It was thought that, when climate change acts as a constraint on the economy, societies undergo radical transformation or 'collapse'. Although humans are conceived to make choices, those choices are rendered in terms of rational economics. As a consequence, ultimate causality remains in evolutionary and environmental constraints.

Questioning the Dichotomy

For post-processual archaeologists enamoured with the concept of human agency, human-environment relations thus present a problem. How is it possible to reconcile the idea of knowledgeable and intentional human action with environmental constraints and evolutionary notions of adaptability? Here the dichotomy between nature and culture comes to the fore. Where does the cultural mind end and the natural body begin? And to what extent is human culture transcendent of the natural world, or is it merely the "extrasomatic means of adaptation" (Binford 1972: 205)? In anthropology, these kinds of questions have formed the basis of intensive research and debate (MacCormack & Strathern 1980; Descola & Pálsson 1996; Ellen & Fukui 1996; Croll & Parkin 1992b; Ingold 2000, 2011; and Shanks & Tilley 1987; Preucel & Hodder 1996 for similar discussion within archaeology). The critique arising from this work recognises that Western conceptions of nature and culture are "fundamentally about our origins and evolution" (MacCormack 1980: 6). Despite this, they are often considered universal and are applied uncritically to non-western societies, both in the past and present (Strathern 1980). As Phillipe Descola (1996: 85) points out: "there can be no escape from the epistemological privilege granted to western culture, the only one whose definition of nature serves as the implicit measuring rod for all others."

The problem with this seemingly universal conception of the nature-culture dichotomy is that ethnographic studies frequently show that non-Western peoples neither recognise nor replicate the divide. Miriam Kahn's (1990) observations of Melanesian societies in Papua New Guinea have, for example, demonstrated how the local environment forms the basis of Melanesian myth and identity. Here the cultural is anchored implicitly in the natural surroundings. Certain stones *are* ancestors and space is equivalent to time (Kahn 1990: 59–61). To the Melanesian people, there is no fundamental cognitive divide between nature and culture, and importantly, there is no physical one either. The ancestors have bodies of stone, the current inhabitants bodies of flesh – both interact with each other and the world around, and so the cultural world of the Melanesians is also their natural world. Alternatively, Chris Tilley's (1994) discussion of the Australian Aborigines draws on ethnographic studies to demonstrate how the natural landscape can be socially constructed. Focussing on totemic geography and the Dreamtime mythology, Tilley (1994: 38) argues that “the landscape is not something 'natural' and opposed to people, but totally socialised.” Because “the landscape is a fundamental reference system in which individual consciousness of the world and social identities are anchored” (Tilley 1994: 40), Aboriginal culture is intrinsically linked to the natural world.

A second strand of critique focusses on the use of evolutionary theory to describe how the environment causes social changes. In the Darwinian schema, adaptation is predicated on organisms with a set of “endogenous, genetically fixed parameters”, which are quite separate from the exogenous parameters which define the environmental conditions to which those organisms adapt (Ingold 2007b: 114). If this sense of adaptation is applied to people's responses to a changing climate, then social and technological change is predicated on the genetic configuration of each individual, rather than skills learnt during each person's lifetime. In this sense, what might be conceived as a society learning to adapt, is actually the natural selection of preconfigured individuals (with death removing those not correctly configured). As Ingold (2007: 114 original emphasis) argues in his book, *Lines*, “evolution is absolutely *not* a life process” – it is not something that describes the actions of an individual, and it does not describe learning. For a better understanding of adaptation within lifetimes, Ingold (2007b: 117) turns to the philosophy of Henri Bergson. Bergson (1911) envisioned evolution to encompass a degree of dynamism and progress within each individual. Action was located within “a meshwork of intertwined thoroughfares along which organisms follow their respective ways of life” (Ingold 2007b: 117). Societal change is therefore not constituted primarily through the deaths of poorly configured individuals, but instead through “a trans-generational flow in which people and their knowledge undergo perpetual formation” (Ingold 2007b: 117). Adaptation is transformed from the Darwinian sense of an external arbitration of biological fitness to an internal life-process, through which environmental knowledge is produced and reproduced socially.

These two critiques present a thorough deconstruction of the some of the key assumptions underpinning systems theory. Whereas natural and cultural processes had been conceived of as separate, thereby resulting in the awkward confluence of economic and ecological explanations of change, it is now shown that nature can be culturally constructed. Adaptation was formerly integral to *natural* selection and the principal mechanism through which the environment acted to control human societies, but here adaptation is recast as a *social* process, involving the production, transmission and application of cultural and environmental knowledge. The last chapter discussed attempts to re-examine the mechanics of climate-society interaction by integrating post-structuralist social theory into the analyses. It was through these attempts that deconstructions of the nature-culture dichotomy were incorporated into the research of the last two decades. Although approached slightly differently in historical ecology, complex modelling and environmental archaeology, the aims were broadly the same: to confront the socially-embedded nature of human-environment relationships. This, however, is a difficult task when attempting to explain how societies experience climate changes over long time-scales. It requires a means by which the interactions observed in ethnographic studies can be stretched out across decades or centuries.

Social Memory

In response to this problem, social memory has emerged as a concept that manages the multi-scalar nature of human-climate interactions. It is recognised that, if it is human perception that guides human action, “widely used terms such as 'stability,' 'change,' 'variability,' 'normal,' or 'degradation' only have meaning within defined scales of analysis” (McIntosh et al. 2000a: 12) – scales that are relevant to human perception and experience. Arising from an ethnographic case study of the Mande people of Africa (McIntosh 2000), this application of social memory describes how communities actively sort through information on successful interactions with past climates when tackling problems immediate to them (McIntosh et al. 2000a: 25). People's adaptations to changing climates are thus filtered through a collective ecological knowledge comprising of the transmitted experiences of their ancestors. In *The Way the Wind Blows* (McIntosh et al. 2000b), an edited volume including perspectives from palaeoecology, historical ecology, historical climatology, complex modelling and anthropology, the concept is developed further to address this problem of intentional action, juxtaposed against the limits of human perception and experience (McIntosh 2000).

According to R. McIntosh at al. (2000a: 26), the transmission of knowledge as social memory does not necessarily occur through a straight verbal exchange of information. They explain how a “symbolic reservoir guides a community's formation of perception.” In the context of this reservoir, knowledge may be encoded in a society's ideology, symbolism or metaphorical and mythical notions. Transmitted knowledge may therefore exist as “unconscious operating and generalised analytical procedures (but not the specific protocols) employed by communities” (McIntosh et al. 2000a: 26). Because its meanings are deeply encoded within a society's norms and cultural expression, the application of social memory is in itself a seemingly natural act. It is “effective in that it is authoritative, and it is authoritative in that it is legitimate” (McIntosh et al. 2000a: 28). The uneven distribution of social memory within a society, within certain persons or social groupings, along hierarchical or heterarchical routes of transmission and application, ensures that the development of social memory and its application in times of need is very much dependent on the particular societal context in which it is mobilised. Human responses to climate change can, therefore, be dominated by intangible behaviours (Dean 2000; van der Leeuw 2000). Consequently, social memory is not a simplistic model of evolutionary adaptation, in which social changes are determined by the forces of natural selection. The ability of societies to draw on a long-held culturally encoded repository of past experience affords humans an extraordinary capacity for adaptation – one which is based upon learning and acquired knowledge. Social evolution is thus rendered as a life process that operates through culturally encoded knowledge and the capacity of individuals to apply that knowledge, modify it according to need, and to then re-encode it for transmission to future generations.

From MacKay's (1981) study of religious responses to climatic stress to Johnson's (2000) historical analysis of the Chumash of California, the concept of social memory is the culmination of clear trend within the historical literature towards describing climate change through culturally embedded social practices. Its ability to unite long and short term narratives of change means that it is an attractive concept for those applying complex modelling and resilience theory to analyses of material culture (Cooper ; Redman and Kinzig 2003). However, although social memory describes how cultural information is stored and disseminated, it says very little about what that information comprises.

Anthropological Perspectives on Climate

In order to better understand the contents of social memory, more detailed anthropological and ethnographic research is required. The perspectives on weather and climate that are revealed in such research have presented challenges to the ways in which climate has been approached in archaeology. Recent investigations by anthropologists into the relationships between people and climate have explored a diverse range of topics (Crate and Nuttall 2009; Hsu and Low 2007b; Strauss and Orlove 2003b). These range from farmers' perceptions of climate variability (West and Vásquez-León 2003) to the ways in which social relations engender differing degrees of resilience in the face of climate change (Green 2008). Their contemporary focus allows anthropologists to look closely at the short-term experience of weather in a way not often open to historical studies. This sheds light on the kinds of information that could be stored within social memory, and how that is then expressed and referenced in interactions with the climate. For example, Strauss and Orloves's (2003b) volume, *Weather, Climate, Culture* recognises the different time frames in which weather and climate are experienced: "people experience, discuss, and interpret meteorological phenomena in ways that are dependent not only on the physical characteristics of the events, but also on the cultural frameworks that divide time into current, recent, and distant periods" (Strauss and Orlove 2003a: 6). It shows that an appreciation of weather can be worked into daily life, not just through the passive acknowledgement of events, but in the ways weather is actively felt, comprehended, discussed and responded to (Paolisso 2003; Sanders 2008; Strauss 2003).

Tim Ingold (2005, 2007a) locates the physical experience of weather with a sense of landscape. After all, the land is not impervious to the weather, rather it responds in countless ways to the weather's myriad expressions as the medium in which we live. Conversely, the land, with its juxtaposition with the sea and its extension into the sky, helps define those myriad expressions into prevailing weather conditions. “The more one reads into the land”, writes Ingold (2007a: S33), “the more difficult it becomes to ascertain with certainty where the substance ends and the medium begins.” When viewed like this, it serves no purpose to distinguish between land and the weather: the two are enmeshed in constant flux, in something Ingold (2011) describes as the weather-world (Figure 4). Jan Golinski (2003: 18) has argued that the British sense of weather, “its peculiarities and regularities, and its providential role in the life of the nation,” was central to national identity during the Enlightenment. Golinski is not alone in pointing out this cultural connection between weather and location (Ingold and Kurttila 2000; Janković 2000; Rantala et al. 2011). It seems the weather in which one stands can be as much responsible for generating a sense and use of place as the ground on which one stands. It is a conception of nature that does not separate out into discrete spheres people, weather and land; they are all bound up in a singular sense of the natural environment, of the landscape. If this is the case, then it suggests that social memory, and the means by which people draw upon ecological knowledge, might be traced through people's social constructions of landscape.

Like many other disciplines, anthropology has found itself influenced by the growing public concern with environmental issues and, specifically, global environmental change. Consequently, there is a strong desire to produce research that is of direct relevance in characterising and responding to global problems (Crate and Nuttall 2009). It is clear, however, that in respect of climate change, anthropologists feel constrained by the narrow temporal focus of their studies (Peterson and Broad 2008: 78). As Roncoli et al. (2008: 104) state: “the multiscale and long-range nature of climate change is leading anthropologists to field settings that do not always lend themselves to approaches familiar to anthropologists, particularly those that hinge on personal interactions and sustained observations of everyday life.” Although social memory is a concept that addresses this problem, it remains difficult to trace specific incarnations of social memory in the past, and identify ways in which environmental knowledge was culturally embedded.

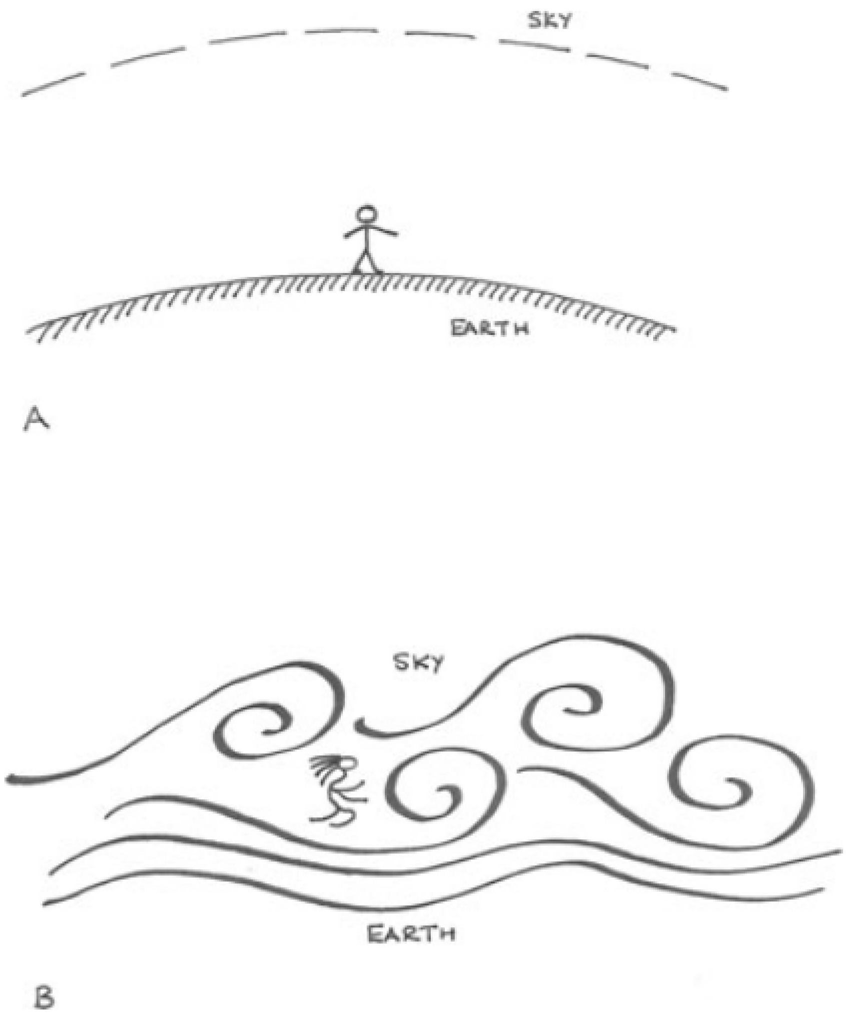

Figure 4: “The exhabitant of the earth (a) and the inhabitant of the weather-world (b)”
Source: Ingold 2011: 120

In the Mande example, social memory is expressed through a 'weather machine': a person, power association or occult group, that has the ability to predict future and dictate responses (McIntosh 2000: 142). The Mande's own oral histories are used to describe how this sense of a weather machine has transformed over time and offered different responses to the changing climate. The problem is that anthropological research shows that social memory is likely to have a range of expressions at different times and across different communities. The Mande example cannot be transplanted wholesale into other interpretations. Although Téréba Togola (2000) argues that social values can be seen in aspects of the material record, Jeffrey Dean (2000: 110) surmises that “the chances of directly tracking long-term changes in cultural schemata, including social memory, through archaeology are virtually zero.” The implication is that archaeologists have tended to remain detached from the debate surrounding human-climate dynamics because much of the evidence that has been mobilised towards this socially embedded, inhabited perspective is simply not available in archaeological research.

Socially Embedded Approaches to Climate in Archaeology

There are few examples where social memory has been traced through archaeological research, and some hold significant doubts over whether it can be achieved. Nevertheless, landscape archaeology has been strongly influenced by the anthropological examination of human-environment relations (Ashmore and Knapp 1999; Bender et al. 2007; Bradley 2000; Layton and Ucko 1998; Tilley 1994). This, coupled with Ingold's linking of weather and landscape, raises hopes that socially embedded climate-society relationships of the past might be accessible through landscape archaeology.

Aside from case studies in *The Way the Wind Blows* (McIntosh et al. 2000b), one of the few other attempts to apply social memory in the past can be found in John Evans' (2003) *Environmental Archaeology and the Social Order* (but see also Tipping 2002; Cooper & Peros 2010; Cooper forthcoming). Evans sets out to "emphasise the social manipulation of the physical environment," where environments "are related primarily to the development of socialities and only secondarily to producing food or gaining shelter" (Evans 2003: 19). It is recognised that environmental archaeologists have ignored the importance of social engagement in their interpretations, and that data do not exist outside interpretation, practice and materiality (Evans 2003: 17; cf Barrett 1997: 122). Evans' discussion of climate in archaeological interpretation includes numerous references to *The Way the Wind Blows* in general, and social memory in particular. However, when it comes to applying these concepts, the result is less convincing than the philosophical argument.

Evans (2003: 108–112) explores in detail Martin Parry's (1975, 1976a,b, 1978, 1981, 1985; Parry and Carter 1985) work on the Lammermuir Hills in an attempt to add a different, more socially embedded interpretation to what is an ostensibly mechanistic argument, in which climate changes inhibited cereal cultivation and forced settlement abandonment (see Chapter 6). Unfortunately, the subsequent assertions are poorly supported by the evidence. For example, he attempts to reorientate the debate by moving the interpretative focus from abandonment to the initial settling of the climatically marginal land, where people would have encountered variable land potential and harvest quality. Evans (2003: 110) claims that this “could have been a deliberate act of engaging with a deeper, more intensive social world”, demanding increased interdependence between households and communities. Yet there is no empirical evidence to indicate that this was either the cause or effect of settlement on the Lammermuir Hills. A similar problem is encountered when Evans attempts to describe the movements of palaeolithic people and artefacts in terms of knowledgeable engagements with changing climate. Evans (2003: 114) makes liberal use of the Mande example to explain how environmental knowledge might have been transmitted, but without the oral histories to characterise this process, he is forced to admit that “we do not actually know this.” Thus although his theoretical position is a welcome progression towards exploring socially-embedded perspectives on climate-society interactions, these weaknesses in interpretation mean that Evans' approach has not been widely adopted.

Whilst not subscribing entirely to its methods, *Environmental Archaeology and the Social Order* is influenced strongly by a branch of landscape archaeology that attempts to bring understandings from the philosophy of phenomenology into the study of the past. This trajectory of archaeological thought is commonly attributed to the work of Julian Thomas (1993) and Chris Tilley (1994), who began to consider how the spatial ordering of monuments related to their use. By drawing on the philosophies of Husserl, Merlau-Ponty and Heidegger there was an attempt to “move from the irrational abstracted idealism of a geometrical universal space to an ontological grounding of space in the differential structuring of human experience and action in the world” (Tilley 1994: 11). Whereas some scholars' (e.g. Bender 1993; Bender and Winer 2001) post-processual handling of landscape archaeology described landscapes in terms of politics and identity, and as mediums of social practice, Tilley (1994) attempted use phenomenology as a methodology for directly accessing and characterising the ontology of these relationships. As such, Tilley's phenomenological method might be seen a way of accessing past experiences of climate change, and therefore as means of tracing social memory in the past. There is, however, a significant body of critique that challenges aspects of Tilley's method. It is worth examining these in more detail to see how the weaknesses in Evans' work on climate are, in part, reflective of the points made in those critiques.

Phenomenology in Archaeology

Phenomenology in landscape archaeology emerged out of a dissatisfaction with the functionalist economic rationalism that dominated archaeologies of space and place, and was manifested in methods such as site catchment analyses and distribution studies. It was a rejection of “the traditional archaeological distribution map of sites and artefacts” that had become “clothed with Thiessen polygons, site catchments, regression lines, trend surfaces and gravity models” (Tilley 1994: 10; e.g. Vita-Finzi & Higgs 1970; Clarke 1977; Hodder 1978, 1982; Binford 1983). As such, the application of phenomenology can be seen as an attempt to access the detailed, socially embedded nature of human-environment relations. It enables archaeologists to apply concepts that were formerly thought precluded by the nature of archaeological data, such as social memory.

Whereas the landscape palimpsests of W. G. Hoskins (1955), O. G. S. Crawford (1953) and, later, Aston and Rowley (1974) offered landscapes as texts through which the past could be directly 'read', the abstracted, descriptive empiricism of distribution maps and 'spatial archaeology' (Clarke 1977; Hodder 1978) saw landscapes as a codified resource from which processes, laws, land use and economy could be decrypted (Muir 2000). In Tilley's (1994, 1995, 2004, 2008) conceptualisation, however, to understand the complexity of meaning past people embedded in their use of the landscape, the archaeologists must themselves subjectively experience landscapes, cataloguing their emotional and sensual engagements (primarily through vision) as indicative of past understandings. A phenomenological understanding is based up the idea that landscape is produced out of a dialectic between “Being and Being-in-the-world”; a physical engagement between body and landscape (Tilley 1994: 12). Phenomenological landscape archaeology thus operates in direct contrast to the Renaissance ideal of landscape, in which there was “a fixed relationship between object and subject, [that locates] the viewer outside of the picture" (Thomas 1993: 21).

Evans' book foreshadows a number of ideas developed in Tilley's (2004) *The Materiality of Stone*, in which the phenomenological programme is further revealed. To Tilley (2004: 21), landscapes cannot be understood from vantage points that emphasise divisions between nature and culture, objective and subjective: "things, places and landscapes influence us, alter our consciousness, constitute us beyond ourselves. In this sense they are not radically divorced from us." Landscapes can, therefore, only be understood by bodily immersing oneself within them. Advocating a synthesis of structuralism, post-structuralism, structuration and the phenomenological understanding of embodied engagement, Tilley both describes the past (megalithic monuments) and seeks to find meaning in it through metaphor. It is this aspect of Tilley's treatise that most reflects Evans' work: the ascription of meaning and intentionality in the past through the researcher's own subjective engagement with the archaeological evidence:

> "'the interpretative approach' entails an active articulation of the researcher with the materials, using them in the creation and understanding of his or her own sociality. Since this was how these materials were used in the past as well, the situation for the interpretative environmental archaeologist can get quite complicated" (Evans 2003: 19)

The subjectivity that underlies Tilley's phenomenological approach contains an assertion that there is no singular objective landscape that can be empirically measured and understood. Instead, subject and object are combined, thereby providing "multiple and alternative descriptions of landscape and place" (Tilley 1995: 12). This emphasis on subjective engagement as a means of interpretation has drawn criticism from diverse quarters.

Andrew Fleming's critique of the phenomenological method in particular, and post-processual landscape archaeology in general, centres on the desire to "go beyond the evidence" (Bender 1998 in Fleming 2006: 268) in forming interpretations that emphasise "the 'otherness' or 'strangeness' of past peoples" (Fleming 2006: 269). Fleming (2006: 268) argues that, as a result, by negating the value of 'objective' interpretation and focussing on subjective imaginative conceptions, phenomenology has “largely freed itself from traditional concerns with verification”. Moreover, the association of traditional landscape archaeology “with patrician, proprietorial attitudes, with vision-privileging post-Enlightenment, patriarchal, gendered 'gaze'” – an association that formed the basis for a new way of working – is, says Fleming (2006: 272), “to indulge in caricature”. Most worrying, perhaps, is that when Fleming came to test a number of phenomenological interpretations in the field, the result is not a shared sense of experience but a host of incongruities. If one cannot find a shared sense of interpretation between people engaging with similar landscapes in the present, it is hard to understand how we might better recognise the experiences of the people of the distant past through such means. Indeed, this is the point Joanna Brück (2005) makes in her analysis of Tilley's work. According to Brück the premise of human experience as a point of commonality linking the past and present is inherently flawed. Varying cultural values, social relationships and physical embodiments all affect our perception of experience, thus “our own bodily encounters with ancient monuments are unlikely to match those of past people” (Brück 2005: 55). Furthermore, the use of embodied experience of landscapes in the present as a means of exploring the past “implicitly ascribes the material world a primordial reality” (Brück 2005: 56 see also Fleming 2006:272); an inscription that necessarily conflicts with the stated desire of Tilley to transcend the subject/object and nature/culture dichotomies.

Environmental Archaeology and the Social Order does not dwell too much on the subjectivity of the phenomenological method; more relevant, however, is the attribution of meaning and intentionality to archaeological materials and past peoples, respectively. In Ingold's (2005: 123 original emphasis) review of *The Materiality of Stone* he criticises this aspect of Tilley's work, asking why “if his concern is really with experience … do these conjectures deal so exclusively with what people might have *believed*?” Ingold (2005: 123) goes on to claim that “Tilley remains encumbered by the philosophical baggage of a tradition of material culture studies that treats the physical world as a pool of metaphorical resources for the expression of social or cosmological principles.” Barrett & Ko (2009: 9) argue that this represents a fundamental misunderstanding of Heidegger and Merleau-Ponty's philosophy: whereas Heidegger sought “the physical working upon the world as given, a labour that creates consciousness itself,” Tilley (1994: 12) expresses Being-in-the-world as a product of "objectification in which people objectify the world by setting themselves apart from it." Put more simply, Tilley theorises a pre-existent subjective baseline upon which experience operates. To Heidegger, this subjectivity is not pre-existent and a-historical, rather it emerges as product of history, of lived experience itself (Barrett and Ko 2009: 15). In this, it is argued that Tilley is influenced more by the older, Cartesian, phenomenological philosophy of Husserl, rather than the anti-Cartesian stances of Heidegger and Merleau-Ponty (Barrett and Ko 2009: 12–13). Thus where Tilley attempts to ascribe meaning through phenomenological engagement with archaeological remains, Barrett & Ko (2009: 16) state that a truer reading of Heidegger means that motivations cannot be sought in the consequences observed in the archaeological record, rather that we should instead consider how certain material conditions and emotional perspectives might bring meaning into being.

Problems in Archaeology

The critique of phenomenology and Evans' work is relevant to wider studies of past climate changes. It demonstrates the difficulties entailed when ascribing meaning and intentionality to past people, whether by metaphor or analogy – something that directly affects our ability to trace social memory in the past. Although Evans was attempting to create an environmental archaeology that was socially embedded, by adopting wholesale the findings from the Mande ethnographic study to a body of evidence far removed geographically and temporally from the people under discussion, he constructed an interpretation that hinges on a static, ahistorical conception of human subjectivity. In this, he ascribed intentionality (and meaning) to archaeological remains based on his own subjective engagement with the material, tempered by inferences from the ethnographic literature. As with the criticism of a similar process within Tilley's work, this manifests a divide between the human subject and the environmental object (Brück 2005). Then, by emphasising the sociality of being, Evans creates a distinction between the physical world (nature) and social engagement with it (culture) – this is an inadvertent return to Cartesian dualism, and one that culminates in what is essentially cultural determinism. Thus not only does Evans 'go beyond the evidence', there is a distinction to be drawn between Evans' environment as socially constructed, and the environment as the medium through which sociality emerges (Fleming 2006). The problem is that this approach then runs counter to the findings from anthropology that are supposedly guiding the research of the past.

The critique is also relevant because it shows that, although some uses of phenomenology in archaeology have been widely criticised and derided, there are nevertheless useful ideas to be drawn from the philosophy. In particular, none of the critics challenge the utilisation of a dwelling perspective, one that places human experience at the heart of archaeological endeavour. There are ways, for example, in which such a perspective might be better applied to Evans' study: he is right to consider how more intensive sociality emerged from the process of living under certain material conditions, an unstable climate being one. Where Evans goes wrong, is to infer that upland, marginal environments were intentionally colonised based upon a desire for this intensification of social relations – there is no evidence to support that claim. Although Evans' use of ethnographic analogy is somewhat flawed, there is no doubt as to the value of using the diversity of present-day human societies to inform our interpretations of the past.

As stated earlier, anthropologists have had a prominent influence on the field of human-environment relations and debates surrounding the conception of a nature/culture divide (e.g. MacCormack and Strathern 1980; Croll and Parkin 1992b), and more recent research has centred on people's engagements with weather and climate (e.g. Strauss and Orlove 2003a; Crate and Nuttall 2009; Ingold 2011). Taking this into account, it could be suggested that in some respects Evans does not extend his social and experiential interpretation far enough. For example, Evans' focus on the productive capacity of land in marginal environments is only a partial consideration of the material conditions from which history emerged from interaction with the climate. Ostensibly, social memory is a concept through which archaeologists can unite various theoretical influences and scales of working, but Evans does not consider the individual, historically situated, experience of climate – through weather – and the sociality that thereafter emerges.

Arguably, then, there is a theoretical approach to examining climate-society interactions in the past that has not been tested within archaeology. Recent work in anthropology has implications for those that wish to seek a socially embedded understanding of human-climate relationships through experientially or phenomenologically informed archaeology, but these have been left largely unexplored (Crate and Nuttall 2009; Ingold 2011; Strauss and Orlove 2003b). Tim Ingold's (2007a, 2011) concept of weather-worlds suggests that it is not enough to look at past climates, we also need to explore our cognitive understanding and sensual perception of weather. The cultural experience of climate lies not only in the aggregated abstractions of long-term change, but in the immediacy of weather and the regular passing of the seasons (Hsu and Low 2007a; Ingold 2007a; Strauss and Orlove 2003a). Within weather-worlds, emphasis is placed on the social construction of landscape as a medium through which the social memory of climate interactions might be constituted and expressed. This accords well with the approach from historical ecology that describes landscapes as the “material manifestation” (Crumley 1994a: 6) of human-environment relationships (see also Hirsch and O’Hanlon 1995 for an anthropological perspective). Once these manifestations are characterised, social memory can help explain how individual engagements with weather are integrated within the histories of societies spanning centuries or more. The short-term experience of weather is thus placed within an understanding of long-term climate change.

In summary, although the motivations and perceptions of past people are not directly accessible, a reading of phenomenology suggests that is instead possible to consider how certain material conditions and emotional perspectives brought meaning into being (Barrett and Ko 2009). An archaeological approach might, therefore, concern itself with characterising the material conditions of climate change in the past before drawing on ethnographic analogy to suggests ways in which past people might have made sense of those conditions and acted accordingly. Crucially, such an approach would need, at least to some degree, to focus on experiences of weather, and how they are reflected in the trends and patterns observed in the archaeological record.

Conclusion

Climate-society relationships have been conceived in a variety of different ways, ranging from the environmentally determined to the socially determined. Yet the characterisation of human-environment relations arising from anthropological research emphasises the importance of socially mediated perceptions and interactions with the natural world. Simplistic and mechanistic models of economic responses to environmental change become less relevant because responses are now known to be embedded in social practice. These transitions in theory are reflected in the previous chapter, as environmental determinism was addressed, in turn, by economic and social historians, historical climatologists, historical ecologists, archaeologists and palaeoecologists. The scalar focus of interpretations narrowed, causality was addressed, and complexity increased. Continuing in this vein, the concept of social memory has emerged as way of describing adaptation as a cultural process of learning, through which societies encode and transmit knowledge about the environment. It is a concept through which human action can be integrated within climate change processes spanning supra-generational time-scales.

Few scholars have attempted to develop this idea of socially-embedded interactions with climate in relation to the environmental evidence accessed within archaeology – John Evans (2003) is one. Drawing upon phenomenology, Evans attempted to produce an inherently social environmental (and landscape) archaeology. Unfortunately, there are not only problems with Evans' particular arguments, but with the body of theory he works from. A number of scholars have criticised the phenomenological method, with some arguing that Tilley's (1994, 2004) application of the philosophy (which influenced Evans) runs counter to the ideas of Heidegger and Merleau-Ponty (Barrett and Ko 2009; Brück 2005; Fleming 2006). This, combined with Evans' (2003) uncritical use of ethnographic analogy, meant the interpretations in *Environmental Archaeology and Social Order* were unconvincing. Despite the problems in this application, however, experiential perspectives could be of use in producing socially aware interpretations of human interactions with climate. Indeed, research in anthropology has shown that generalised and abstracted notions of climate have real, but limited, influence in a social context. In contrast, on a more narrow time-scale, ideas of weather are seen to be woven intimately into individuals' cultural understandings of place, ideology and identity. More socially and culturally aware interpretations of past climate and its influence on people's lives would need to reconcile these different scales of working. The following chapters present a case study through which such an approach is applied and evaluated.

Chapter 4: Project Introduction

Chapters 2 and 3 reviewed how research into climate-society relationships developed in response to wider theoretical and philosophical debates concerning humanity's place within the natural world. There is a clear trend in the literature away from simplistic causal models, in which environmental and climatic influences on societies are characterised through the lens of rational economics and the principles of Darwinian evolution (Ingold 1996; Rabb 1980; Tipping 2002; De Vries 1980). However, although it has long been understood that coincidence and correlation don't necessarily equate to causality (McGhee 1981), the nature of archaeological and palaeoenvironmental evidence means that to some extent, archaeologists have remained mired in issues of climate reconstruction, correlation and causation. That is not to say that there have not been advances. Developments in dating and other scientific techniques have helped improve chronological resolution, and processual models are now able to better accommodate a more interpretative, rather than descriptive, emphasis on human agency. Nevertheless, archaeologists have struggled to fully adopt inferences from anthropology, in which the focus is on the role of individuals and how environmental knowledge is culturally encoded. Social memory has been suggested as way of finding middle ground between interpretative social theory and the mechanics of ecosystems modelling, as well as between long and short term processes, but there is scepticism as to whether social memory can be identified and characterised within the material remains of the past. Experiential and ethnographic perspectives may address this problem, but these have rarely been applied when exploring the relationships between climate and society. Importantly, archaeologists have yet to consider how daily interactions with, and perceptions of, weather might present a new way of thinking about people's relationships with the climate, both during times of stability and change.

The previous chapter concluded by outlining a new approach to climate in archaeology based on characterising material conditions and thinking about how people might have made sense of those conditions. This approach would be focused on the experiences of individuals and, therefore, would centre on interactions with weather. There are, however, an array of potential problems associated with this programme of study. It is not clear, for example, whether the subjective, embodied experience of weather can be reconciled with scientific reconstructions of climate. Nor is it obvious how perspectives on weather might be gleaned from archaeological evidence. The following case study attempts to address these questions by constructing and comparing three narratives of change for a small Cumbrian township during the late eighteenth century:

- An environmental narrative is constructed using existing palaeoenvironmental data and instrumental weather records. An environmental model, first applied by Martin Parry to explain post-medieval abandonment of the Lammermuir Hills, is used to suggest how climate changes might impact upon the landscape.
- The landscape narrative draws upon social and economic histories of eighteenth-century Cumbria to place the case study in a wider historical context. A more focused picture of landscape change is produced from archaeological landscape survey and archival research centred on the case study area.
- An experiential narrative is produced from two historical diaries. Methods adapted from historical climatology are adapted to convert qualitative statements into quantitative records of weather. The content of the diaries is analysed in order to access the diarists' perceptions and experiences of weather, and how these were mediated by and reflected in activity on their farms, their sense and use landscape, and their religious and philosophical outlooks.

By exploring the interfaces between these narratives, and by identifying the strengths and weaknesses of each approach, the project aims to produce an integrated narrative of change centred on interactions with weather and climate. Inspired by Ingold's concept of weather-worlds, the project evaluates whether perspectives on weather are feasible and useful. The analysis questions how an appreciation of weather can be better incorporated within studies of landscape. In doing so, the project touches on topics such as uniting scales of analysis, the role of modelling, and archaeology's relationship with modernity.

The remainder of this chapter is dedicated to introducing the study area. It begins by outlining how the area was chosen, before giving a brief overview of its geography, environment and history. Also introduced are the two eighteenth-century diarists, whose records are crucial to providing an experiential perspective on living with the weather.

Choosing the Study Area

In order to develop experiential perspectives on weather, it was decided to focus on a period with good historical documentation and, specifically, personal diaries. Furthermore, it was important to investigate an area that was likely impacted by changes in the climate. As a consequence, the project centres on upland Britain, and follows considerable research on the climatic 'marginality' of upland settlements (e.g. Parry 1975, 1978; Parry & Carter 1985; but also Tipping 2002).

A shortlist of four potential case study areas – Redesdale (Northumberland), Holmfirth (Yorkshire), Mosser (Cumbria), Ettrick Forest (Scottish Borders) – was established after consulting with senior researchers around the country. Each area was then assessed on the availability of a personal diary and the existence of other historical sources that would enable the production of a detailed landscape history. Also important were the results from other nearby archaeological studies and the information contained within the Historic Environment Record (HER). This process entailed visiting local archives and libraries, and discussing the project with researchers who had worked in the respective areas. As a result, Redesdale was discarded because the associated diary was too late in date to explore the pre-improvement landscape, and Holmfirth was rejected due to a lack of historical sources.The final element of the evaluation involved field visits to Mosser, Cumbria, and Ettrick Forest in the Scottish Borders. Each landscape was assessed on its suitability for archaeological fieldwork by the visibility of boundary changes, past land use, disused buildings, and former routeways. The accessibility of each area was also considered.

As a result of these investigations, Mosser proved to have more potential as the subject of the case study. Sources of information include an extensive list of palaeoecological studies (e.g. Pearsall & Pennington 1947; Pennington 1970; Charman et al. 2006), as well as two focussed on the nearby area (Coombes 2003; Morton 1973). The Cumbria County Archive Service at Whitehaven and Carlisle contain a number of historic maps, newspapers, court and Quaker records, as well as numerous documents pertaining to families that live in the area. Crucially, two historic diaries – of Isaac Fletcher (Winchester 1994) and Elihu Robinson (RSF RSS Box R3) – span the period 1756-

1805, with each containing detailed information on weather, farming and life in the late eighteenth century. There is an additional benefit of focussing the study on the eighteenth century, because instrumental weather records can be used to supplement the environmental narrative of change (Alexander and Jones 2000; Parker et al. 1992). In the Mosser landscape, there have been visible changes in the organisation of the farmland in the last few centuries, and there is excellent visibility of both relict earthwork and stone features in the enclosed and unenclosed land.

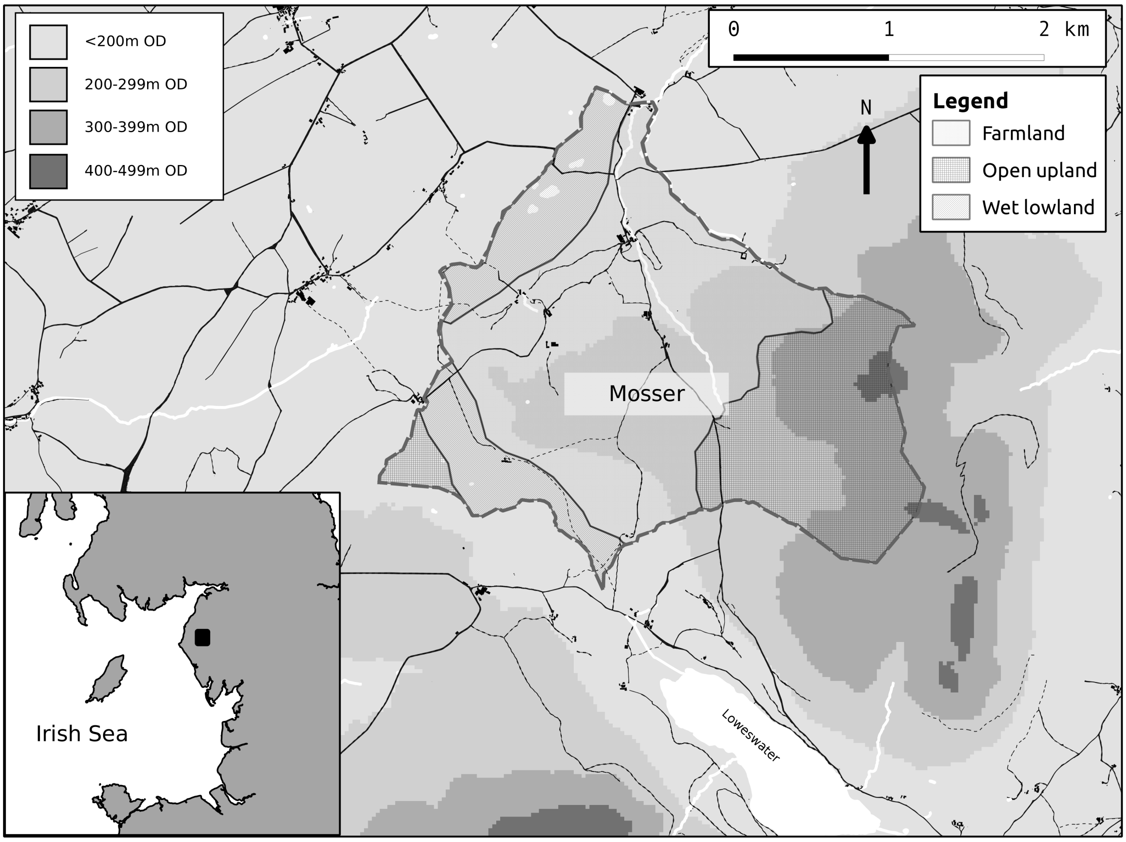

Figure 5: The Location of Mosser. Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

Mosser in Context

Mosser (OS Grid Reference: NY115245, Figure 5) spans an area of roughly 600 hectares within the parish of Blindbothel in the county of Cumbria. In the eighteenth century, Mosser was its own small township residing in the county of Cumberland. It lies just to the north of Loweswater on the north-west edge of the Lake District National Park, with the nearest town, Cockermouth, about 4km to the north. The region is famous for its high imposing hills, interspersed with glacial valleys which house the lakes that give the area its name. To the north-west lies the West Cumbrian coastal plain, whereas travel to the south or east will take you into the high fells. Mosser Fell rises to just over 400m, with Loweswater Fell to the south reaching 500m, making these only foothills by comparison with Scafell Pike, the highest mountain in England at 977m, which dominates the central Lake District.

Environment and Climate

In terms of geology, Mosser is underlain by rocks of the Skiddaw Group. The north-west of Mosser is predominantly Kirkstile formation mud and siltstone, whereas south-east is Loweswater formation wacke (sandstone). The soils, which are fairly acidic, are comprised of superficial deposits of sand and gravels, alluvial silts, tills and peat (BGS 2010). The landscape of Mosser can be divided into three broad categories (Figure 5). To the east of the township, the land rises up onto the sparsely bounded upland fell. This upland is wet and uncultivated, yet used for grazing. There is some peat development where water collects into basins. Moving further to the west, the lower improved and enclosed lands are predominantly used for pasture and meadow; only a small number of fields are cropped. The final category is to the north-west and west of the area, where water collecting in lowland areas forms wet, marshy ground. In the 1970s, core sampling in one of these areas (Leady Moss) showed accumulations of peat over 3m deep, but this land has since been turned into plantation (Morton 1973).

The climate of Cumbria is famously cold and wet, as one man described in 1766:

> "There is a ridge of mountains … by which situation we are deprived of much benefit of the sun … the middle of *February* is the middle of our winter, & the farmers must have one half of their straw, and two thirds of their hay at that time, or their stock perishes. We cannot turn out the horses and cows to grass until the middle of *June*, at which time the grass begins to be fit: add this to the winds and incessant rains, the latter end of the year, from Michaelmas, caused by the situation of those mountains, makes it very unfavourable for good to lie exposed … the land is kept so cold and spongy that we cannot sow oats before *April*, bigg before *June* and the wet and frost in the winter is very unfavourable for wheat, so that our lands, with the vast quantity of manure we must employ, more than is necessary south of the mountains, costs one-third at least more to till than yours [in the south] do, and does not produce half the crops yours produces" (Gentleman's Magazine XXXVI in Bouch & Jones 1961: 219-20).

There is perhaps some exaggeration in the above account, but it is undoubtedly a region with a great deal of climatic variation. Areal averages from 1941-1970 show the temperature falling to 1.0°C in January in the upland zone of Cumbria, compared to 2.8°C in the lowland zone. In terms of precipitation, the upland area averages 1663mm yearly, whereas the coastal lowland zone averages roughly two thirds that value at 1045mm (Smith 1976). In differentiating between the upland and lowland zone, the expectation is that this variation is primarily attributed to relief. Indeed, despite West Cumberland having a “peculiarly moist character” (Caird 1852 in Dilley 1991: 9), the relief has an additional effect in that the Pennines to the east and border hills to the north produce a rain shadow that means “periods of drought are more common than often supposed” (Dilley 1991: 9). The implication is that when winds turn to the north and east, heavy downpours are often interspersed with longer dryer periods. During the eighteenth century, Europe was in the midst of the Little Ice Age, a cold and wet period running from around 1300 to 1900 (Brázdil et al. 2005; Jones 2001). This is likely to have created difficult conditions for those living in upland Britain, and this is examined further in the following chapter.

History

Much of the existing research on Cumbria's history centres either on the deeper Roman and pre-Roman past, or the great Romantic period that caused the Lake District to be immortalised in the national consciousness. Public perceptions of the Lake District tend to refer to a wild and inhospitable landscape, and it is in these terms that historical narratives have often been constructed. Cumbria's 'otherness' has frequently been emphasised: it is and was, as (Searle 1983: 15) aptly reflects using a quote from Hobsbawn (1968: 98), the “odd corner of Britain”. In contrast to these perceptions of isolation, however, eighteenth-century West Cumbria was a busy and vibrant place. Whitehaven was the second largest port in the country, and mineral wealth drove rapid urbanisation along the north-western coastal fringe (Bouch and Jones 1961). Every year, vast quantities of livestock were driven south from Scotland through Cumbria towards London and the South-east (Marshall 1971). As this was happening, communication and transport links were rapidly improving. Some historians (e.g. Searle 1983, 1986) have argued that these developments helped to erode the traditional Cumbrian social system, but others (e.g. Whyte 2003) have emphasised how the Lake District remained distant from the events and processes that gripped the rest of the country. There is debate as to what extent the Lake District remained detached from the 'agricultural revolution' experienced in southern England (Dilley 1991), yet there is no doubt that the landscape of Cumbria underwent a significant transformation as a result of parliamentary enclosure. There is a sense that during this period, rural upland Cumbria was caught between the traditional medieval practices of the past, and the marketisation of modernity.

Towards the end of the eighteenth century, the country found itself embroiled in two wars: one with the American colonies and the other with France. This led to blockades and food shortages, and there is evidence that the effects were made worse by bad weather (Whyte 2003). At the turn of the century, England's inhabitants faced the prospect of famine. The extent to which these events were referenced in Mosser's landscape and the lives of the two diarists is discussed in the following chapters.

The Diarists

Two diaries enable first-hand insights on livelihood, faith, farming and weather in Cumbria during the eighteenth century. The first diarist, Isaac Fletcher, was born at Underwood in Mosser on 20 February 1713/4. His diary, studiously transcribed and annotated by Angus Winchester (1994), runs from 1756 to just before his death in 1781, at the age of 67. At the peak of his life, he owned three large properties within the township. Fletcher was a farmer and a small-scale merchant involved in the import of various goods through the West Cumbrian ports. He also managed the legal and financial affairs of a number of clients. Fletcher was a devout Quaker, and prominent member of the powerful Pardshaw Monthly Meeting. His diary entries are short but regular. They contain a daily record of weather, farm work, legal disputes and religious activity. As such, they present an ideal opportunity to reconstruct the 'weather history' of Mosser.

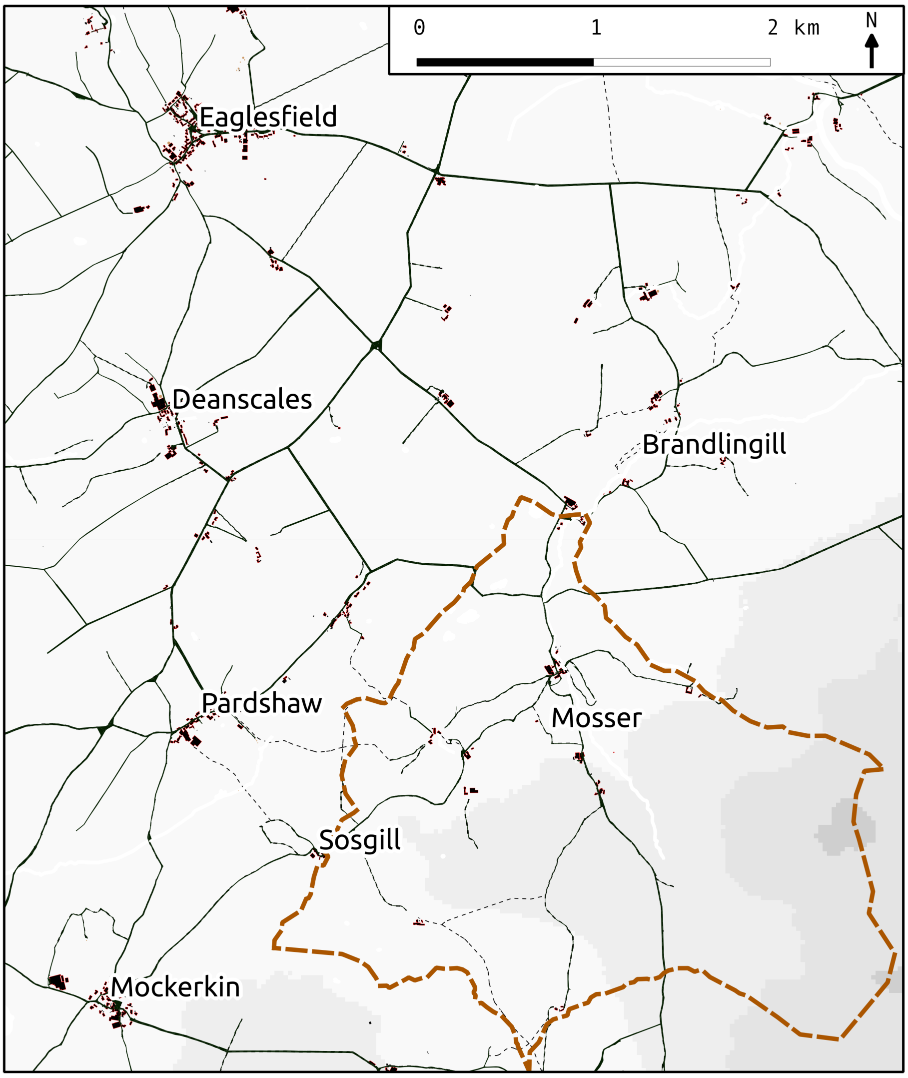

Figure 6: Eaglesfield in relation to Mosser. Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

The second diarist, Elihu Robinson, was Fletcher's friend and fellow Quaker. Robinson was born in 1735 and died in 1807. He lived in Eaglesfield, roughly 3km north-west of Mosser (Figure 6). Like Fletcher, Robinson was a yeoman farmer, with occasional mercantile business interests. The handwritten diary, running from 1779 to 1805 (a further year, 1806, is excluded from this analysis due to limited time in London) and held in the Library of the Religious Society of Friends (RSS Box R3), does not record these activities in as great detail as Fletcher. Nevertheless, Robinson's diary contains considerable information on prices and farming activity. The more reflective entries, in which opinion on events is proffered, contrast starkly with the dry cataloguing that characterises much of Fletcher's earlier records. As such, the diary enables a deeper analysis of Robinson's perceptions and world-views. Although there is a volume missing – the period from August 1795 to January 1798 is lost – the brief overlap between the two accounts from 1779 to 1781 provides an opportunity for the comparison and verification of dates and events.

Summary

Through a detailed study of Mosser during the eighteenth century, it is possible to examine a range of interacting social and environmental processes. Urbanisation along the north-west coast heralded a rapid expansion of the market economy. Mosser stood at the margins of these developments, split between the traditional rural practices of the high fells and the busy, developing world of overseas trade, industry and intensive agriculture. The climate and topography is similarly divided between the uplands to the south-east and the lowlands to the north-west, but it was also the time of the Little Ice Age, when the climate was likely to be colder, wetter, and more variable. In particular, the 1790s are described as a time of war, bad harvests and bad weather, and it will be interesting to examine these events through the eyes of Elihu Robinson. For the Quaker diarists in general, this was a time when the traditional elements of their faith and livelihoods were confronted by the new priorities of modernity. Overall, through studying this area and period in terms of environmental, landscape and experiential narratives, it should become clear how and whether these processes of change can be linked with people's interactions with and perceptions of weather and climate.

A Note on Statistics

As part of the project, a number of statistical investigations were undertaken using the SPSS software package. Primarily, this involved identifying and measuring correlations between datasets. Pearson's (r) product-moment coefficient was the preferred measure, but this requires that assumptions of normality, linearity and homoscedasticity are not violated. Transformations were not applied. Therefore, if the test's assumptions were violated, Spearman's rank correlation (*rho*) was used as the non-parametric alternative (Pallant 2007). Often the number of cases examined was very low, and this affects the measure of statistical significance. Although priority was given to results that conformed to the $p<.05$ level, if a result recorded a high correlation but a low statistical significance, it was examined more closely to see if the result was of practical significance.

Chapter 5: Environmental Narrative I – Palaeoecology

Introduction

The first element of this project is to explore the ways in which an environmental narrative might contribute to an understanding of how weather and climate affected past people. Like the rest of the project, the main temporal and geographic emphasis of this study is mid to late eighteenth-century Mosser. Climatically, this is within the span of the Little Ice Age, a period of cold and wet weather defined by historical climatologists running from c.1300 to 1900, although its precise timing is a matter of debate (Brázdil et al. 2005: 388–96). Despite the eighteenth-century focus, the nature of palaeoecological studies often necessitates a look at longer time-scales and a wider geographical area, incorporating the whole of Cumbria or northern England. This chapter reviews existing palaeoecological research that focuses both on Mosser and the wider region. The results from these studies are evaluated and put into the context of wider palaeoecological theory. The following chapter aims to address some of the problems of chronology inherent in palaeoecology by using instrumental weather records to examine whether climate changes can be related to social and landscape history. Results from the different approaches and sources of information are then brought together to synthesis a more comprehensive environmental narrative for Mosser.

Palaeoecology: Regional Syntheses

Pollen in Cumbria: Land Use

Early attempts at producing an environmental history of Northwest England are dominated by palynological studies (Oldfield 1963, 1965; Pearsall and Pennington 1947; Pennington 1970; Pennington and Tutin 1964). These set Mosser within a rich regional narrative of ecological change that has received little revision over the years. One characteristic of early pollen studies is the focus on anthropogenic changes in land use. The identification of palaeoclimate proxies is not a major consideration, but this does not preclude the discussion of climate at certain key junctures. Pennington's (1970) synthesis and Paul Coombes' (2003) unpublished doctoral thesis offer useful summaries of these studies. Here, I cover some of the main themes and point out places where debate has arisen.

Initial human impact in western Cumbria, indicated by a decline of elm and other tree pollen and an increase in grasses, has been dated to the fourth millennium BC (Pennington 1970: 67). By the middle of the second millennium BC, the region had undergone significant deforestation, and cereal crop cultivation was widespread. The evidence suggests that, barring some minor fluctuations in the prevalence of cereals, the ecological characteristics of the region remained broadly unchanged throughout the second and first millennia BC (Coombes 2003: 229). A significant climate change known as the Sub-Atlantic downturn has been linked to abandonment of the marginal uplands of Britain during the early centuries of the first millennium BC (Baillie 1989; Burgess 1989). This is a hypothesis that has garnered support from researchers in mainland Europe, who have also associated settlement abandonment with environmental change around 2600 BP (van Geel et al. 1996; Magny 2004; Tinner et al. 2003). However, Pennington (1970: 72) observes only a few studies that show vegetation changes relating to a climatic downturn at this time. Petra Dark's (2006) later survey of 75 pollen sequences yielded similar conclusions, implying that human settlement and land use were only mildly affected by the downturn.

Early studies show little evidence of Roman impact, and Higham (1986) argues the Romans had little contact with the native populations in Cumbria. During the fifth century, a brief renaissance in Romano-British culture is termed the 'Brigantian' period (Coombes 2003). This is characterised by “profound soil changes... and high quantities of highly organic soil, rich in *Calluna* pollen and composed of highly acidic humus were washed into the tarns” (Pennington 1970: 72–3). It is argued that these changes constitute a major increase in forest clearance and settlement expansion, and a drier climate which allowed cultivation of cereals at higher altitudes. There is a similar expansion in grasslands attributed to Norse colonisation, with evidence of Viking settlements from Scandinavian place-names (Pennington 1970). More recently, however, Coombes et al.'s (2009) high resolution study in southern Cumbria dates the latter clearances more securely to Anglo-Saxon occupation from the seventh to eleventh centuries, with subsequent deforestation expanding this pattern.

From the Anglo-Saxon period onwards, indicators of pastoralism become increasingly strong, with sheep grazing ending chances of reforestation on the upland slopes. Medieval sheep-grazing is attributed to the large monasteries, but the dissolution is also thought to have resulted in an opening up of the landscape (Coombes et al. 2009; Winchester 2000). Pennington (1970: 76) claims that Beech, Hornbeam and Pine do not appear in pollen diagrams until the eighteenth century, and these are interpreted as deliberate planting. In southern Cumbria, however, Coombes et al. (2009) state that the landscape achieved its contemporary character by 1700.

In terms of climate, only the Sub-Atlantic downturn and Brigantian amelioration are mentioned in any detail, and Pennington (1970: 77) surmises that during the past 2500 years "the most important factor controlling vegetation history is shown to be man." In the studies reviewed by Pennington, the climate proxies tend also to be indicators of anthropogenic land use change. Indeed, during the later post-glacial period looked at here, early climate-only proxies are limited to the definition of the Sub-Atlantic period, where inferences are derived from "overall change in peat humification" (Pennington 1970: 76).

Peat Sediments: Climate

Although macrofossil records from peat bogs have often been used to produce vegetation histories in conjunction with palynological studies, "the recognition of raised mires as valuable archives of climatic information has generated a significant body of research into raised peat stratigraphy" (Hughes et al. 2000: 465). The explosion of interest in peat analysis as a climatic proxy has been directed, to a large extent, at studies of mires in northern Britain (Barber 1981; Barber et al. 2003; Chambers and Charman 2004; Charman et al. 2009; Hughes et al. 2000; Langdon et al. 2004; Langdon and Barber 2005; Mauquoy et al. 2002; Mauquoy and Barber 1999). There are a number of possible techniques used for deriving climate proxy data from peat bogs, ranging through macrofossil, humification and testate amoebae analyses (Charman et al. 2006). For the most part, these measure surface wetness changes. As a climate proxy, these changes are thus dependent on warmth and wetness (evaporation-precipitation balance). In terms of examining the results for Cumbria, although there are a large number of peat-land sites available for palaeoclimate research, comparisons between studies are made difficult by chronological uncertainties and a lack of a common scale for expressing surface wetness changes (Charman et al. 2006: 337). Records are often subject to 'suck in and smear', where they are 'sucked in' to known dated events or 'smeared out' across long periods (Baillie 1991). As Charman et al. (2006: 227) point out, this means there "is little consensus on whether there is a single 'best record' or if not, what the optimal combination of records is". Charman et al.'s (2006) compilation of peat-land testate amoebae studies aims to tackle this issue by building upon regional covariance between sites. The study serves a useful summary of the vast body of work in this area, and also helps to define some of the issues inherent in deriving an unambiguous climate signal from multiple studies.

Charman et al.'s (2006) synthesis was comprised of results for changing assemblages of testate amoebae from 10 different sites. In each study, a transfer function and training set had been used to transform results to values for the reconstructed mean water table. All results were thus based on the same proxy and expressed in the same way. This meant that poor correlation between studies could now more confidently be attributed to chronology. Chronology was then addressed by calculating a single age-depth model derived from key points of change within the records, as well as tephra horizons and pollen matching: "It is not certain that the revised chronologies are any nearer to the true age-depth relationship but they are at least comparable with each other and are no less consistent with the individual age estimates than the original chronologies" (Charman et al. 2006: 343). The act of producing a regional synthesis this way recognises the inherent uncertainties of individual records and imprecision of core chronologies, and these are understood to only have been partially addressed (see Charman et al. 2006: 337). Despite these problems, the dating of wet shift episodes by Charman et al. (2006: 345) do tend to match with those produced by other comparisons of individual studies (Hughes et al. 2000). However, although some of the chronological problems have been addressed, the most meaningful expression of the data is limited to defining peaks along the line of a 100-year moving average – a window that extends well beyond the span of a human lifetime.

Within the resultant compilation, the record for English/Scottish Borders covers a region that includes Cumbria, and incorporates data from four cores: Butterburn Flow 1, Coom Rigg Moss 1, Coom Rigg Moss 4 and Longridge Moss. The record runs from 2250 BC onwards, but there is only enough data to form the 100-year moving average from around 1950 BC (Figure 7). Over the past 2000 years, there have been a number of major shifts in water table levels. Beginning in a comparatively wet period from AD 50-150, water tables experience a sharp fall before declining for 300 years to a low point at AD 350. The period AD 350-650 is characterised by fairly low water tables, and can thus be considered dry. Levels then increase again to AD 700-800 before sharply falling around AD 850. This low point is broadly consistent with the start of the Medieval Warm Period (Jones et al. 2001).

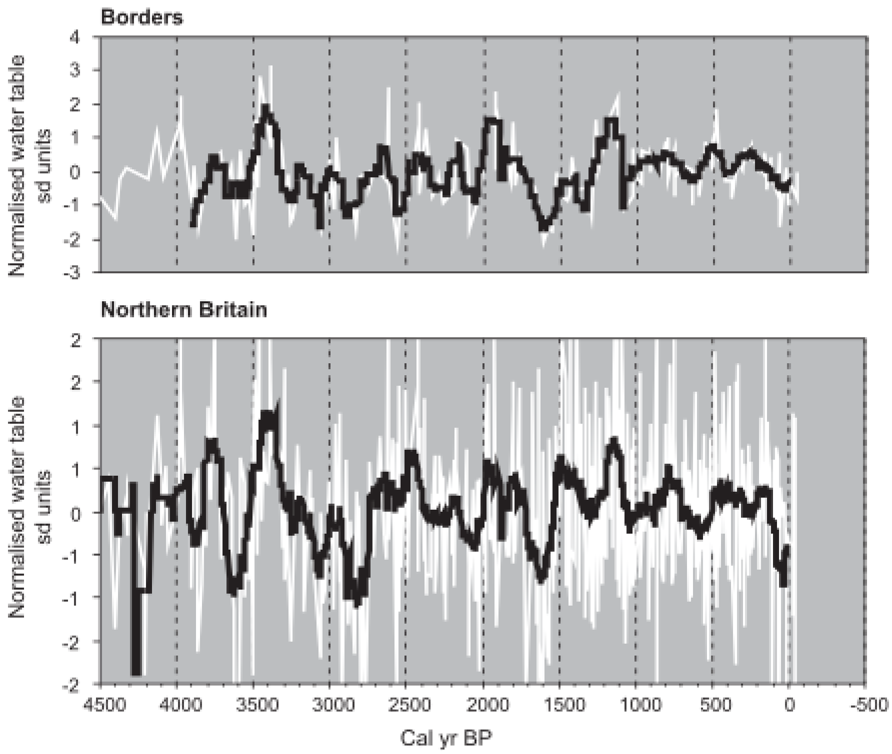

Figure 7: Regional composite water table records for northern England and northern Britain as a whole. The composites are based on the individual values from the profiles within each region (white lines) and the 100-year moving average of these values (thick black line). After Charman et al. 2006

The last millennium is ostensibly less variable the preceding two. Initially increasing sharply from the low point around AD 850, water table levels remain fairly stable until AD 1200. There is then a trough as the levels decline to AD 1350, but they had recovered by AD 1400, and went on to peak around AD 1450. A further shallow decline occurred over the next 100 years, with another peak occurring at about AD 1700. The last 200 years of the record appear to show continual drying (Charman et al. 2006: 343–4). Ostensibly, the results are at odds with the traditional notion of the Little Ice Age, with two drier spells appearing to fall within that period, and there is little to differentiate these years from the preceding 500 (Mauquoy et al. 2002; see Brázdil et al. 2005 for discussion about defining the LIA). Nevertheless, the record for the whole of northern Britain correlates well with Magny's (2004) compilation of lake level records, which do appear to show the influence of the LIA. Moreover, some studies have identified AD 1450 (Mann et al. 1999) and AD 1700 (Luterbacher 2001) as points of peak coldness, which correlate with peaks in the Borders water table record. Elsewhere in Cumbria, studies at Walton Moss (Hughes et al. 2000) and Bolton Fell Moss (Barber 1981, 1994) identified wet shifts around AD 1600, 1740 and 1850.

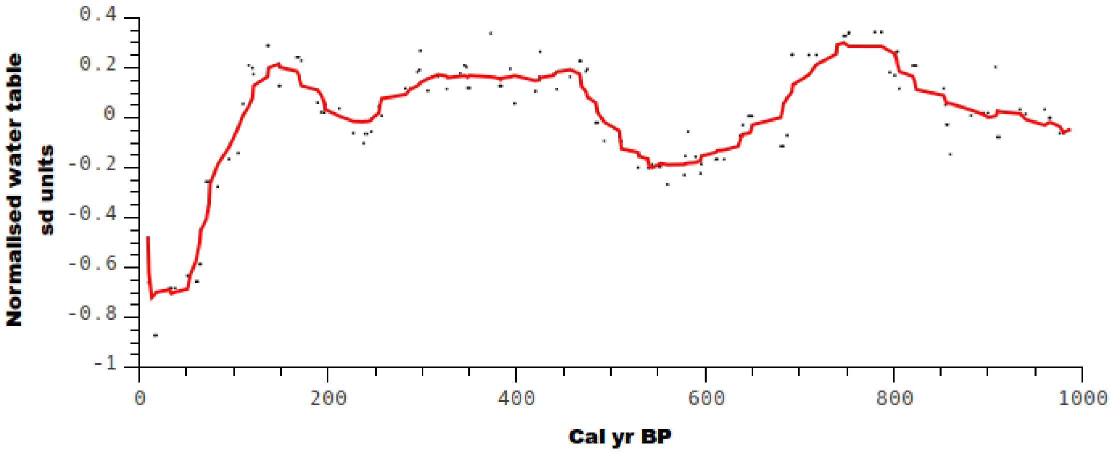

Figure 8: Northern Britain composite water table record, with 10-point moving average. After Charman et al. 2006

In the above analysis, although the 100-year moving average can be traced on yearly basis, the low resolution inhibits a detailed examination of short periods of time. Across the four cores, under 32 samples account for the last 500 years, with a maximum of 7 reflecting the climate during the eighteenth century. Alternatively, using data from Charman's compilation of records across the whole of Northern Britain, 12 cores are combined, resulting in around 16 samples reflecting the climate of the eighteenth century. When the past 1000 years are plotted and smoothed using a 10 point moving average, a more detailed interpretation of the eighteenth century can be produced

(Figure 8). It shows a century characterised by gradually increasing water table levels, before rapid decline sets in after a high point around AD 1800. This was the highest the water tables had been since AD 1150-1250, although the period from AD 1450-1700 appears to have been consistently wet, perhaps reflecting the Little Ice Age.

Although the latter presentation of the data appears to yield a more detailed analysis, there are reasons to be cautious. The number of samples is increased, but only by incorporating data from over a much wider area. Although each core has been analysed according to the same age-depth model, there is a degree of chronological uncertainty associated with each sample, as well as with the absolute dates of the cores. In the original research, the 100-year moving average helps smooth over this imprecision, but when the detail is magnified these problems come to the fore. Recent research has shown that, although peat-based research can identify climatic events on decadal or sub-decadal time-scales using fine resolution analyses, chronological uncertainty associated with absolute dating and differences in micro-topography between coring sites mean that it remains difficult to link these events to calendrical dates (Amesbury 2008).

Palaeoecology: Local Studies

Leady Moss

An unpublished pollen core study of Leady Moss (Figure 9) by W. D. Morton (1973), in the west of Mosser, provides an opportunity to explore the local environmental and ecological history. Prior to tree planting during the late 1970s and 1980s, the area was well positioned to catch water running off Bramley Seat and Toot Hill, resulting in the growth of over 3m of peat within this relatively small drainage basin (Morton 1973). Morton's analysis of five cores, which were wiggle-matched to the contemporary standard pollen zoning schema for the British Isles, found horizons dating back to the Late Glacial period. Here, however, I will only discuss his findings from the beginning of the Sub-Atlantic onwards.

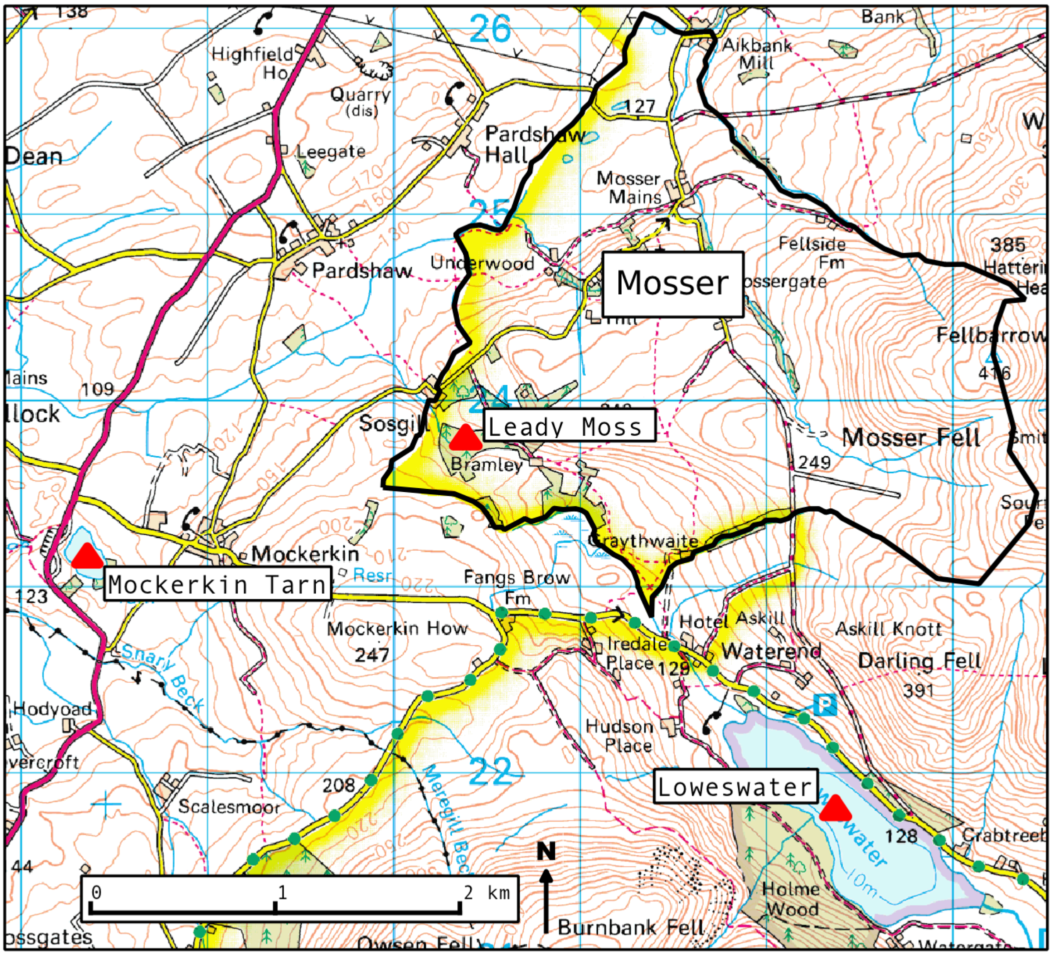

Figure 9: The location of environmental sampling sites at Leady Moss, Mockerkin Tarn and Loweswater in relation to the Mosser township. Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

At Leady Moss, the wetter climate of the Sub-Atlantic brought no change in sedimentation rate. *Sphagna* values increased, and this was attributed to the growth of blanket bogs (Morton 1973: 33). A clearance phase, with reduced prevalence of oak, is interpreted to coincide with "Brigantian" occupation further south into the Loweswater valley. Although cereal grains are not present on the Moss at this time, Morton (1973: 33–5) claims that they are found in Loweswater. The immediate post-Roman period is delineated by the re-establishment of forests in the vicinity of the Moss. There was increased podsolization, indicated by increased *Sphagna* and *Ericaceae*, as well as decreasing amounts of elm. However, despite the forest regeneration, some grassland still remained.

Morton (1973: 35) notes a second period of clearance, this time marked by a reduction in alder in favour of oak, as well as the disappearance of birch cover on the Moss. This is attributed to Viking activity in the valley bottom, whereas a simultaneous reduction of *Filicales* spores is taken to represent the Viking practice of burning bracken on the hill slopes. The pollen evidence leads Morton (1973: 37) to argue that this could be the time at which the Moss was cleared, when the neighbouring settlement at Sosgill (a Norse name) was established. An alternative hypothesis is that the declining birch and increasing *Sphagna* could represent further climatic deterioration characterised by increased precipitation.

The upper samples from Morton's cores show a progressive opening up of the surrounding area. This is thought to represent the growing role of sheep farming, first by the Vikings, then continued by the Cistercians at Calder Abbey. The proximity of two grange farms near Leady Moss is seen as confirmation of this interpretation, and their establishment is suggested to coincide with the introduction of *cerealia* to the assemblage (Morton 1973: 37). An abundance of oak is attributed to its encouragement as pannage for pigs during the same period. Further afield, the existence of blanket bogs and continuing (though reduced) forest cover on the higher slopes is confirmed by *Sphagna*, *Ericaceae* and a rebounding elm population.

Mockerkin Tarn

Mockerin Tarn is a small eutrophic kettlehole, with a catchment area of 40 hectares (Figure 9). A study by Coombes' (2003: 2) was undertaken with three objectives: “to study regional abandonment phases during the Medieval era (particularly in the 14^{th} century AD), to rigorously test the possible impact on environmental changes (climatic deterioration and soil nutrient depletion) on any such phases, and to investigate the potential of diatoms as alternative proxy indicators of human impact.” In addressing these objectives, Coombes performed pollen, diatom and geochemical analyses of his samples from a single core from Mockerkin Tarn, as well as undertaking similar work at five other sites in Cumbria. An age-depth model was generated for the core using a combination of methods, but centred on seven radiocarbon dates. A further three radiocarbon dates were rejected as anomalous after comparisons were made with geochemical and palynological results. The result was a peat record stretching back nearly 4000 years. In order to examine anthropogenic impacts in relation to climate changes, Coombes (2003: 107–14) attempted to 'tune' his records to plant microfossil and humification records from Walton Moss, which provide a precipitation signal for the past 3000 years (Barber and Langdon 2000). This involved wiggle-matching less detailed proxy data from the study cores to key variations in the Walton Moss core with the aim of thereby improving geochronological precision. In combination, these techniques should provide a detailed overview of the environmental changes occurring just outside Mosser over the past three millennia.

The results of Coombes' (2003: 319) investigations into past land use are complicated, but the major changes can be summarised in the table below (Figure 10). The area around Mockerkin was likely partially cleared of woodland during the Bronze Age. Supporting the conclusions from the later pollen studies from southern Cumbria, further clearances observed in the Dark Ages were attributed to Anglo-Saxon colonisation, as opposed to Irish-Norse Vikings (Coombes et al. 2009). In contrast to Morton's (1973) early pollen work, the Mockerkin cores showed “no signs of agricultural expansion … during the Roman era, nor is there any evidence for a 'Brigantian' period of forest clearance” (Coombes 2003: 322). Declines in anthropogenic indicators were observed during the ninth, eleventh and fourteenth centuries, although the decline in the eleventh century was considered only of local significance and none of these declines were considered catastrophic (Coombes 2003: 322).

Helpfully for this study, a regional increase in coniferous woodland during the eighteenth century allows us to pinpoint this period in the record (Coombes 2010: Pers. Comm.). At this time, the pollen cores show that, apart from a few trees growing close to the lake, much of the area was open, pastoral grassland. This was a picture broadly unchanged since AD 650. “Declines in key weed species such as *Plantago lanceolata* (plantain) and *Rumex acetosella* (sorrel) suggest a slight decline in land-use intensity during the 18th century” (Coombes 2010: Pers. Comm.), although there is a risk of over-interpretation. The eighteenth century saw a marked shift in the lake's ecology. The change from an anoxic environment dominated by cyanobacteria, to a more open system featuring surface vegetation and *Aulacoseira* diatoms, could be indicative of declining land use intensity (Coombes 2010: Pers. Comm.). The record also shows an increase in Phosphorous flow at this time. Although this might be associated with land use change, its interpretation remains complicated (Coombes 2003: 326; 2010: Pers. Comm.).

Date:	Limnological and catchment development:
1190 BC	Low-level cultivation in catchment: first appearance of *Cannabis sativa*-type, slight increase in cereal-type pollen above this level. Minor peak in LOI values.
710 BC	Possible site abandonment and climatic decline. Reduced erosional input (major fall in K, Na, Mg & Al sedimentation) and rise in *Isoetes lacustris*.
220 BC	Renewed cultivation within the catchment: first sustained presence of *Cannabis sativa*-type, brief peak in lithophile (K, Na, Al) sedimentation. Transition marked by rises in *Achnanthes minutissima* and pH; DOC falls.
AD 70	Possible early episode of hypolimnetic anoxia: peaks in Co and Ni sedimentation, sharp rise in LOI. Major fall in *Isoetes lacustris* pollen.
AD 290	Regeneration phase within catchment: decline in Poaceae undiff., *Corylus avellana*-type expands.
AD 450	Beginning of long-term changes in chemical and ecological structure of lake: declining diatom abundance (esp. *Fragilaria* spp.) and beginning of rise in S sedimentation indicate increasing stratification in the water column. LOI and P sedimentation both falling from this period.
AD 650	Clearance phase in catchment: pastoral-type indicators (Poaceae undiff., Ranunculaceae, *Plantago lanceolata*) all rise significantly; rises in lithophile (K, Na, Mg, Al) sedimentation also noted. Major increase in *Cannabis sativa*-type suggests increased hemp retting in lake. Early stages of first eutrophication phase at Mockerkin Tarn: *Navicula minima*, *Cocconeis placentula*, *Achnanthes* spp. rise and *Nymphaea alba* expand. Possible rise in seasonal anoxia (increasing Fe/Mn ratios and Cr sedimentation).
AD 840	Peak in *Cannabis* retting and of first eutrophication phase: *Navicula minima* and TP concentrations reach maximum. Peak in *Isoetes lacustris*.
AD 870	Possible abandonment of site. Collapse of *Cannabis* retting; major falls in *Navicula minima*, TP and pH. DOC rises.
AD 980	Final phase of epiphyte dominance in Mockerkin Tarn: *Achnanthes minutissima* declines sharply, supplanted by *Tabellaria flocculosa*, *Fragilaria construens* var. *venter*, *Fragilaria pinnata*. First significant presence of *Asterionella formosa* in record.
AD 1030	Planktonic forms become dominant in Mockerkin Tarn diatom assemblages: rises in *Aulacoseira ambigua*, *Aulacoseira granulata* and TP. Very high levels of *Gyrosigma acuminatum* noted.
AD 1150	Maximum in S sedimentation, possible maxima in seasonal stratification and hypolimnetic anoxia? Possible peak in cyanobacteria dominance of system: minima in diatom abundance and P sedimentation.
AD 1510	Second eutrophication stage at Mockerkin Tarn: rises in *Aulacoseira granulata*, *Navicula minima*; sharp rises in TP and pH. Contemporaneous decline in anoxia suggested by falls in Fe/Mn ratios and S sedimentation; sudden acceleration in P sedimentation.

Figure 10: Late Holocene catchment limnological changes at Mockerkin Tarn.
Source: Coombes 2003

As mentioned above, Coombes' method for linking land use proxies to the off-site climate record at Walton Moss involved deriving a separate (limited detail) climate proxy record from his Mockerkin cores. This would allow major climatic shifts to be correlated across sites, thereby 'tuning' the record of land use changes to the record of climate changes (Coombes 2003: 271–6). For the Mockerkin core, Coombes attempted to use halogen concentrations as the crude climatic proxy, which could be used to major variations in Mockerkin with those at Walton Moss. Unfortunately, however, this record was found to have a low chronological resolution, “which made identification of secular-scale climatic variations in the record extremely difficult” (Coombes 2003: 271). Furthermore, the iodine record (considered most important, climatically) bore little relation to the precipitation records derived from peat-based proxies at Walton Moss. This forced Coombes to reject the record at Mockerkin for further palaeoclimatic analysis.

Although the climate data for Mockerkin Tarn was poor, Coombes draws some surprising conclusions from the results from his other sites. In these marginal environments, the relationship between climate and culture is expected to be at its most linear, but Coombes' (2003: 278–9) was only able to make very limited statements on the extent of climatic influence. Interestingly, however, where it was possible to tentatively suggest a link between climate and land use practices, greater sensitivity was found on lowland sites compared to those in the uplands (Coombes 2003: 324–6). A possible reason for this could be that “these communities exhibited considerable greater economic and ecological diversity” (Coombes 2003: 325) compared to their lowland counterparts. The part-pastoral economy could have buffered climatic risk to a greater degree than predominantly arable regimes. This research suggests that the interpretation of climatic effects on marginal communities may be more complicated than is often assumed (cf Parry 1975).

Loweswater

A recent palaeolimnological study of Loweswater, a reasonably large lake just to the south of Mosser (Figure 9), was conducted on behalf of the Environment Agency (Bennion et al. 2000). The primary aim was to understand the extent of recent eutrophication at the lake, but the study also provides an insight into land use change within the Loweswater catchment from the fourteenth century onwards. Unfortunately, it is likely that the influence of nutrient enrichment of the last few centuries would over-ride any climate signal – a palaeoclimate study was not undertaken (Bennion 2009: Pers. Comm.). The results from the study show an increase in productivity beginning around 1750. Although the causes of this are not discussed in detail, it is possible that the associated nutrient influx was caused by more intensive farming practices (Bennion et al. 2000: 35). This date also marks a large increase in metal pollution, which is tentatively attributed to mining (Bennion et al. 2000: 55–6). Earlier peaks in metal concentration are also attributed to human activity, but these are undated. Most changes in water quality occur from 1850 onwards, and this is considered the result of industrialisation. Overall, the significant increase in lake productivity during the last 50 years dwarfs earlier changes (Bennion et al. 2000: 59–60).

Discussion

The regional environmental narrative described by Pennington (1970) has changed little over the years. One reason is that without an absolute way of anchoring sequences in time, early palynologists and palaeoecologists contextualised their local findings relative to regional and national frameworks that are based, in part, on documentary histories. It is why, for example, Morton's study of Leady Moss bears such close resemblance to Pennington's regional synthesis. Existing descriptions of the past are confirmed and reinforced, rather than questioned and reformed: in this 'confirmatory' approach, "there are no challenges to the historical orthodoxy" (Tipping 2004: 19). Misinterpretations of chronology are made more probable and the differences between pollen cores, even on an intrasite basis, are downplayed (Dumayne-Peaty and Barber 1998). One solution is to focus on the diversity of the local environment around individual sites rather than on confirming regional patterns, but there are difficulties in defining provenance for pollen in open landscapes (Sugita et al. 1999; Tipping 2004: 18). Crucially, Tipping (2004: 20) argues that palaeoecological analyses should maintain "an independence of thought," thereby providing a less deferential, more confident and heterogeneous narrative of the past.

One problem with this approach is that, in the historic period, high chronological resolution becomes essential. An example of best practice is Tipping's (1999) work in the Bowmont Valley and the northern Cheviot Hills. Here, a combination of dating techniques allowed error ranges to be constrained to ±10-15 years (Tipping 1999: 41). High resolution dating and detailed pollen analyses enabled the production of a very rich environmental history, with discussion of specific economic issues, including grazing pressures, hemp growing and timber supply, amongst others. By considering the scientific data independently from other narratives of change, Tipping (1999: 47) was able to generate "new insights" on the social and economic history of the area, directly from the scientific palaeoenvironmental data. The results also show interesting hints at climatic impacts. Geoarchaeological investigations reveal increased waterlogging that could reflect the Little Ice Age, as well as accelerated fluvial activity, with the erosion and deposition of coarse gravels occurring as recently as the late eighteenth and/or early nineteenth century. These could have had "profound impacts on the re-orientation of farming practice" but these have "barely begun to be understood" (Tipping 1999: 46). With such potential demonstrated in this work, it is unfortunate that such a detailed analysis was not available for Mosser.

There are, of course, instances when a regional record is useful. This is particularly true with climate proxies, when the overall picture might be considered more reliable than that provided by individual cores or sites. Although Charman et al.'s (2006) method for compiling peat records improves the comparability of similar proxy measures of climate, there remain problems in linking this narrative with other forms of palaeoecological evidence, especially when the same data is used to infer both anthropogenic and environmental changes. In Morton's (1973: 37) case, this made differentiating between human and climatic causes for declining birch values problematic. It could be argued that by interpreting climate and land use change from the same core, there is the potential for better identifying how each episode might be chronologically related, but such an approach runs the risk of circular reasoning. The development of radiocarbon dating and the use of independent proxies has alleviated this problem somewhat, but Paul Coombes (2003: 328) still found that "the epistemological and statistical tools used in palaeoecology are poorly suited to the task" of understanding causality, where cultural and climatic changes occur synchronously.

It is, moreover, not necessary to increase the resolution in order to start thinking about how people might have experienced climate changes. This can be attempted by relating changes to prevailing weather patterns using climate models (Charman et al. 2006: 345–7). Precipitation variability in northern Britain, for example, is attributed to changes in the intensity of major pressure systems and the migration of prevailing westerly winds. The authors (Charman et al. 2006: 347) postulate that further studies may build upon this kind of analysis to produce a closer examination of atmospheric circulation, and consequently a better understanding of the weather.

The Little Ice Age

The Little Ice Age (LIA) and Medieval Warm Period (MWP) are the two defining climate epochs of the past millennium. The LIA was debated by the historians Braudel, Utterström and Ladurie, and has been a core concept in historical climatology ever since (Behringer 2009; Brázdil et al. 2005; Jones et al. 2001a; Lamb 1966, 1977). Although the timing and magnitude of the LIA has been questioned many times (e.g. Lamb 1977; Jones et al. 1996; Bradley et al. 2003; Ogilvie & Jónsson 2001), along with its usefulness as a concept (Jones et al. 2001a), the LIA remains dominant in the literature concerning European climate change. The analysis here of climate signals for Cumbria reflects both the uncertainty and gravity surrounding the subject. Although indicators of the LIA can be found in Charman et al.'s (2006) peat-based proxy analysis, the overriding impression in the Borders region is of a period indistinguishable from the MWP before it. Yet this interpretation of the data runs counter to the sizeable body of research that affirms the LIA's significance in Cumbria (e.g. Hughes et al. 2000), as well as myriad historical anecdotes that appear to attest to a period of unusually bad weather across Europe (Behringer 2009). The explanation suggested by Charman et al. (2006) is that different regions experienced different conditions, but it is clear that much larger and less ambiguous climatic shifts were experienced in the more distant past.

Conclusion

This chapter has reviewed a range of palaeoecological studies that help build an environmental narrative for Mosser. Early pollen work at Leady Moss sought to set the Mosser area against the wider backdrop of land use changes observed across the

Cumbria region. Clearances of tree cover were thought to relate to Brigantian and Viking phases of occupation. The gradual opening up of the area and increase in pastoral indicators towards the top of Morton's (1973) Leady Moss core was linked to the growing role of sheep farming from the Cistercian monastic influence onwards. Coombes, however, dismisses the emphasis on Brigantian and Viking clearance. His results show that within the vicinity of Mockerkin, vegetation clearance episodes correlated with phases of Bronze Age and Anglo-Saxon colonisation. A slight decline in land use intensity during the eighteenth century is suggested by the pollen data. This is corroborated by a marked change in lake ecology at this time, but the interpretation of such changes remains tentative at best. The limnological study of Loweswater also shows significant changes occurring during the eighteenth century, particularly in terms of heavy metal pollution. On balance, these changes suggest a more intensive use of the land during the early modern period, rather than the decline hinted at at Mockerkin.

In Cumbria, significant peat growth has preserved a range of palaeoclimate proxies, which have helped build a detailed picture of late Holocene climate change. This has been used to identify a number of periods where large shifts in climate might have affected human occupation. A synthesis of peat records indicates increasing wetness throughout the eighteenth century, but it is difficult to highlight wider expressions of a Little Ice Age. Unfortunately, Coombes' efforts to link his study of land use change around Mockerkin Tarn to the peat palaeoclimatic record was hampered by problems with his local proxy, thereby highlighting the complexity of correlating change across different records and studies.

The discovery of independent sources of climatic information and the use of radiometric dating have helped increase confidence in interpretations of climatic influence on human activity. It remains difficult, however, to reconcile different narratives produced from diverse proxies and sites, and studies with archaeological and historical narratives of change. This means that, despite reviewing three local ecological studies, conclusions regarding climate change and land use in Mosser are only broad and limited. Nevertheless, one aspect of Coombes' study might well be pertinent: where climate did seem to have an affect on human activity, this was more keenly felt on lowland sites. This is in direct contradiction to a common sense understanding, where greater impact would be predicted in the 'marginal' uplands. The work of Richard Tipping and others in the Cheviot Hills has demonstrated what is possible when environmental evidence is considered in detail at high resolution. It is unfortunate that a similar study has not been undertaken in the Mosser area, but Coombes' work at Mockerkin suggests that there is the potential for such an approach.

Chapter 6: Environmental Narrative II – Using Instrumental Series

Introduction

Although there have been a wide array of palaeoecological and palaeoclimatological studies centred on Cumbria, attempts to produce a detailed environmental narrative for Mosser in the late eighteenth century are hindered by low chronological resolution. However, there is one further source of climate information that can be drawn upon: instrumental series. In Britain during the eighteenth century, weather was becoming a topic of great public interest. Amateur meteorologists were increasingly prevalent, as were the instruments of their trade: thermometers and barometers (Golinski 2007). Regular recording of the weather became a gentlemanly past-time, and some stations were very methodical in their approach. With this long history of scientific weather recording, researchers since the 1950s have been attempting to merge records in the hope of producing aggregated series for entire regions (Jones 2001). The Central England Temperature (CET) and England and Wales Precipitation (EWP) series are two of the longest running and most analysed examples of such aggregations (Alexander and Jones 2000; Parker et al. 1992). In this chapter, these series are introduced and analysed before undergoing transformations to present a more accurate picture of weather in Cumbria. Then, these records are used to develop an environmental model for Mosser that links climate changes with changes in the landscape. The model is evaluated before the chapter concludes with the synthesis of a more comprehensive environmental narrative.

The Central England Temperature Series

The CET was the life's work of Gordon Manley (1974). What started as a detailed study of temperature variations in England led on to the production of the world's longest instrumental series. The CET records monthly means of temperature for a triangular area stretching across the breadth of the English Midlands and north to Lancashire. Produced using data from a number of different recording stations, the series stretches back to 1659 – although the period before 1721 is considered less reliable (Jones and Hulme 1997). There are a number of problems in producing a synthetic series from multiple records. Errors and systematic bias may be introduced at a number of stages, including by the quality of the equipment, the method, time and location of recording, and through the influence of local microclimates (Jones 2001: 57). Nevertheless, the CET is an extremely well respected and researched series (Jones and Hulme 1997).

Although the CET is centred only on a specific region of England, Jones and Hulme (1997) report significant positive correlations with temperature series from other sites in the British Isles. There is, however, a weakening of the relationship towards the north of the country. Here, agreement between series appears to "arise because of similar year-to-year extremes rather than because of coincident trends over time" (Jones and Hulme 1997: 178) – individual year averages correlate better than decadal trends. The reason for this is suggested to be a large cooling area over the North Atlantic that affects northern Britain more than the south. Indeed, there has been a great deal of research investigating how the CET relates to atmospheric circulation. For example, the North Atlantic Oscillation (NAO), which is effectively a measure of wind speed across the Atlantic, is shown to affect average temperatures, with stronger flows bringing warm air from the southwest (Benner 1999; Jones and Hulme 1997: 184). Some researchers have gone further, examining how the CET is then linked with external forcing mechanisms, such as sun spot activity (Lockwood et al. 2010; Shindell et al. 2001) and anthropogenic climate change (Karoly and Stott 2006). Other studies have looked at the relationship between the CET and proxy temperature series, sometimes only finding weak correlations: "This … emphasises the caution that should be applied when interpreting the Central England Temperature records as an indicator of larger, hemispheric-scale temperature fluctuations" (Jones and Hulme 1997: 189). That being said, it is not unusual for the CET to be used to calibrate other non-instrumental climatic proxies (Baker et al. 2002; Brázdil et al. 2005; Jones et al. 2001b).

In order to produce a temperature series more appropriate to the case study area in Cumbria, and following the method of Parry and Carter (1985), the CET was 'bridged' to the Newton Rigg weather station near Penrith. Using the SPSS software package, a series of regression equations were derived for each month by comparing 50 years of data (1959-2008) from the CET with the same period at Newton Rigg.[1] The equations were then used to predict the likely temperature at Newton Rigg based on values of the CET. Because the relationship between the CET and Newton Rigg temperatures is assumed to be unchanged throughout the synthesised period, the resultant trends are broadly unchanged, but the new temperature values should be much closer to those experienced in Mosser (Figure 11). It should, however, be remembered that this is a synthesised series, not an accurate record. Moreover, although relatively nearby, the microclimate of Mosser is likely to be slightly different to that experienced near Penrith.

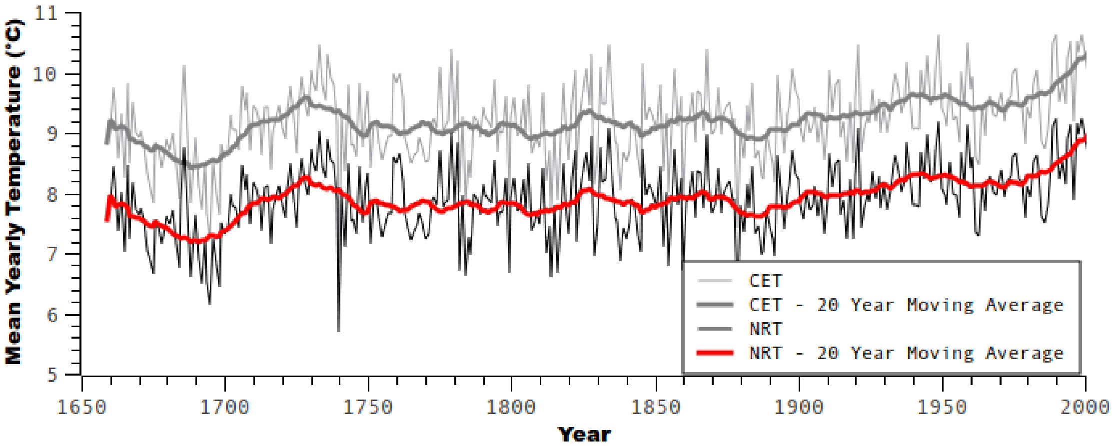

Figure 11: Central England Temperatures (above) and Newton Rigg Temperatures (below). After Parker et al. 1992

Analysis of the CET shows gradual warming from the late seventeenth century onwards, with temperatures rising rapidly and consistently for the past 50 years (Jones and Hulme 1997: 174). Looking in more detail at the Newton Rigg synthesised series (NRT), the underlying trend remained fairly stable from 1700 to 1900, but there are some notable periods of cold and warmth (Figure 11). The late eighteenth and early nineteenth centuries were very variable, with two periods of particularly cold years during the 1780s and 1810s. The 1730s, 1760s and 1820/30s stand out as being fairly warm. The period from 1751 to 1806 (roughly equating to span covered by the

1 Regression equations used to transform CET to NRT, where *x* is the CET value and *y* is the resultant NRT value.

January: $y=0.842x-0.42$ February: $y=0.941x-0.668$ March: $y=0.971x-0.936$
April: $y=0.946x-0.624$ May: $y=0.987x-1.12$ June: $y=0.826x+1.095$
July: $y=0.837x+1.019$ August: $y=0.856x+0.575$ September: $y=0.877x+0.008$
October: $y=1.049x-1.96$ November: $y=1.009x-1.395$
December: $y=0.961x-1.04$

historical diaries) has a mean temperature of 7.79°C with a standard deviation of 0.512°C (Figure 12). This period can be split in half: in the first half, temperatures are fairly stable (std dev: 0.433°C), with 3 years exceeding mean temperatures of 8.5°C and no years falling below 7°C. The second half is slightly more variable (std dev: 0.587°C) with 3 years exceeding 8.5°C and 4 years falling below 7°C. The 2 years from 1781-2 show the greatest year-to-year change, with mean temperatures falling from 8.82°C in 1781 to 6.72°C in 1782. The level of detail provided by the instrumental records enables a closer look at months or seasons. For example, the sharp change from 1781 to 1782 is shown to be a result of falls in spring, summer and autumn temperatures, but there was a surprising increase in winter temperatures. Similarly, particularly cold or warm seasons can be identified, such as the cold winter of 1794, warm winter of 1775 and warm summer of 1781.

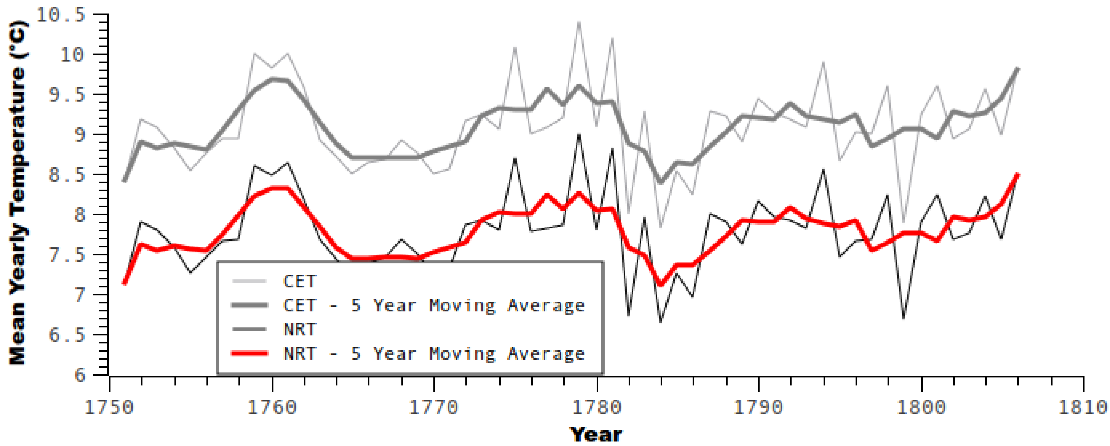

Figure 12: CET (above) and NRT (below) 1751-1806. After Parker et al. 1992

In summary, the CET is the longest running and most researched instrumental series in the world. It has been examined in relation to other proxies records, hemispheric and global climate models, as well as atmospheric and solar phenomena (Jones and Hulme 1997). Although Cumbria is north of the central England region, the fact that much of the CET was based on data from nearby Lancashire means that we might still expect the CET to provide a rough guide to temperature in Mosser (Parker et al. 1992). Indeed, Jones and Hulme (1997: 178) argue that there is good correlation between yearly temperatures amongst the British instrumental series. Using Newton Rigg data, however, it is possible to 'bridge' the CET to Cumbria, hopefully thereby creating a more accurate representation of the weather experienced in Mosser. Looking at these values in the latter half of the eighteenth century, the period from 1779 to 1806 seems to have become slightly more variable compared with the period from 1751-1778, with greater numbers of unusually cold or warm years.

The England and Wales Precipitation Series

Like the CET, the EWP series is a long running instrumental record (Alexander and Jones 2000). Much of the early work on the series was conducted by Nicholas and Glasspool (1931), who produced a record back to 1727. More recent work homogenising and updating the series has produced a record that dates back to 1766, with earlier records unable to reliably support regional inferences. As with the CET, or any multi-site instrumental series, the EWP could contain a variety of errors and systematic biases, particularly due to changes in the design and location of rain gauges (Jones 2001). As a consequence of underestimating precipitation over large land areas, precipitation records are thought to be less accurate than temperature readings. That being said, "precipitation recording is considerably easier than temperature and pressure measuring as readings only need to be taken every day or month" (Jones 2001: 57). The EWP is well researched, with studies looking at its relationship to wider climatic models and instrumental records (Croxton et al. 2006), as well as other non-instrumental proxies (Charman 2007). The series not only covers all of England and Wales, but can be divided into its constituent regions. The record for north-west England (NWE) stretches back to 1873, so not early enough to look at Cumbria in the eighteenth century. However, using a similar process to that used to 'bridge' the CET to Cumbria, it is possible to synthesise a new series based on the EWP and data from Newton Rigg[2] (Figure 13). The new series (NRP) annual means were found to correlate with the NWE over the period 1873-2009 (*rho*=.756, *n*=128*, p*=0.000). Overall, annual precipitation in the NRP is less than the NWE, but more than the EWP.

2 Regression equations used to transform EWP to NRP, where *x* is the EWP value and *y* the resultant NRP value.

January: $y=1.063x+3.44$ February: $y=1.054x-1.997$ March: $y=0.625x+22.647$ April: $y=0.515x+17.365$ May: $y=0.664x+13.354$ June: $y=0.586x+22.253$ July: $y=0.956x+3.895$ August: $y=0.827x+8.628$ September: $y=0.68x 26.027$ October: $y=0.915x+14.454$ November: $y=0.866x+13.149$ December: $y=0.857x+14.063$

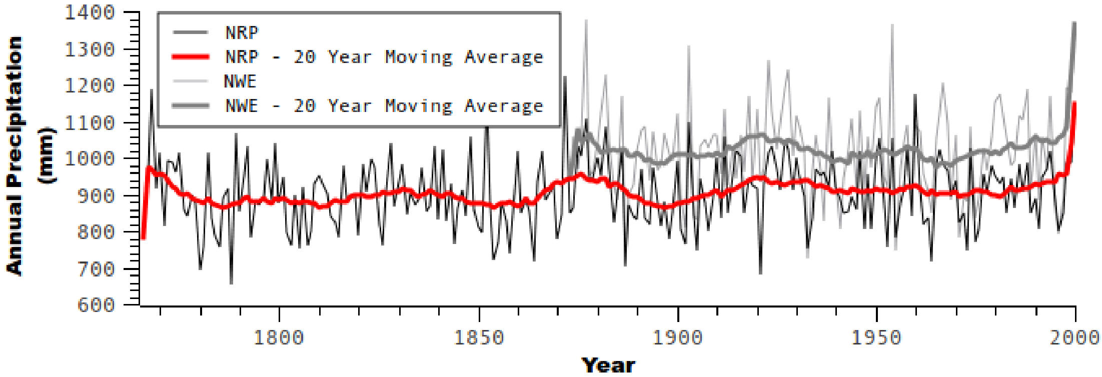

Figure 13: North-west England Precipitation from the EWP (above) and Newton Rigg Precipitation (below). After Alexander and Jones 2000

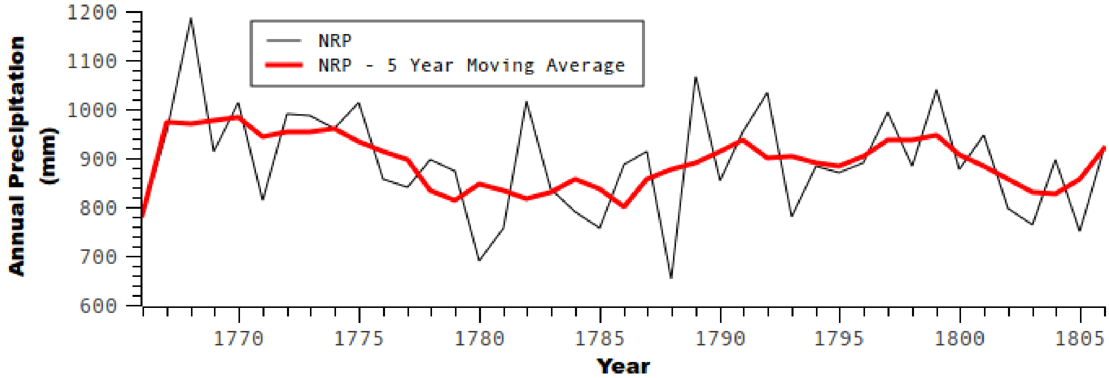

Figure 14: Newton Rigg Precipitation 1766-1806. After Alexander and Jones 2000

Since 1766, the EWP shows "a significant increase in winter (JFM) and winter half-year (Oct.-Mar.) precipitation contrasting with a significant decrease in summer (JA) and summer half-year (Apr.-Sep.) precipitation" (Alexander and Jones 2000: 6). In all regions of the EWP, precipitation is seen to drop significantly during July and August from 1873 onwards, but there is no concomitant increase in the consecutive number of dry days (CDD) in those months. Looking at the late eighteenth century in more detail using the synthesised NRP series, precipitation appears to decline over the period from 1766 to 1806 (Figure 14). This decline can be described as two waves, the first from 1766-1780, with slightly increasing rates of precipitation until 1800, after which there is a further sharp decline. Mean precipitation throughout this period is 892.3mm, with a standard deviation of 109.6mm. Precipitation increases above one standard deviation from the mean seven times, and falls below one standard deviation from the mean seven times. The two most extreme years, where precipitation is more than two standard deviations from the mean are the wet year of 1768, with 1186mm rainfall, and the dry year of 1788, with only 654mm. The biggest year-to-year change was from 1788-9, where rainfall went from 654mm to 1067.4mm. Although increased rainfall was spread throughout the seasons, the biggest change from 1788 to 1789 was an increase in winter and, especially, autumn precipitation. Unusual seasons include the dry spring of 1785, the wet summer of 1768, and a cluster of wet autumns around 1768-1773. The dry winters of 1780 and 1788 also stand out.

Conclusions drawn for the EWP are similar to those for CET. It is a long-running and well-researched instrumental record. Although the EWP approximates rainfall across the whole country, the later regional series allows us to see differences that might be expected in Cumbria, compared to the EWP as a whole. Using a series of regression equations, the EWP was 'bridged' to Newton Rigg in order to provide a better approximation of the levels of precipitation experienced in Mosser. Good positive correlation between the NWE and NRT shows that the differences between these series are not great. Overall, for the people of eighteenth-century Mosser, the record indicates that the period from 1780 would have been a time of increased variability in rainfall, with annual totals tending to decline from the mid 1760s onwards.

Summary

By focussing a study on eighteenth-century Britain, we are able to bring to bear two of the most well respected instrumental weather recording series in the world. Despite not focussing directly on the study area, previous research has shown that each series has a relevance throughout Britain. For this reason, the instrumental series were used as the basis for new, synthesised records for the Cumbrian region. Using these records it is possible to highlight months and years where the weather might be expected to be particularly bad for farming. Unlike the palaeoecological research, however, there has been little consideration of how to link information from the instrumental series with social and historical narratives of change. One exception to this is Martin Parry's (1975, 1976a,b, 1978, 1981, 1985; Parry and Carter 1985) work in the Lammermuir Hills, where instrumental series were essential to his model of social responses to climate change.

Martin Parry in the Lammermuir Hills

Martin Parry's (1975, 1978, 1981; Parry and Carter 1985) work on the Lammermuir Hills has already been discussed briefly in chapters two and three (Figure 15). Employing the 'retrodictive' strategy, Parry used data from a combination of several long temperature series as part of a research programme that explored mechanisms of climate-driven economic and social change. The central premise of the research – that settlement in upland Britain was highly sensitive to climate changes – has been highly influential in studies of human-environment relations, with Richard Tipping (2002: 11) referring to it as “one of the keystones of the deterministic paradigm”.

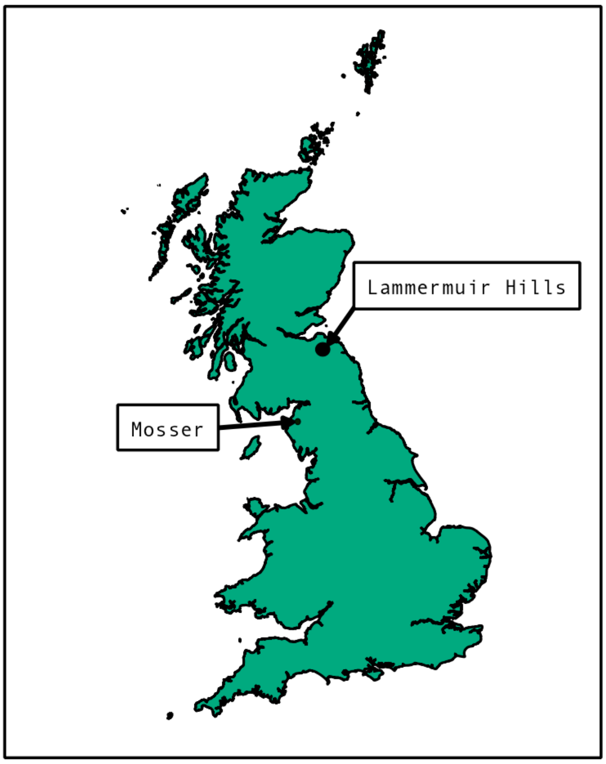

Figure 15: Location of the Lammermuir Hills relative to Mosser.

Parry's (1975) paper 'Secular climatic change and marginal agriculture', published in the *Transactions of the Institute of British Geographers*, outlined work conducted as part of his PhD at Edinburgh during the late 1960s and early 70s. This research into climatic change and human activity on the Lammermuir Hills was present in publications spanning over ten years. Parry first looked at all the physical restraints that could have affected the cultivation of oats on upper hill-slopes during the medieval and post-medieval periods. He then selected a few key parameters for further discussion, including insolation (solar radiation), exposure (windspeed), summer wetness (precipitation) and summer warmth (temperature) (Parry 1975: 2). The aim was to establish the relative effects of these parameters on cereal cultivation, then map the results in such a way that changes in climate over time could be seen to affect the physical limits of cultivation. Parry hoped to correlate these changing physical limits with periods of settlement and abandonment in the history of the Lammermuirs. After reviewing phenological data, Parry (1975: 3) stated that the critical limit for cultivation amounted to 60mm potential water surplus (PWS), 6.2m/s average windspeed and a minimum warmth requirement of 1050 day-degrees C. This placed the 1856-95 limit to cultivation at 320m – 350m OD. By applying more moderate figures for the limit of commercial cereal cropping (1200 day-degrees C, 20mm PWS and 5.0m/s average windspeed), Parry (1975: 3) was able to define a belt of marginal land between these two isopleths: "the location of the lower limit is, of course, largely the product of the economic or social incentives to cultivation operating at any one time. But the upper limit may be an absolute one, above which cultivation of oats would have been impracticable under most socio-economic conditions."

The parameters selected as critical to cultivation are worth considering in more detail. *Insolation* is a measure of solar radiation, which increases according to altitude but is off-set by a reduction in sunshine due to persistent cloud and mist. Parry (1975: 2) did not discuss this parameter further, claiming that the resultant effect is "insignificant … when compared with the changes in exposure, wetness and warmth." Of these other parameters, *exposure* is a measure of average windspeed. This is apparently more important in coastal uplands, where "average windspeeds increase more rapidly with altitude" (Parry 1975: 2). Regarding wetness, Parry (1978: 76) noted that oats, the predominant cereal crop associated with upland farming, are particularly tolerant of wetness and humidity. While this makes them well suited to upland conditions, the effect of excess water through increased rainfall and reduced evapo-transpiration at high altitudes means that "waterlogging places an absolute limit to cultivation of oats at about 425m OD" (Parry 1978: 76). The measure of this waterlogging, *potential water surplus* (PWS), is based on the more familiar standard of potential water deficit (PWD), where potential transpiration outstrips summer rainfall. The new measure is constructed to reflect the high levels of rainfall and low transpiration at the end of summer at high altitudes, and is thus defined as "the excess of a middle and late summer surplus (up to 31 August) over an early summer deficit" (Parry 1978: 78). Observing that isopleths of PWS correlate closely with the 1860 cultivation limit in the Lammermuirs, Parry (1978: 79) argues that soil moisture contributes to "the increasing meso-climatic restraint imposed by altitude on successful cropping and points to the similarly large effects that a change in climate would have on this marginal fringe."

Although recognising the adverse affects of waterlogging, Parry (1978: 76) argues that "absolute levels of inadequate summer warmth are reached well before those of excess moisture". Indeed, Parry's work goes on to focus on changing levels of *warmth*, and it is this aspect of his work, along with the retrodictive strategy in general, that is most prevalent in subsequent papers (Parry 1981, 1985; Parry and Carter 1985). Parry uses a measure of 'day-degrees' (later 'growing degree-days' or GDD), which was originally proposed by geographers in the 1950s (Gregory 1954). Parry (1978: 80) defines the method thus: "'accumulated temperature' … multiplies the amount by which the mean monthly temperature exceeds a selected base temperature, or growth threshold, by the number of days in each month." The results of each month are then summed to give a GDD figure for each year. The threshold selected by Parry (1975: 3) for his work on the Lammermuirs is 4.4°C, which reflects the onset of growth in cereals. By combining long term temperature series with the knowledge that average temperature decreases by 0.68°C with every 100m of altitude, Parry is able to map isopleths of GDD to altitudes, and observe how these change with time, both in terms of yearly differences and longer term climatic change. The most important isopleth in this process is that which reflects the point at which the cereal crop harvest was so affected as to have serious social impacts. By reference to historical diaries and journals, Parry observes that the harvest was extremely late during 1799. Using temperature data from Edinburgh, Parry (1978: 88) calculates that at the upper limit of cultivation in the Lammermuirs (c. 320m OD, 1050 GDD average) there would have been about 970 GDD that year. By inference, any "summer in which the accumulated warmth failed to exceed 970 day-degrees C would have led to an extremely delayed or reduced harvest" (Parry 1978: 88).

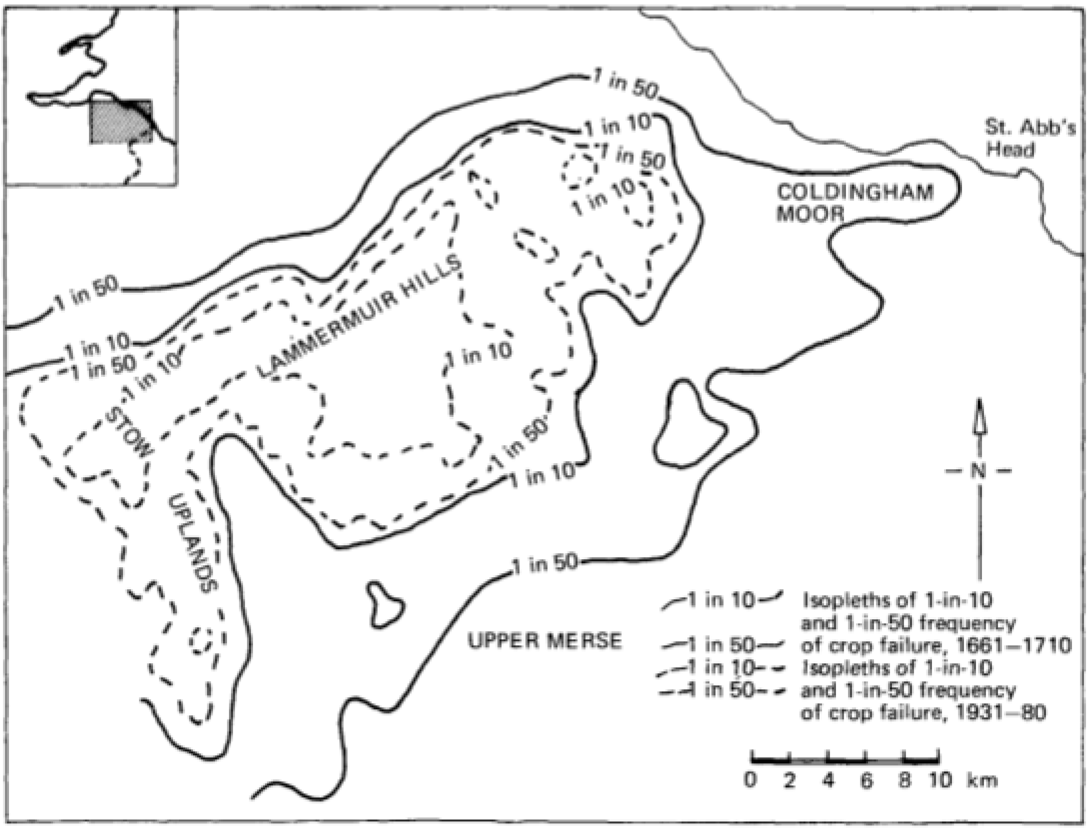

Figure 16: Parry and Carter's (1985: 108) risk surface. The high-risk marginal zone moves altitudinally between cool (1661-1710) and warmer (1931-80) periods.

Low GDD figures can be correlated with historical sources to good effect. For example, Parry and Carter (1985: 99) note isolated poor harvests in 1740 and 1782. Longer runs can also be detected, such as the 'Seven Ill Years' of the 1960s, as well as periods of instability, such as the period 1879-1892 (Parry and Carter 1985: 99). However, "such historical, ideographic descriptions of single, successive, and clustered extremes are … not a sufficient basis for generalisations concerning the impact on agriculture of climatic variability and of changes in the variability" (Parry and Carter 1985: 99). Parry recognises that retrospectively correlating low GDDs with historical sources does not give a perspective on past people's choices in respect to marginal farming. For that reason, Parry converts the GDD figures into an exploration of the probability of crop failure and its relationship to farmers' perceptions of risk. This is justified on the basis that marginal farmers operate on the limits of profitability and are most concerned with survival, and that commercial farming strikes a balance between "gambling on good years and insuring against bad ones" (Parry and Carter 1985: 99). In earlier incarnations of the study (Parry 1975, 1978, 1981) it is assumed that the accumulated temperatures are normally distributed and probabilities are then resolved into average frequencies at 50 GDD intervals. In Parry and Carter's (1985) paper, this method is abandoned in favour of using a synthesised temperature series (derived from the CET, Mossman's (1897) Edinburgh temperatures and weather stations in and around the Lammermuirs) as the basis for calculating yearly GDD. The 970 GDD limit was then applied to identify years of total crop failure. By counting incidences in which GDD fell below the bad harvest threshold, Parry and Carter created a geographic risk surface based on the probability of harvest failure at different altitudes. This method can then be used to map how the climatically marginal zone shifted up and down slope over time (Figure 16).

Applying Parry's Method in Mosser

Using this approach, Parry was able to convincingly argue that post-medieval settlement abandonment on the Lammermuir Hills was caused by changes in climate. As the Medieval Warm Period descended into the Little Ice Age, temperatures dropped and the bad harvest threshold and marginal zone began to move down-slope, forcing subsistence farmers to abandon the higher slopes. This is, therefore, a description of climate-society interaction which is dependent solely on environmental data. It is one that is annually resolved and directly linked to calendrical dates. Moreover, although ostensibly deterministic, the method attempts to foreground human decision-making by theorising risk perception. This thesis aims to examine the links between social and climate history, and Parry's approach presents a clear way of doing this: it is possible to adapt the method for Mosser and develop a narrative of change that is very similar to the one produced by Parry. In doing so, it would enable a detailed, practical assessment of the strengths and weaknesses of the resultant model, and allow us to judge whether the method is useful for identifying when and explaining how climate affects human history.

In order to apply the method, a suitable temperature series is required. Parry and Carter (1985) created their temperature series by extending the Edinburgh series according to its relationship with the CET, then further bridging that to stations in and around the Lammermuirs. A new, synthesised series for the Newton Rigg weather station (NRT) has already been produced above. This was used when applying Parry's method to Mosser. Following Parry and Carter's (1985: 97) method, GDD was calculated for years from 1700 to 1949 using the following formula:

$$A = \sum_{i=1}^{12} m_i(\bar{t}_i - t_b) \qquad \text{for } \bar{t}_i \geqslant t_b$$

"Growing degree-days are calculated as the excess of mean monthly temperature $\bar{t}_i$ over the base temperature t_b (set at 4.4°C) multiplied by the number of days in the month, m_i , and cumulated over one year to give an annual total *A*." It is important to remember that the GDD figures produced using this formula are relative only to the NRT and can be considered only rough approximations of actual temperatures within Mosser.

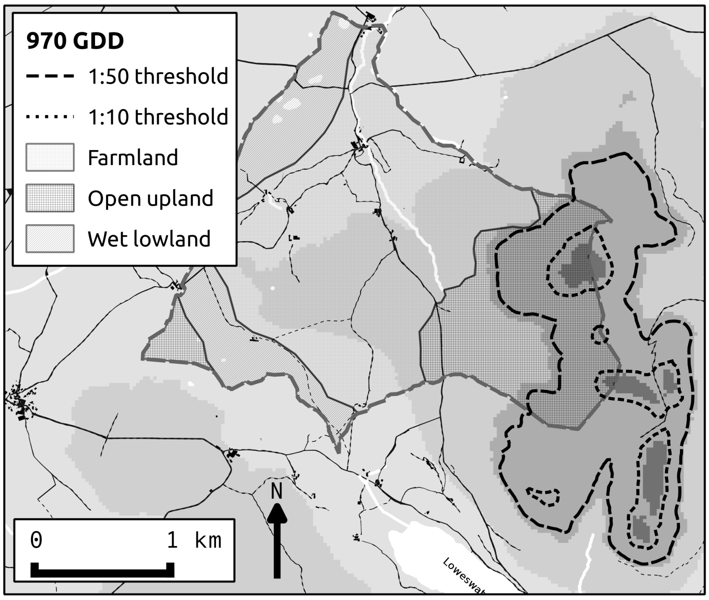

Figure 17: The marginal zone with harvest failure defined as <970 GDD. After Parry and Carter 1985

Parry consistently states that the average temperature declines 0.68 °C with every 100m of elevation (cf. Parry & Carter 1985: 100). This figure was used to calculate GDD at intervals of 10m elevation for each year, starting with the base height of 169m OD for the station at Newton Rigg (Parry and Carter 1985: 96). Using the resultant table it is possible to observe, as Parry and Carter (1985: 97–99) did, where cold years occurred either individually, or in clusters. Earlier investigations showed that on average oat cultivation requires a minimum of 1050 GDD (Parry 1978: 81). On the Lammermuirs this threshold occurs between 320 and 350m. In Mosser, that threshold occurs around 430m. The implication is that only the very highest slopes around Mosser and Loweswater would have been located in the marginal zone Parry devised for the

Lammermuirs. This zone was delineated by isopleths marking the 1-in-50 and 1-in-10 risk of a bad harvest (ie. years below 970 GDD) (Parry and Carter 1985: 103). From 1659-1949, those thresholds lie at 320m and 385m, well above the limit of cultivation implied on the Ordnance Survey first edition maps of the 1860s. Here the edge of the fell runs along the contour roughly between 230m and 280m, and is marked by the transition from smaller fields to large straight-edged parliamentary enclosures (Figure 17).

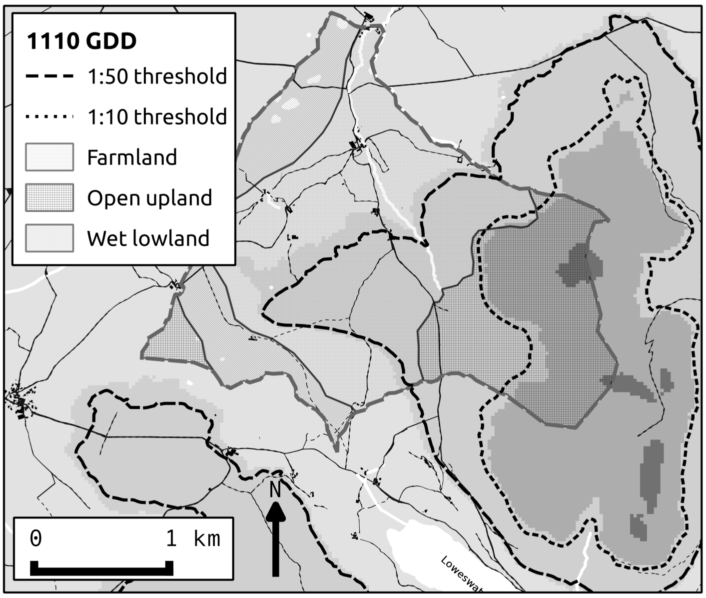

Figure 18: The marginal zone with harvest failure defined as <1110 GDD. After Parry and Carter 1985

Parry (1978: 81) identified a second threshold at 1200 GDD, which he described as the upper limit of commercial cereal cropping. In Mosser, that threshold is reached at around 330m OD, again well above the edge of the fell. At the 1200 GDD threshold on the Lammermuirs, Parry (1975: 4, 1978: 88) noted that during the bad year of 1799, accumulated warmth was unlikely to have been more than 1110 GDD. It is possible to delineate a new marginal zone based on the 1-in-50 and 1-in-10 risk of warmth not reaching this level. From the period 1659-1949, this zone covers between 210 and 285m. This time, the upper limit of the marginal zone is located very close to the edge of the open upland (Figure 18). Here, at the edge of the enclosed land, accumulated warmth failed to reach the bad harvest limit 15 times from 1700-1949 (Figure 19). There are progressively more failures per 50 year period from 1700 until 1949. The worst period was 1850-1899, when there were 5 cold years. During the late eighteenth century, there were 3 instances in which the threshold was not reached: 1751, 1782 and 1799.

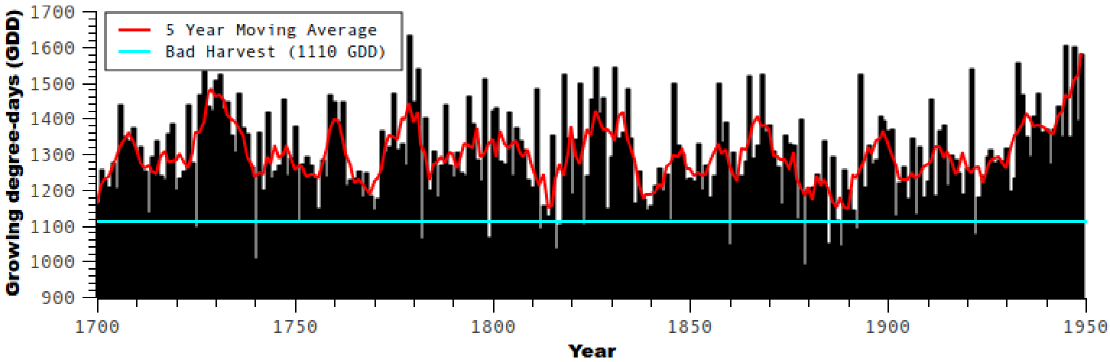

Figure 19: Accumulated warmth at 280m OD. After Parry 1975

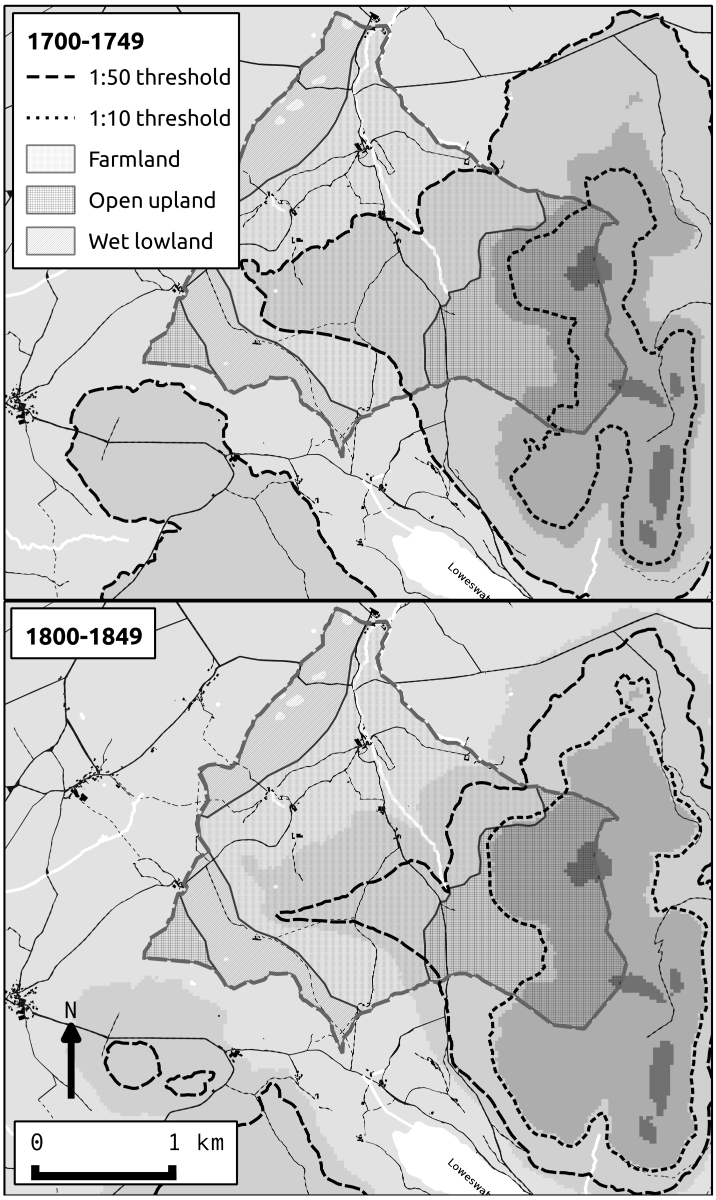

Figure 20: The marginal zone 1700-1749 and 1800-1849. The thresholds move up and down-slope over time. After Parry and Carter 1985

Observed on the Ordnance Survey first edition maps of the 1860s, it seems likely that the upland area of common pasture was not enclosed because it was unsuitable for cereal cultivation. The results from applying Parry's method suggest that warmth could have been one of the main factors preventing expansion of improved agricultural land to higher altitudes. It also suggests that the inhabitants of Mosser were primarily concerned with commercial crop exploitation, and did not need to farm the higher lands for a subsistence crop. Nevertheless, a significant proportion of the Mosser landscape can be considered marginal for commercial cereal farming – the people of Mosser were working at the limits of profitable agriculture. By plotting how the incidence of 'failure' changes over time, the boundaries of the marginal zone can be seen to move up and down slope dependent on the changing climate (Figure 20). This raises the possibility that farmers would have been forced to alter their farming practices in response to climate changes, just as people on the Lammermuirs were forced down from the upper slopes.

Interestingly, the size of the marginal zone varies markedly from period to period (Figure 21). The marginal zone from 1700-1749, for example, covers a much wider area than the comparatively small zone of 1750-1799. Such differences can be explained by changes in the variability of weather. From 1700-1749, the marginal zone stretches all the way from 200m to 340m OD (using the 1110 GDD threshold). Across all five periods, this is the highest and second lowest limit to the marginal zone. It suggests a predominantly warm period, with average GDD remaining very high. The lower limit is so far down-slope because there was one particularly bad year, in which GDD only reached a level far below the bad harvest threshold. Conversely the small marginal zone of 1750-1799, with a low upper limit and a high lower limit, suggests a cooler period overall, but one where the bad years were fairly moderate. This is borne out by the mean temperatures from the NRT for each period: from 1700-1749 it was 7.95°C, whereas from 1750-1799 it was 7.77°C. The coldest year in the former period averaged 5.69°C, in the latter the coldest year only dropped to 6.64°C. This radical change in the size of the marginal zone from period to period reflects the importance extreme years might have had in farmers' calculations of risk (Parry and Carter 1985: 106). It also shows how, in these upland areas, relatively small changes in the annual weather could affect the profitability of crop farming across wide geographical areas.

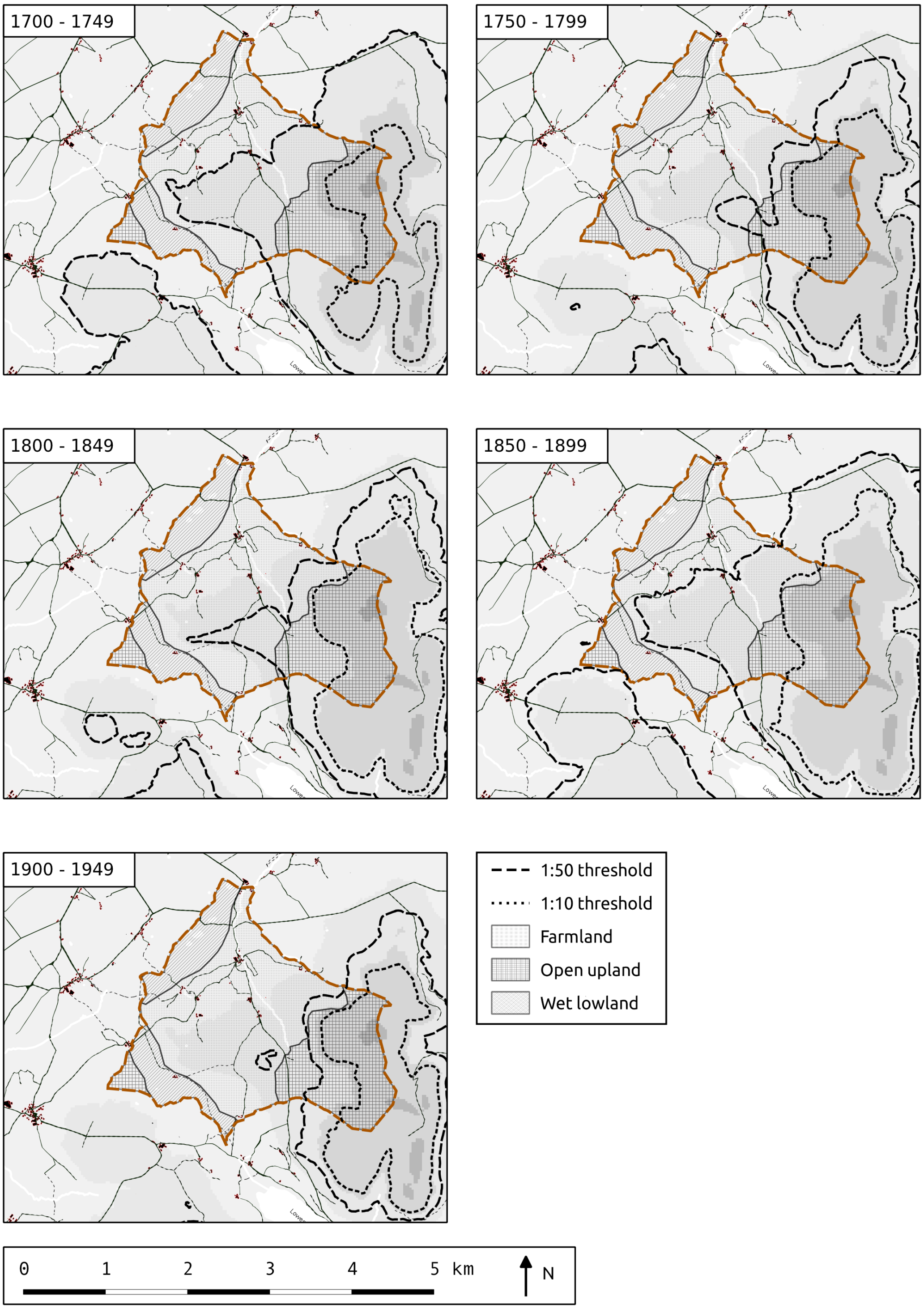

Figure 21: The size and position of the marginal zone varies from period to period.

Evaluating the Model

Parry's results and methodology have been discussed in detail by Richard Tipping (1998, 1999, 2002, 2004). Tipping (1998) originally tested Parry's hypothesis using a high resolution palaeoecological case study in the nearby Cheviot Hills. Using pollen records, Tipping demonstrated that cereal pollen grains were present even during times of climatic stress. This, coupled with the assumptions that cereal crops played an important role in upland subsistence and that cereal pollen grains only tend to travel short distances, led Tipping (1998: 9) to conclude that "the Cheviot uplands could be and were cropped." There is one caveat to Tipping's (1998: 9, 2002: 13) research that he is keen to point out: "uncertainties remain about the comparability of these two southern Scottish landscapes, because the Cheviots do not represent the broad expanses of the cultivable land seen on the Lammermuir Hills." It is, nevertheless, clear that Parry's model is by no means universally applicable.

In part, Parry understood this. Although he initially designed the method to describe and explain the relationship between climate change and crop cultivation in marginal environments (Parry 1975, 1976a, 1976b, 1978), he later argues that the model should be used as a 'retrodictive' tool, in which the causal relationships that form the model are hypotheses that are to be tested against the historical actuality (Parry 1981). This came in response to growing concerns about simplistic environmental determinism (Wigley et al. 1981). Parry saw his method as a means by which determinism could be avoided and hypotheses rigorously tested. Such testing provides opportunities for employing alternative interpretations and reconfiguring the model where expectations are not met. To this end, Parry (1981: 329–32) makes specific mention of "proximate and indirect factors" that may be operating, but which are not traced through his particular study. Nevertheless, even prior to the testing stage, it has become clear that there are a number of areas where problems may arise. These relate to three core assumptions: 1) people were reliant on cereal cultivation; 2) temperature is the primary means by which cultivation is limited at high altitudes; 3) farmers conceptualised risk according to the frequency of bad years. These will be discussed in turn.

Assumption 1

Parry's method is wholly concerned with cereal cultivation. The focus is on marginal upland environments, where the productivity of agriculture "does not generally allow the accumulation of a surplus to act as a buffer against hard times" (Parry 1978: 74). However, such marginal environments are more commonly associated with pastoral economies (Winchester 2000). There is no accommodation in the model for differential reliance on crops for subsistence, or indeed risk buffering strategies that extend beyond a reliance on grain surplus (Halstead and O'Shea 1989). Such strategies may be numerous and might include anything from storage practices and cultural taboos to individual farm diversification and regional trading links (Tipping 2002). Parry might have envisaged this kind of information to arise out of testing the model, but the core premise of creating the model is the marginality of agricultural production. In some cases, however, the very marginality of these upland environments might be brought into question by good risk management strategies. Indeed it could be argued, for example, that upland environments might be less susceptible to climatic events than their lowland counterparts because their altitude helps protect them from droughts, while good trading links with the lowlands ensures survival in bad times (Tipping 2002). Alternatively the research of Coombes (2003), outlined in the previous chapter, suggests a diverse mix of resources might present a more resilient regime compared to lowland locations that are wholly dependent on arable agriculture. In any of these scenarios, employing a model that specifically examines the viability of crop farming seems inappropriate.

Assumption 2

Parry's (1975, 1978) early work, although privileging warmth as the most important factor affecting changes in cultivation areas, looked at a range of other variables, including a measure of wetness in the form of potential water surplus. However, in Parry and Carter's (1985) study of risk surfaces, wetness is hardly mentioned. This is because increasing altitude was observed to cause "great reduction in the intensity of accumulated warmth", as well as increased variability (Parry and Carter 1985: 96). The analysis had shown that crops were less sensitive to small changes in other factors. In the Lake District, however, the vast quantity of rainfall means that precipitation could well be an equally, if not more, important limiting factor in crop cultivation – when even a small amount of rainfall above the norm can cause waterlogging, sensitivity is almost certainly increased.

Temperature can tell us something about precipitation. Although there is no significant correlation between the NRT and NRP yearly averages (1873-2000) using Spearman's *rho*, there is a fairly strong negative correlation between temperature and rainfall during the summer months (*rho* = -.567, p = 0.000). So although rainfall gets very little explicit recognition in Parry and Carter's (1985) later paper, there is a link to wetness through temperature and GDD. Nevertheless, it is possible that it would be more appropriate in some areas to produce risk surface maps based solely on precipitation and/or PWS, or to combine climatic variables as Parry did in some of his earlier work. Other environmental factors such as soil types and hydrology are also likely to play a role in limiting crop cultivation, and although discussed, were not influential in his methodology (Parry 1978: 75–6). This is fine over a wide geographic region, where the influence of these factors is averaged out, but on a narrower and more local level they could be critical. There is, therefore, a potential geographic limit to the effectiveness of the model, and it is one that is not discussed beyond the focus on marginal environments (Parry 1978: 73–4).

Assumption 3

In Parry's (1978: 94) model, farmers "confronted by uncertain conditions, make rational decisions and choose strategies that maximise the certainty and quantity of return in relation to time and effort." It is through farmers' perceptions of risk that the trade-off between time, effort and economic return is judged. In Parry and Carter's (1985: 95) paper, the risk surface method emphasises the importance of extreme or anomalous events in the risk assessment process. This approach to risk perception is supported by a number of anthropological studies (Bryant et al. 2000; Kempton et al. 1996). For example, in one study of Canadian adaptations to climatic variability, when "70% of … farmer respondents claimed to have observed 'climatic change' over the last 20 years, these 'changes' were for the most part related to specific events over the period of one or two years" (Bryant et al. 2000: 192). There are, however, other studies that show farmers can detect long-term trends and changes in variability (Ovuka and Lindqvist 2000; Sollod 1990; West and Vásquez-León 2003). In particular, West and Vásquez-León (2003: 247) argue that farmers' perceptions of variability closely correlated with rainfall in the meteorological records: they were keyed into "changes in *climate* as opposed to just meteorological *events.*" Although the model does account for change over time, we have seen how it is tuned primarily to changes in the prevalence of particularly bad years (or events, in this context). Of course it is true to say that one feature of the a changing climate could be increased or decreased incidences of extremely bad years, but that might not be the only, or most important, feature. A model that handles the concept of risk in a different way might produce results significantly different to those generated using Parry and Carter's (1985) method.

In addition to these assumptions, there are two other problems that are particular to application of the method in Mosser. Firstly, the lack of precise temperature records for Mosser precludes the production of a long term, locally calibrated temperature series. Although the trends and extremes of the CET can be bridged to Newton Rigg, without accurate records for the local area the use of phenological research to inform the precise definition of cultivation limits is flawed – the altitudinal limits designated in the Lammermuirs may not be appropriate in Mosser. This then leads on the second problem: Parry's (1978: 81–2) method was designed primarily to focus on the physical limits of subsistence cultivation, with the limits to commercial cultivation considered rather more flexible. As discussed earlier, according to Parry's figures, only the highest slopes around Loweswater would not have received enough warmth to provide subsistence cultivation. This means that for Mosser absolute thresholds are not relevant. Instead, the thresholds for commercial cropping are "largely the product of the economic and social incentives to cultivation operating at any one time" (Parry 1978: 82). The power of the model to offer a climatic explanation for landscape change is thus immediately reduced.

In summary, Martin Parry's (1975, 1976b, 1978, 1981; Parry and Carter 1985) work on the climatic limits to agriculture in the Lammermuir Hills has been highly influential in the realm of climate-society studies. His hypothesis that post-medieval abandonment of the upper slopes of the Lammermuirs was caused by climatic deterioration during the Little Ice Age is compelling, with early incarnations of his model examining a wide range of environmental variables (Parry 1975, 1978). The application of Parry and Carter's (1985) version of the methodology to the Mosser and Loweswater area produced a model that was ostensibly very similar: climatic thresholds to crop production were seen to move up and down slope in response to changes in climate, thereby extending and contracting an area of marginal land. Whilst Parry's 'retrodictive' model is designed to be tested against the historical actuality, close examination of the method has revealed a number of clear problems, both general and specific to the application in Mosser. In particular, Parry and Carter's (1985) conception of risk makes numerous, potentially unfounded, assumptions about farming practices in marginal environments. Moreover, the focus on warmth as the main climatic factor affecting cultivation limits may well have been appropriate in the Lammermuirs, but is called into question in a region as wet as the Lake District. And where I have applied the GDD measure of warmth, there are problems in translating limits from the Lammermuirs to the Mosser township. Overall, there is a strong argument that the method is only applicable without modification within well-defined geographical limits, and only under certain socio-economic conditions.

Conclusions

Although in the previous chapter, low chronological resolution caused difficulties in linking palaeoecological results with detailed social histories, for this study instrumental records can be used to help overcome these issues. The Central England Temperature series and England and Wales Precipitation series are two of the longest running and most researched instrumental records in the world (Alexander and Jones 2000; Parker et al. 1992). The usefulness of such records extends from calibrating non-instrumental proxies to producing detailed analyses of the global climate system. Neither record centres directly on the Cumbrian region, but each can be 'bridged' to a weather station near Penrith in order to provide a better approximation of how the weather might been experienced in the study area over the last 250 years. Although months and years can be highlighted where it might be expected that the weather was particularly bad for farming, the records in themselves provide no way of linking social change to meteorological or climatic phenomena. Martin Parry's (1975, 1978) work in the Lammermuir Hills has been particularly influential for this reason: it employs a method that takes the accuracy of instrumental records and converts them into means of exploring how climatic change can drive landscape change. This is achieved through a process of human risk perception and response. It is a method that has produced a compelling model of post-medieval settlement abandonment as a consequence of cooler and wetter impacting on high altitude cereal cultivation (Parry 1975, 1978; Parry and Carter 1985).

The application of Parry and Carter's (1985) method to the Mosser area produced a model not dissimilar to the one produced for the Lammermuirs. There were, however, a range of problems discovered. The way in which risk is handled remains one of the core issues, as it is around this that the rest of the method hinges. Furthermore, assumptions concerning the importance of warmth (as opposed to wetness) and upland farming practices may have been suitable for the Lammermuirs, but potentially require revision for Mosser. There is a strong argument that the method is only applicable without modification within well-defined geographical limits, and only under certain socio-economic conditions. As it stands, the model produced for Mosser shows climatic limits to cultivation moving up and down the hillside in response to warm or cold years. The upper limit appears to be indicative of overall trend in temperature, while the lower limit is very much dependent on the extremity of one or two bad years.

The Environmental Narrative

The past two chapters have aimed to show how an environmental narrative of climate-society relations might be developed for eighteenth-century Mosser, but with such a range of perspectives on offer, it is difficult to produce a single, unambiguous narrative of change. Early palaeoecological research is hindered by a lack of absolute dates, making contextualising environmental data with archaeological and historical research problematic. Nevertheless, the regional picture resulting from these studies shows various periods of vegetation change, which have been linked to periods of settlement expansion, forest clearances and cereal production: first with a Romano-British (Brigantian) renaissance during the fifth century, and later with Anglo-Saxon colonisation. At Leady Moss within Mosser, Morton (1973) related local changes to this wider regional picture. He argued that clearing of the landscape occurred from the Viking period onwards. In particular, the Cistercians were thought to herald the start of extensive sheep farming, as well as the first signs of cereals within the pollen assemblage. However, using more recent methods, including radiocarbon dating, Coombes (2003) has produced a more refined narrative of change. His cores show "no signs of agricultural expansion … during the Roman era, nor is there any evidence for a 'Brigantian' period of forest clearance." There is evidence for declines in land use during the ninth, eleventh and fourteenth centuries, but none of these are thought to constitute catastrophic abandonment. Overall, Mosser was probably predominantly open, pastoral grassland from the seventh century onwards, but there is agreement between studies that show marked changes in Loweswater and Mockerkin Tarn's lake ecologies during the eighteenth century. Interpreting this is complicated, and while at Mockerkin the changes appear to suggest declining land-use intensity, the increase in lake productivity and metal pollution in Loweswater could be attributed to more intensive land use and mining.

The palaeoclimatic element of the narrative is similarly ambiguous. The clearest expression of Charman et al.'s (2006) multi-site compilation of peat bog evidence is limited to defining peaks of wet periods along the line of a 100-year moving average, although there have been attempts to translate his findings into models of prevailing weather patterns. Frustratingly, locating events such as the Little Ice Age remains a difficult and complicated task. According to Charman et al.'s proxy record for the Borders, the climate of the last millennium appears to have been considerably less variable than the previous two. Within it, major peaks of wetness occurred around 1450 and 1700. Dry periods occurred around 1350 and 1550, and there has been almost continual drying over the past 200 years. Elsewhere in Cumbria, studies at Walton Moss (Hughes et al. 2000) and Bolton Fell Moss (Barber 1981, 1994) identified wet shifts around AD 1600, 1740 and 1850. The fact that theses dates do not always match reflects the difficulties in forming accurate chronologies and comparing across different studies. A deeper analysis of Charman et al.'s data, focussed on the eighteenth century, produced yet another narrative. Here the eighteenth century is characterised by gradually increasing water table levels, before rapid decline sets in after 1800, at which point water tables were the highest they had been since the thirteenth century. In combination, it can perhaps be suggested that the eighteenth century came at the end of a millennium where the first 500 years was drier than the second. This century also heralded the end of wetter conditions, with most water table records showing a decline in levels over the past 200 years. Over the past two millennia the greatest peak in wetness occurred around 800, with the lowest water tables around 350. It is worth pointing out that, according to Charman et al. (2006), both these shifts were over double the magnitude of any occurring since 1000.

Instrumental records provide a chronologically accurate means of testing the palaeoclimatological results. Both regional records, the CET and EWP, were bridged to Newton Rigg, thereby providing a more realistic assessment of weather in Cumbria. The temperature record shows gradual warming from the late seventeenth century onwards, but that the late eighteenth and early nineteenth centuries were very variable. Analysis of the precipitation record shows a long term change in annual precipitation balance: an increase in winter precipitation is offset by a decrease in summer rainfall. During the eighteenth century, precipitation declines from 1766 to 1806, but there is no overall decline over the last 200 years, as suggested in the proxy record. This might be explained by the fact that water table levels are a function of precipitation and evapo-transpiration – while precipitation remained steady, increased temperatures could account for falling water tables. The detailed nature of the instrumental records also enables a close look at specific years, months or seasons, but in many ways this is rendered meaningless without a method of relating weather to wider social and environmental histories.

Although Pennington confidently asserted that during the past 2500 years, "the most important factor controlling vegetation history is shown to be man," Paul Coombes' (2003: 328) summed up the problems of trying to examine causality in his multiproxy study of climatically influenced land use change by saying: "the epistemological and statistical tools used in palaeoecology are poorly suited to the task." This was demonstrated at Mockerkin Tarn, where Coombes' attempt to relate a climatic proxy record from Mockerkin to the regional picture failed due to poor chronological resolution and a general lack of covariance across records. Parry's method presented a means of translating the detailed instrumental temperature data into effects that could be observed across the landscape. Although when evaluated a range of problems were identified, the model can be used to make some broad statements. Firstly, the climate of Mosser was likely marginal for commercial cereal crop exploitation. Secondly, the marginal zone moved up- and down-slope over time, and the size of zone was dependent on changes in the variability of the temperatures. During the period covered by the historic diaries, the model suggests that the average temperatures were cool, but that bad years were fairly moderate. In contrast, the preceding 50 years were, on the whole, warmer, but the coldest years were more pronounced. Importantly, the model shows that these variations could have had significant effects in upland areas, where relief is steep. In particular, it shows that the profitability of crop farming in Mosser was likely very sensitive to bad years, and therefore to changes in the climate that altered their rate of incidence.

In conclusion, perhaps the best expression of an environmental narrative for Mosser is that the landscape was predominantly open and pastoral. Commercial cereal cultivation, though possible, was likely very sensitive to changes in the climate – perhaps so sensitive as to ensure that the landscape remained primarily pastoral, despite the fact that the climate changes of the past millennium have been relatively minor. A number of changes occurred in the eighteenth century. There were significant alterations in the lake ecologies of Loweswater and Mockerkin Tarn, there was a regional increase in coniferous woodland, and it was a century that marked the beginning of two hundred years of falling water table levels. This narrative is not clear, nor is it chronologically well defined. There are questions as to how or whether the various events, trends and processes are related. Moreover, the ambiguity associated with palaeoecological approaches, and the problems of risk conceptualisation and unfounded assumptions within Parry's method, mean that both strands of research require more information in order to make sense of the results. In the case of palaeoecology, conclusions need to be more confidently placed in the context of landscape and social change. We have seen how working across these different narratives has been problematic in the past, but questions of human-environment relations cannot fully be addressed without first exploring the human narrative in more detail. In terms of environmental modelling, Parry's method provides a clear means of translating climatic changes into landscape changes, yet there is so much about the resultant model that can be questioned. Drawing on the historical narrative of landscape change, the model can be tested against the historical actuality. In so doing, it might be possible affirm or refute many of Parry's assumptions regarding the importance of warmth, farmers' risk perception, risk management and farming practices (see Chapter 10).

Chapter 7: Landscape Narrative I – Cumbria in the Eighteenth Century

Introduction

We have seen that historical ecologists, anthropologists and landscape archaeologists have described landscapes as the "material manifestation" of human-environment relationships (Crumley 1994a: 6). Ingold's (2011) concept of weather-worlds sees landscape and weather inextricably linked. These points suggest that, in order to explore the links between climate and human history, we need to have a detailed appreciation of landscape history – of how people understood, utilised and developed the land on which they lived and worked. Therefore, the second element of this project is to look more closely at the landscape of Mosser. This will involve using methods of landscape history and landscape archaeology to produce a narrative centred on people's relationships with the land and how they have changed over time. Rather than trying to focus specifically on environment and climate issues, I instead want to develop a separate, independent narrative, with its own collection of processes and research themes. Only after this, in chapter seven, will the different approaches be compared and contrasted. The aim then will be to link across the environmental and landscape narratives in order to shed light on interactions between people, the land, and climate. Investigations of the landscape narrative will be split across three chapters. The first will examine secondary sources, providing an overview of the key debates in the history of Cumberland. The second will focus specifically on a landscape survey of Mosser, while the final chapter links evidence from archival sources with the broader regional narrative. As with the rest of the project, the temporal emphasis will be on the late eighteenth century, but a wider time-frame will often be used to contextualise results.

Population and Economy

The eighteenth-century Lakeland economy was, for the most part, centred on farming. Those farmers, however, "doubled as agricultural labourers, blacksmiths, carpenters and tanners. They developed interests in salt panning, shipping and mining" (Dilley 1991: 91). Indeed, there were the beginnings of a flourishing trade in mining, particularly of coal and lead. Moreover, prior to industrialisation, the area around Kendal was well-known for its wool trade based on widespread home spinning cottage industries (Marshall 1971: 47). Far from being isolated, the Lakeland farm "often had a window to the wider world, and was the base of a large but often invisible family" (Marshall 1971: 49). Like many places before the development of canals and railways, rural Cumberland was a patchwork of neighbourly communities of people often closely related. Marshal (1971: 50) notes that this could be both help and hindrance, with poorer relatives placing strain on those better off; yet with such ties came the promise of free or cheap labour in times of ploughing or harvest. This kind of local outlook was coming under threat in the eighteenth century. Rapid expansion of the Plantation trade in sugar and tobacco made "Whitehaven the second port in the kingdom by 1750 and incidentally to provide some of the capital for industrial expansion" (Hughes 1965: 3).

The first turnpike trusts were created in the early 1750s, meaning overland transportation became increasingly less difficult from this point on. This heralded the appearance of carriages, stage coaches, mail coaches and large wagons (Bouch and Jones 1961: 280). The centralisation born of improving transportation and communication links around Kendal, Penrith, Carlisle, Cockermouth and Whitehaven soon proceeded into urbanisation. These were the processes by which the rural uplands were inexorably drawn into complex socio-economic networks and the transformations engendered by that complicated bundle of changes popularly described as the industrial revolution (Bouch and Jones 1961). The growing concentration of population around urban centres saw a synchronous decline in rural holdings: "Wordsworth held that between 1770 and 1820 the number of 'statesmen ' with freehold land was halved while the size of such holdings doubled" (Bouch and Jones 1961: 237). The implication is that this was a period of migration of people and consolidation of landholdings. Nevertheless, there was also a concomitant rise in population: Bouch & Jones (1961: 215) cautiously estimate that between 1688 and 1801 the Cumberland population almost doubled from around 60,000 to 117,000. It is clear that there was a very complex set of socio-economic processes operating during the eighteenth and early nineteenth centuries. Historians are divided on the causes: agricultural depression, over-taxation, lack of labour, rising wage costs, inheritance customs, parliamentary enclosure, failed mining enterprises and a lack of ability to secure credit have all been implicated in the consolidation of farm holdings in the hands of fewer, richer farmers (or statesmen)

(Bouch and Jones 1961; Hughes 1965; Marshall 1971; Searle 1983, 1986).

Improving transport links played a further role in placing the Lake District on the path to its current fame, as the first tourists began to come, fall in love with and write about Cumberland's "wild unpeopled hills" (Wordsworth: 'The Cumberland Beggar'). Books like Thomas West's (1778) *A Guide to the Lakes* gained popularity as Lake tours became fashionable amongst the country's gentry. While the Romantic ideals lent Cumberland a majestic charm, its airs and waters were thought to have health benefits:

> "the romantickness of the place, the extraordinary healthyness of the Air, the fine variety of Prospects, combine to entertain the Fancy with pleasant Ideas, exhilerate the Spirits, raise the sluggish Circulation, brace the languid Nerves, and restore Health without Physick, or Waters, and what may we not expect where we have the last added in Perfection" (Short 1740 in Bouch and Jones 1961: 286)

The result was the birth of the tourism industry in Cumbria. It could be argued, then, that the Romantic wilderness that defines the Lake District of today was itself dependent on those varied socio-economic processes that manifested themselves in rural depopulation and social transformation in eighteenth-century Cumberland. This was a time in which ideas of wilderness were constructed, yet "even before 1830 … the simple rusticity and solitude of the Lake District, among its major charms to reflective minds, were in danger because of the numbers attracted to it by contemporary fashion" (Bouch and Jones 1961: 289).

Landholding

Bailey and Culley (1794) estimated at the end of the eighteenth century that about two thirds of land in Cumberland was held under a system of customary tenure. Searle (1986: 109) describes this as a "staggeringly high proportion, as in other parts of the country leasehold had displaced all other types of tenure by the beginning of the century." Within this system, tenants were obligated to their landlords through a system of fines, boons and heriots, some of which could be levied on an arbitrary basis but the vast majority were fixed according to local custom (Searle 1986: 111). In Searle's (1983, 1986) thesis and subsequent journal article, he discusses the eighteenth-century customary economy in Cumberland in relation to a wider debate that mobilised Marxist explanations for the transition from feudal to capitalist social structures. For some, such as Brenner (1976) and Tawney (1912), it was the class struggle between the landowners and peasantry that defined agrarian economic development in Europe. Searle (1986: 133), however, supports writers such as Kerridge (1969) and Thompson (1978) in arguing that "the consolidation of capitalist class relations was, in fact, a complex and protracted process, which owed more to the volatility of the commodity markets and the unintended consequences of inheritance practices, than it did to the *Sturm and Drang* of the class struggle." Interestingly, these authors were debating the shift to capitalism in the sixteenth and seventeenth centuries, but Searle (1986: 109) claims that the resilience of the customary tenure system "allows us to say that the feudal mode of production was still dominant within the Cumbrian rural formation" as late as the eighteenth century. By the turn of the century, however, this class structure was gradually being eroded by the new market economy (see Searle 1983: 247-72 for his analysis of this process).

Farming

Despite its forays into mining and goods from the New World, Cumberland was very much a land of farmers. Robert Dilley's (1991) thesis on *Agricultural Change and Common Land in Cumberland* contains a very detailed appraisal of farming practices and, necessarily, much of the following summarises his points. A first-hand assessment of farming during the period can be obtained in Bailey and Culley's (1794) report on improving Cumbrian farming to the Board of Agriculture. This report contains information on diverse subjects from land tenure to the proliferation of artificial grasses. Whilst we cannot expect the information contained within to reflect, unambiguously, all practices across the county, the report is nevertheless a valuable source of information.

Livestock

Historians of Cumbrian agriculture are unanimous in highlighting the primacy of livestock farming as the main means of agricultural production (Bouch and Jones 1961; Dilley 1991; Marshall 1971; Searle 1983). From this it is often assumed that sheep were the mainstay of the local economy. This predisposition towards livestock is attributed directly to the topography, with Bailey and Culley (1794: 8) differentiating between upland and lowland zones on the basis that the former was “incapable of being improved by the plough”. Sheep, especially the Blackface/Herdwick type, were particularly suited to the harsh environment of the upland fells, where “in winter, if hay were in short supply, Cumberland sheep might have been expected to feed on ash leaves, pea and even corn straw, and holly leaves” (Dilley 1991: 164). This probably accounted for their popularity in the upland districts, where combined flock sizes averaged nearly 5000 as opposed to around 2000 in the lowlands (Dilley 1991: 136). It also helps us understand why the Blackface/Herdwick type, with its low quality wool, was favoured over the less hardy but better coated long-wool breeds of Yorkshire and Northumberland. This consideration did not stop Bailey and Culley (1794: 17) from asserting that the breeds could be improved. One peculiar characteristic of the Cumberland sheep was its instinct to remain close to its heaf, or place where it was born and weaned (Dilley 1991: 165). This allowed unsupervised grazing on the upland commons. Dilley (1991: 166–7) points out that this meant that a heaf was a valuable piece of land. Indeed, many of the court proceedings of the period reflect the fact that it was an offence to disturb another person's sheep on their heaf. It is possible that this homing characteristic among the flocks thereby conferred a sense of belonging and responsibility in the farmers over the otherwise untamed and unenclosed upland wastes.

Whilst sheep were seen as the mainstay of the economy, it is thought that they were not the most valuable of the livestock. Indeed, Dilley (1991: 141) argues that it was the cattle trade that generated the most wealth. Nevertheless, analysis of the court records indicates that in the western part of Cumberland, most emphasis was placed on sheep. This discrepancy in estimated value and subsequent distribution is perhaps explained by Bailey and Culley's (1794: 19) suggestion that most of the cattle trade centred around the urban centres, helping to supply the dairies. There was, moreover, an important influx of cattle into the area from Scottish farmers, who drove their cattle to the northern fairs, and from there down into the Midlands towards London. Searle (1983: 159) notes that in the mid-eighteenth century, 80,000 cattle streamed yearly through Carlisle and down the Eden Valley towards fairs at Brough and Rosley. The importance of this migration to the local economy cannot be underestimated – Marshall (1971) dedicates an entire chapter to it in his *Old Lakeland*. This importance manifested itself through the supply of food and fodder to the drovers and animals, respectively. The need to find suitable resting places, as well as the problems this could engender, have been immortalised in Sir Walter Scott's story 'The Two Drovers', where Marshall (1971: 80) notes the “ticklish diplomacy” involved in securing suitable temporary pasture. Marshall (1971: 80) also argues that Lakeland yeoman became “increasingly interested … in purchasing and wintering young cattle for later resale.” The practice of allowing use of one's stint (allowance of stock on the common pasture) for the wintering of non-local animals was, however, often a contentious subject, particularly during times of stress (Dilley 1991: 301–6). That said, recognition of the drovers' importance to the local economy often saw communities make compromises, such as in the provision of one-hour stopovers at Inglewood and Dalston (Dilley 1991: 306).

Searle (1983: 126) records a doubling of the price for beef and mutton in Carlisle in the last 30 years of the eighteenth century, which he attributes to rising urban demand. The improved transport links and growing centres have, therefore, been deemed responsible for increases in livestock numbers, which perhaps doubled over the course of the eighteenth century (Dilley 1991: 128). That being said, it is important to also point out that these transport links were themselves dependent on the widespread ownership of horses during the period. Bailey and Culley (1794: 47–8) were particularly praising of the use of single horse carts as opposed to larger wagons which they deemed inefficient and damaging to the roads. They were not, however, impressed that pretty young girls were often given the task of driving these vehicles (Bailey and Culley 1794: 31). Horses were also favoured above oxen for pulling ploughs (Bouch and Jones 1961: 103, 224; Dilley 1991: 219; Searle 1983). Other important livestock included pigs, geese and rabbits, although these all required careful management to prevent damage to crops (Dilley 1991: 135). Bees also played an important role, as honey was a main sweetening agent and special delicacy. There are some indications that beehives were prized more highly than pigs or poultry (Dilley 1991: 143). Overall, the picture is of a burgeoning, important livestock trade in which cattle were prized, but where sheep dominated due to the environmental context of the upland fells. A theme is beginning to arise regarding the role of transportation in the period, and this was manifested in a reliance on horses that possibly out-stripped that of the rest of the country (Bouch and Jones 1961: 103).

Crops

Arable farming in the eighteenth century had developed and diversified so much that poor harvests no longer had the destabilising effect they had once had on food prices, thereby lessening the extremes of feast and famine (Dilley 1991: 181; Walter and Schofield 1991: 17). This is not to say that there was no influence at all; fluctuations did occur, but instances of catastrophic harvest failure decreased. Whilst overseas trade allowed the import and export of grain, the cross-country transport network was not yet efficient enough to embed grain in a regionally specialised production network (Dilley 1991: 182). Instead, it was the local market that was key to grain production, with dietary habits adjusted to reflect the agricultural potential of the region (Walton 1978). Supply of grain to the markets was somewhat dependent on the weather, but there were also various Corn Laws that controlled the extent of imports and exports, as well as prices (Dilley 1991: 182). Demand certainly increased during the period: "it was estimated that in 1750 nearly a quarter of that year's wheat crop was exported, but by the end of the eighteenth century the country had become a net importer" (Dilley 1991: 182). The nationwide picture was in some respects significantly different from the situation in Cumberland, however, where wheat cultivation was limited. Instead, oats were the predominant grain crop, as Celia Fiennes (in Bouch & Jones 1961: 99) explains at the end of the seventeenth century:

> "In the northern Countyes they have only the summer graine as barley oats peas beans and lentils noe wheate or rhye, for they are so cold and late in their year they cannot venture at what sort of tillage, so have none but what they are supply'd out of other counties adjacent."

The primacy of oats and barley in Cumberland is supported by other contemporary observers, including Housman (in Hutchinson 1794) and Bailey and Culley (1794). Contrary to some assumptions, including Celia Fiennes', wheat *was* cultivated in the county, but mainly concentrated on the lowland plains (Dilley 1991: 193–4). It was oats, however, that were considered the bread corn of the masses: "The bread used by all persons of condition is made of wheat but the common people eat oaten bread as do the dry-bellied scots" (Richard Burn in Hughes 1965: 25). Oats were also eaten as porridge and oatcake, or clap bread (a type of beaten flat bread). Whilst barley was also a bread corn, the majority of the harvest tended to end up in brewing, with demand often out-stripping local supply (Bouch and Jones 1961: 100; Dilley 1991: 193).

The relative importance of oats and barley compared to wheat is confirmed by the 1801 Crop Return, of which data for two thirds of Cumberland survive. With 55% of the arable land planted with oats, Cumberland was devoting double the proportion of land compared to the national figure. Barley planting was about average, but the proportion of land sowed with wheat was less than one third the English average (Dilley 1991: 195). Overall, grain crops probably accounted for about 80% of the arable land. Of the other types of crop, there are some further interesting regional variations. Bailey and Culley (1794: 24) commented of peas: "in a climate where so much rain falls, and where harvest is so precarious, the culture of pease would be attended with so many chances of loss, and so few of grain, that we were not surprised to find them so generally neglected." This accords well with the Crop Return, which indicates that the proportion of beans and peas cultivated in the region was only one quarter the national average. Potatoes seem to have been of special significance in Cumberland, where their distribution slowly branched out from their south-west Cumbrian origin over the course of the eighteenth century. Dilley (1991: 203) notes that they were to begin with, "a lowland phenomenon", but by 1801 their coverage spanned both upland and lowland zones as well as representing three times the proportion of national acreage. One of the most important root crops was the turnip. Introduced around 1750, it "meant an improved rotation and also, by providing winter feed, made the usual autumn slaughter of beasts unnecessary, so that milk, butter and fresh meat, instead of salted or smoked flesh, became available all year round" (Bouch and Jones 1961: 226). Whilst Dilley (1991: 200–2) cites good evidence for patchy uptake of the crop, the 1801 survey indicates that Cumberland had similar proportions of acreage for turnips and rape as the rest of the country.

With livestock playing such an important role in the local economy, the growth of fodder was essential. Grasses became especially valuable along the drove routes, and there is evidence to suggest that meadows were sometimes cherished over grain fields (Dilley 1991: 207). The emphasis on pasture and meadows led, however, to a neglect of crop farming improvement. Dilley (1991: 209) argues that in the early eighteenth century, Cumberland farmers favoured field rotations (between plough and fallow) over proper crop rotation, where nitrogen fixing plants help recharge the soil. This, he goes on to say, is reminiscent of shifting cultivation. Towards the end of the century, crop rotation had become prevalent but there was, instead, a concern with planting as many grain crops as possible. Contemporary commentators were horrified at “the barbarous and unprofitable system of taking two or more white (cereal) crops in succession” (Housman in Hutchinson 1794), which was widespread according to a number of sources (Bailey and Culley 1794: 22; Bouch and Jones 1961: 221). It is not until well into the nineteenth century that Dilley (1991: 213–4) finds numerous incidences of a recognisably modern crop rotation. Another bone of contention amongst would-be reformers was the use of fertilisers. At least from the early eighteenth century, liming had been widely used in the area. Used correctly, lime can improve soil structure and reduce acidity, and it is especially valuable for preparing newly enclosed wastes for crops. However, Bailey and Culley (1794: 30) were sceptical of the practice of spreading lime onto grassland instead of fallow, as well as observing “the abuse of lime”, on which they note: “like many good things, a superabundance maybe prejudicial.” Whilst the value of organic manures was certainly recognised, it was not until 1850 that manures were truly assuming the importance they merited; a realisation that coincided with the decline of over-liming (Dilley 1991: 216–8).

Agricultural Change

The impression given thus far is of a county that lagged behind in terms of the adoption of agricultural innovations (see Martins 2004 for a general overview of 'improvement'). This is confirmed by Dilley (1991: 219–22) in his assessment of farming technology. In the fields, the wheel-less swing plough predominated, with Bouch & Jones (1961: 224) asserting that some were still home-made. Whilst winnowing machines were fairly common in 1801, threshing machines, seed drills or horse drawn hoes were mostly absent (Dilley 1991: 219). Overall, machine innovations did not become widespread until the mid-nineteenth century. I have already mentioned Bailey and Culley's (1794) comments praising the single-horse cart, but the poorer farms had to make do with sledges, which were particular useful for collecting peat from the fells (Dilley 1991: 222). Certainly when examined in terms of the principal improvements expected as part of an agricultural revolution – convertible, and then alternate husbandry, improvements in livestock and crops, improved drainage, better soil treatment and new machinery – Robert Dilley (1991: 41, 526–39) finds that Cumberland had no early revolution, that the county was very much lagging behind the rest of the country in terms of innovation, and concludes that there was progress, but not at a revolutionary pace. As Turner's (1981) estimates from the 1801 Crop Return show, in terms of crops "Cumberland was not a very productive county" (Dilley 1991: 223). Whilst livestock farming was more on a footing with the rest of the country, contemporary observers such as Bailey & Culley (1794) found plenty of room for improvement.

Landscape Change

Prior to 1750, the Cumberland landscape had undergone a century characterised by the drift of property to larger estates. In explanation, Searle (1983: 190) repeats Beckett's (1982) insistence that "it was [the lesser gentry's] inability to secure mortgages in a time of financial hardship, and their speculative dabbling in the unsuccessful exploitation of minerals which compelled many of them to put their estates on the market." Whilst this is open to debate, it seems certain that increasing economic differentiation amongst the peasantry from the 1720s onwards, related to a rising population and the growth of urban centres, helped accelerate the pace of change. This was a change characterised by both the consolidation and extensification of farm holdings (Bouch and Jones 1961). So although Dilley (1991: 538–9) sees no agricultural revolution in eighteenth and early nineteenth century Cumberland, he does argue that there was an enclosure revolution. This was the culmination of a process that began centuries before with the first enclosures of the Cumbrian lowlands, and one that then continued to deep into the nineteenth century. It involved a change in prevailing attitudes about what was shared and what was owned, and arguably it was a process deeply entwined with the rapid technological progress of early modern Britain (Whyte 2003).

Common Rights

"The importance of common rights to the tenant farmers has been clear for some time" (Dilley 1991: 278). Farmers were reliant on access to common lands for peat, turf, stone, heather (ling), gorse (whin), thorns and briar, wood and clay. It was also possible to have common rights of pasture and arable cultivation. Dilley's (1991: 232–45) analysis of this subject rejects Elliot's (1959) authoritative work, which explored the prevalence of common arable fields in Cumberland. Elliot, he claimed, had severely over-estimated the number of common arable fields by assuming field names associated with common rights were indicative of common arable rights, when in fact they could have been, and were more likely, associated with meadow or pasture. Nevertheless, Dilley (1991: 245), using a revised methodology, found a significant number of common arable fields still in use by 1700, but concluded that "a great many Cumberland communities either never had common arable fields, or had enclosed them very early." Of undoubted significance in Cumberland were the common wastes. By the eighteenth century it was mostly the areas with poor soils or of steep relief that remained unenclosed as waste. Whilst this tended to be the upland areas, not all marginal land was located in the fells. Dilley (1991: 265) makes a distinction between lands which could not support cultivation and those that could, but were deliberately left as waste. The processes by which these wastes were enclosed, and the socio-economic effects of that enclosure throughout the country, have been the subject of intense historical debate.

Enclosure

A great many books have been written on the subject of enclosure (e.g. M. E. Turner 1980; Neeson 1996; Mingay 1997) but Ian Whyte's (2003) *Transforming Fell and Valley* gives a succinct and authoritative overview of the issues in north-west England. The most discussed aspect is that of the enclosure of upland commons under parliamentary act from the mid-eighteenth century onwards. Prior to 1801, this process entailed individual parliamentary consent for each area, but after this date the General Enclosure Acts helped standardise the process, paving the way for an acceleration in the rate of enclosure (Whyte 2003: 16–7). In Dilley's (1991: 388–90) thesis, a distinction is made between this more encompassing form of enclosure and the less well understood enclosure by private agreement, that perhaps played a significant role in the consolidation of farm holdings. Further still, he examines in detail the "too-often neglected" procedure of encroachment, whereby small parcels of common land were enclosed in an illegal and piecemeal fashion. Whilst this process was slow and individual actions small, it was ongoing throughout the period and perhaps contributed to the steady enclosure of significant amounts of common land.

It is the more visible form of enclosure – both within the historical record and across the physical landscape – that dominates historical discussion. In the north-west counties of Cumberland, Westmorland and North Lancashire, general enclosure by act of parliament, or parliamentary enclosure, "occurred in three main bursts" (Whyte 2003: 23). The first was in the 1770s, the second during the Napoleonic Wars and the third during the mid-nineteenth century. The first two peaks of activity reflected nationwide trends and it is pertinent to note that they both coincide with wars (the American War of Independence and the Napoleonic Wars), when grain prices were high. Searle (1993) has suggested that this early enclosure resulted from over-use of the commons related to the burgeoning cattle trade, but Whyte (2003: 24) argues that the principal aim behind enclosure of relatively good land was "the conversion of pasture to arable". During the second, major peak of parliamentary enclosure, it was not only expensive to import grain during wartime but "poor weather conditions and thin harvests also pushed up prices" (Whyte 2003: 26). According to Beckett (1990: 65), 14 of the 22 harvests between 1793 and 1814 were deficient. After Waterloo grain prices fell sharply and the rate of enclosure slowed. It wasn't until the 1820s that the rate increased with the third peak of enclosure activity, one confined primarily to the north-west, but more significant in Westmorland than Cumberland. This surge "was linked almost entirely with the improvement of pasture, mainly for sheep farming" (Whyte 2003: 27–8). It was encouraged by improvements to the parliamentary acts, which lowered costs and increased speed, as well as further advances in the transport network, notably the spread of the railways. Often, then, enclosure accompanied improvement and changes between pasture and arable. There were some areas, however, that remained broadly unchanged apart from the appearance of boundaries delineating patchworks of regularly defined enclosures, which contrasted starkly with the older enclosures of the lower, more profitable land.

As well as socio-economic factors affecting the progress of enclosure, Dilley makes special mention of the physical environment. Arguing that discussion has been lacking in this aspect of the debate through a desire to avoid accusations of environmental determinism, Dilley (1991: 426) claims that "it is hard to see how the physical environment can be ignored in an area such as Cumberland," where environmental characteristics can change from one type to another "within a few miles". When attempting to disentangle the relative importance of various environmental variables, Dilley found that most analyses reflected a highland/lowland split, beyond which it was hard to see further patterns. Dilley (1991: 439) summed this up by stating: "the principal physical influence on date of enclosure was relief; both altitude and roughness. Soil and agricultural potential appear to have been of little significance except when associated with especially high and rugged terrain." Ostensibly, this seems to have reflected a common sense approach in which the lower, more easily accessible lands were enclosed first, with more difficult areas put off until required. With relief associated with so many other environmental variables, such as climate, it is hard to differentiate meaningfully between them and draw a deeper analysis that separates relief and roughness out from the associated environmental detail.

Effects of Enclosure

The extent to which widespread enclosure of the commons impacted on the social fabric of the nation is one of the biggest debates in British rural history (Butlin 1979; Chambers and Mingay 1966; Curtler 1920; Gonner 1966; Kerridge 1967, 1969; Mingay 1997; Neeson 1996; Searle 1993; Slater 1907; Turner 1980; Walton 1978). From an almost slavish adherence to the shock of contemporary commentators, such as John Clare, who lamented the loss of the commons and all it represented:

> There was a time my bit of ground
> Made freemen of the slave
> The ass no pindar'd dare to pound
> When I his supper gave
> The gipsey's camp was not afraid
> I made his dwelling free
> Till vile enclosure came and made
> A parish slave of me … (The Lament of Swordy Well LL.177-184)

To the right leaning historians who saw enclosure as a process of economic improvement and social empowerment; the debate is one that remains politically charged (Whyte 2003). In terms of Cumberland and the north-west, Dilley's (1991: 464–515) analysis of the Earl of Egremont's manorial records suggests that early enclosure was guided by the smaller landowners and customary tenants, although the attitudes of the truly poor were hard to discern. Later enclosure, however, was guided by the Earl of Egremont and his agents, and also included the tricky process of converting customary tenants into freeholders – the two main areas of controversy being the reduction in grazing land for small landholders and the extinguishing of rights of intercommon, where two or more parishes or townships had rights of common on the same piece of land. Later again, around the turn of the nineteenth century, it was the Earl, as landlord, who held up proceedings by asking too much by way of compensation for converting customary land into freehold. Mentioned as well is the Church, which "was seen as something of a drag on enclosure" (Dilley 1991: 505), although further investigation suggests "the Church did not seem to be a major problem in Cumberland" (Dilley 1991: 506). The overall picture is one of a process characterised by changing levels of enthusiasm and activity amongst the various parties involved. This was dependent on people's particular economic circumstances, which were forever changing throughout the eighteenth and nineteenth centuries.

To emphasise the role of the smaller landowners (and leaseholders) in this process, Searle looks in detail at the Cumbrian manorial court records. According to Searle (1993), the over-riding concern for many in the peasant class was the decline of customary rights linked to the rapid expansion of the livestock trade. Enclosure, in this context, was a means by which rights could be held intact, as the power of the Manorial Courts – the body responsible for upholding the customary system – gradually waned. This, he argues, was not "some abstract process of 'expanding the area under regular cultivation'" (Searle 1993: 152), but one that had specific social and economic goals – goals which changed from area to area and from person to person. Furthermore, Ian Whyte (2003) is keen to point out that the plight of the poor cottager workforce might not have been as great in the north-west as it was in the better understood south, simply because that cottager workforce was not particularly populous. Whyte (2003: 90) argues that in the north, the "farms were small, using mainly family labour, while access to land seems to have been more widespread." Moreover, the upland enclosures often had an effect of increasing access to lands, and "in proportional terms smallholders often did better than larger landowners" (Whyte 2003: 90). Despite this, Whyte (2003: 91) also reviews clear evidence for abandonment and poverty following enclosure; although this, he argues, could have been the effect of numerous other factors, from industrialisation and mechanisation to farm amalgamation. Whyte (2003: 92) argues that what is most interesting, is the fact that the social fabric of the rural Northwest remained broadly speaking intact throughout these various upheavals, concluding: "enclosure was one element, along with improved transport and the development of more distant markets, which gradually made rural society more prosperous without altering it drastically."

Conclusion

This chapter has examined the social and economic history of Cumbria, as described in a range of secondary sources. They describe farming in Cumberland during the eighteenth and nineteenth centuries as almost certainly lagging behind the country in terms of production and innovation. Contemporary commentators bemoaned the poor agricultural practices and gave the impression of a county that was "distinctly backward" when it came to farm and field management (Dilley 1991: 224). Cumberland was not, however, completely detached from the rest of the country. Nationwide there was an increasing population, with innovations in industry driving rapid urban growth. In the countryside this meant increased production. Responding to a national need born of war, weather and wealth, the emphasis in agricultural production alternated between crops and livestock. Meanwhile economic stresses threatened the ability of the Manorial Courts to enforce the complex legalities of customary tenancy. The result was a drive towards enclosure and the decline of common rights; a protracted process both welcomed and rejected by various groups at various times throughout the period. Governed in part by the physical characteristics of the terrain, enclosure radically altered the upland landscape. This transformation manifested a whole network of inter-related social, economic and political processes operating throughout the post-medieval and early modern periods. Yet despite these drivers of change bearing down on Cumberland's inhabitants during the eighteenth century, Ian Whyte has argued that the social fabric remained intact. While farmsteads became larger but fewer, the rural lifestyle was broadly speaking unchanged. Attention will now turn to a detailed historical and archaeological study of Mosser to test this general historical account with a more intensive, local study.

Chapter 8: Landscape Narrative II – Mosser Landscape Survey

Introduction

In the previous chapter, I outlined how a landscape narrative is essential for engaging with climate-society relationships in the past. A review of literature relating to Cumberland in the eighteenth century highlighted some key themes that might form the basis of this narrative: tensions over tenurial practices, changing land use over time and the process of enclosure, and the growing influence of the market economy, stimulated by the urban centres on Cumberland's north-west coast. Over the next two chapters, focus moves to Mosser, where a detailed local history is compared against, and placed in the context of these wider themes. This chapter will first detail the methodologies used in the investigation, including map and archive analysis, hedge and boundary survey, and upland walkover survey. The survey results will then be discussed separately before a more thematic analysis is undertaken in the following chapter. Throughout, the emphasis remains on producing a narrative primarily independent of climate and environment interactions. Connections between the different narratives will be explored in chapter seven.

Methodology

Maps and Archives

A programme of map and archive work was undertaken in 2009 and 2010. The Cumbria County Council and Lake District National Park Historic Environment Records (HER) were consulted, with study visits to view the paper records and the County Council aerial photograph collection in June 2010. A number of visits to the Cumbria Archives Service and Local Studies Libraries at Carlisle and Whitehaven were also undertaken. Although a large number of documents were consulted or transcribed, the following discussion will centre on a few selected sources – those deemed most useful in the context of this thesis. Two historical diaries will be examined in more detail in the following chapter, where I evaluate the usefulness of a first-person perspective on eighteenth-century life, but we should not discount diaries as a source of landscape history in themselves. Furthermore, Angus Winchester's (1994) annotations and appendices in *The Diary of Isaac Fletcher* contain a great deal of valuable information about Mosser, and his findings have been used to augment my own research. A variety of maps were used to build up a picture of landscape change over time. Some, such as the 1839 Tithe Map (Wh YPR 30/4) and the 1864 Enclosure Award (Ca QRE/1/127), were consulted in the archives. Others, including Ordnance Survey maps stretching back to the original 1863 first editions, were available through the Digimap service (Edina Digimap Collections 2012). Map sheets and data were loaded into Quantum GIS to aid analysis.

Lowland Survey

As well as archival work, a short programme of archaeological landscape survey was also undertaken. Nearly three weeks were spent recording and photographing all boundaries and historic features of the enclosed lowlands in the summer and autumn of 2010. For all boundaries, the existence of gates, walls, banks and hedges were noted. Following Martin Wildgoose's (1991) survey of the drystone walls around Roystone Grange in the Peak District, a number of wall characteristics were recorded in the hope of producing a typology. These included dimensions, presence and type of capping, presence of through-stones, construction style and an assessment of the wall's condition. Similarly, following Gerry Barnes and Tom Williamson's (2006) *Hedgerow History*, which used hedgerows to produce sophisticated landscape histories, hedges were recorded using separate *pro forma*. This involved noting the tree and shrub species within a randomly selected 30m length of hedge, as well as other notable characteristics such as laying (cutting and bending stems to create a stock-proof barrier), coppicing, pollarding, and the proximity to roads and paths. Hedges adjacent to gardens were not recorded. During the survey, all potential historic features – whether in boundaries or not – were recorded, with their location, dimensions and suggested interpretations all measured and assessed in the field. Data from the lowland survey was digitised in a vector format within Quantum GIS for analysis.

Upland Survey

In addition to the lowland survey, a team of ten volunteers and supervisors conducted an upland walkover survey of historic features on Mosser Fell over a weekend in the spring of 2011. The survey was undertaken along transects 20m apart, with features recorded using mapping-grade GPS on hand-held PDAs. Descriptions and dimensions of the features, as well as brief in-field interpretations were recorded on paper. GPS points were uploaded from the PDAs to Quantum GIS for analysis. Although some features were sketched in plan, most were only photographed. The initial plan was to systematically survey the whole upland area to the east of Mosser, but time constraints only allowed the area within the Mosser boundary to be completed. Instead, an unsystematic, limited-coverage walkover assessment of the fell beyond the bounds of Mosser was undertaken by the author.

The Structure of the Landscape

The first mention of Mosser (Moserhe) was in a twelfth- or thirteenth-century charter granting land rights from Richard de Lucy to Adam of Mosser (Ca D/Lec/301). This set out the boundaries of the old township, although residents were also allowed to graze livestock on the land between what is now Whittern Gill (Raisthuaitebec) and Crabtree Beck (Caypeltrebec) (Figure 22). Despite these medieval origins, the prevalence of Scandinavian and Old English place names, such as Sosgill (gil - 'ravine'), Bramley Seat (sætr - 'shieling') and Mosser itself (mos – 'bog' or 'swamp'), suggest habitation stretching back at least as far as the early medieval period, with Bramley Seat possibly a site for seasonal stock grazing (Field 1972; Mills 2003). There have been very few new developments in the past two centuries, but a number of ruined dwellings were recorded during the field survey: at Whinnah, Gillbrow and Mill Dam. Many of the extant former farmsteads are now solely domestic houses or converted cottages. There is one new farm at Mosser Heights, which was almost certainly built post-1970. Mosser Mains (NY115250) contains the highest concentration of dwellings within the area, but there are no shops or public amenities apart from a small chapel (NY114248), which according to the National Monuments Record, was built in 1773 on the site of a medieval chantry chapel.

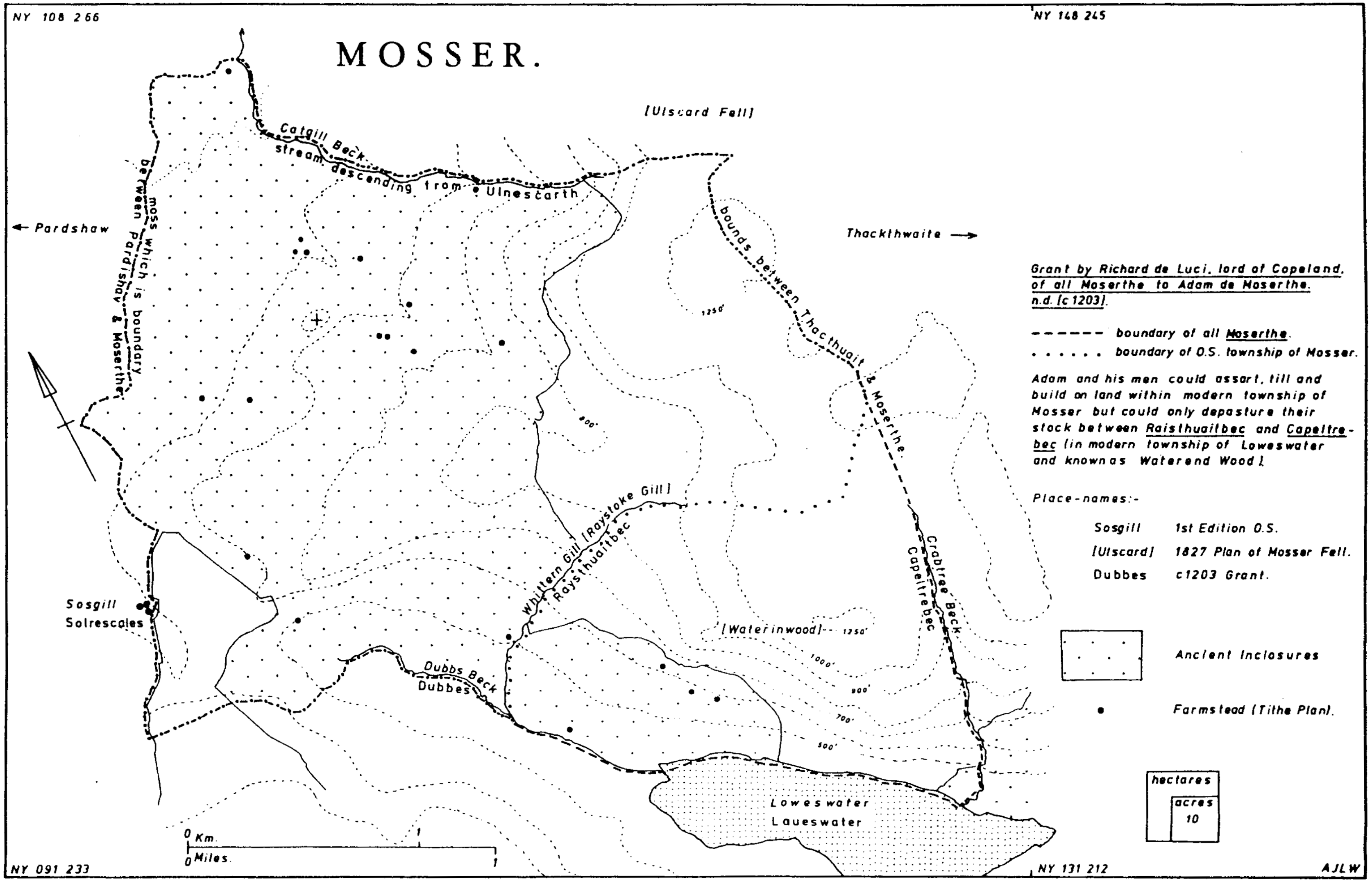

Figure 22: Angus Winchester's (1978) map of Mosser, based on the medieval charter granting land to Adam of Mosser.

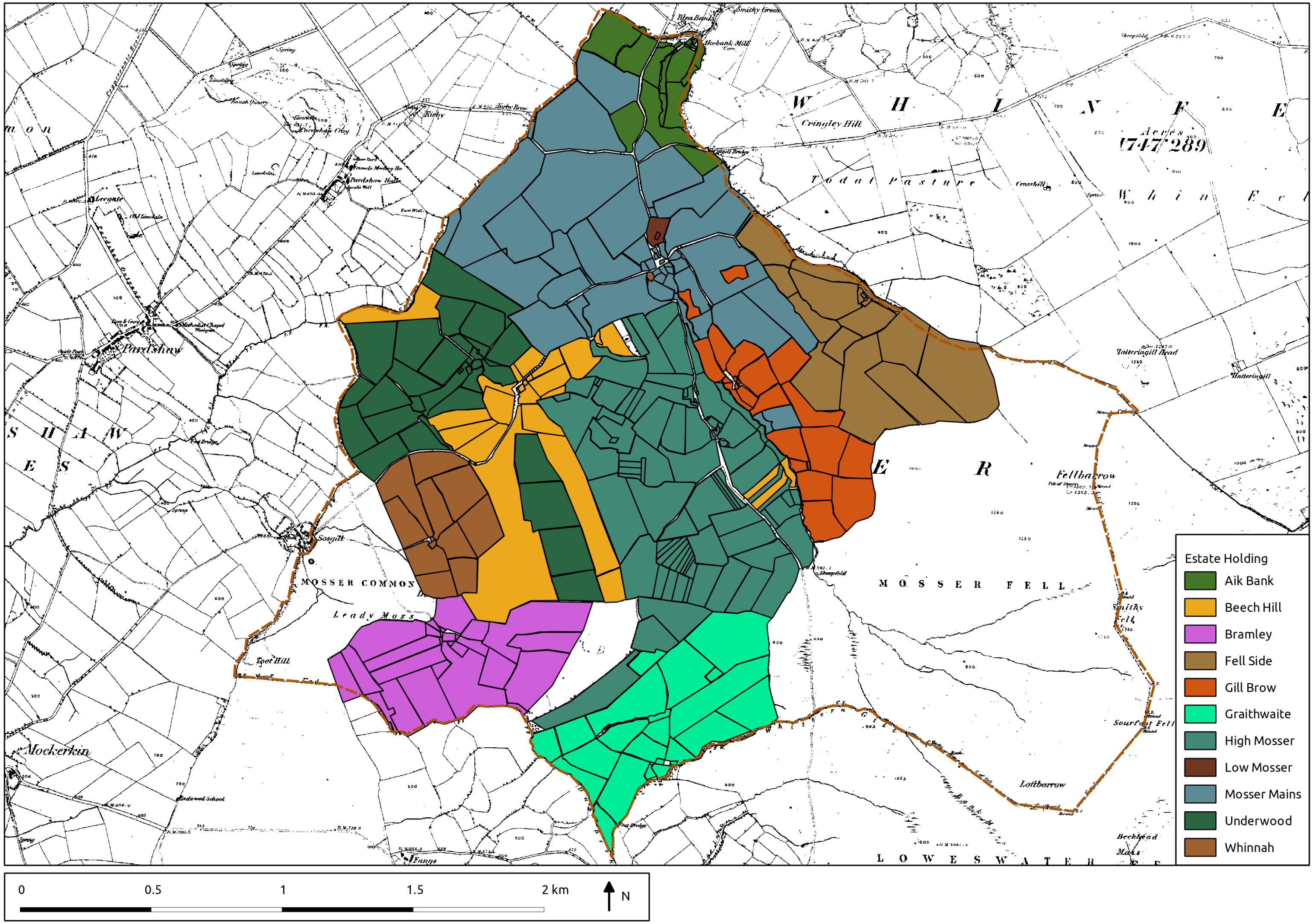

Figure 23: Estate holdings according to the 1839 Tithe Map (Wh YPR 30/4). Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

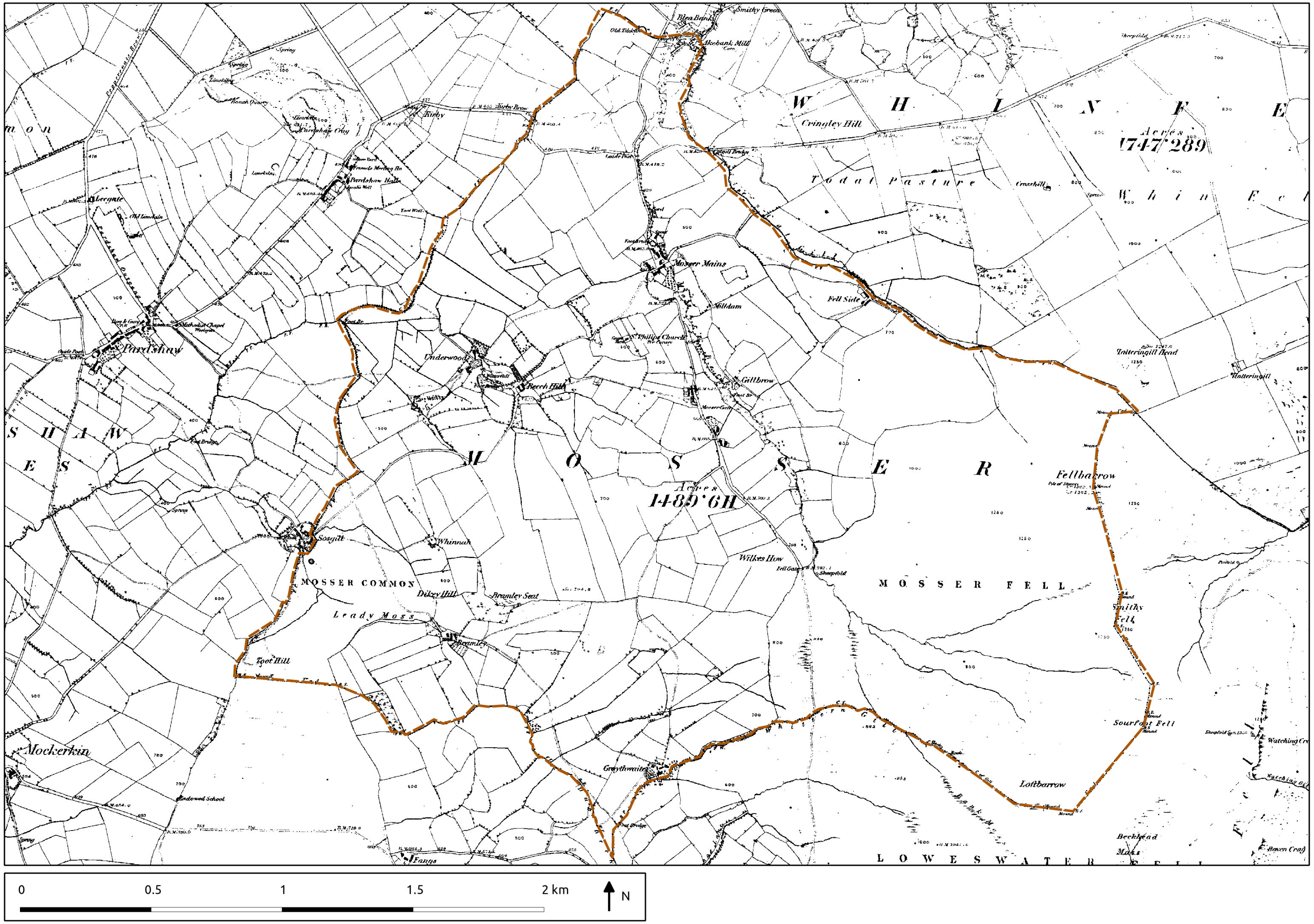

Figure 24: The Ordnance Survey 1:10560 First Edition c. 1863. © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

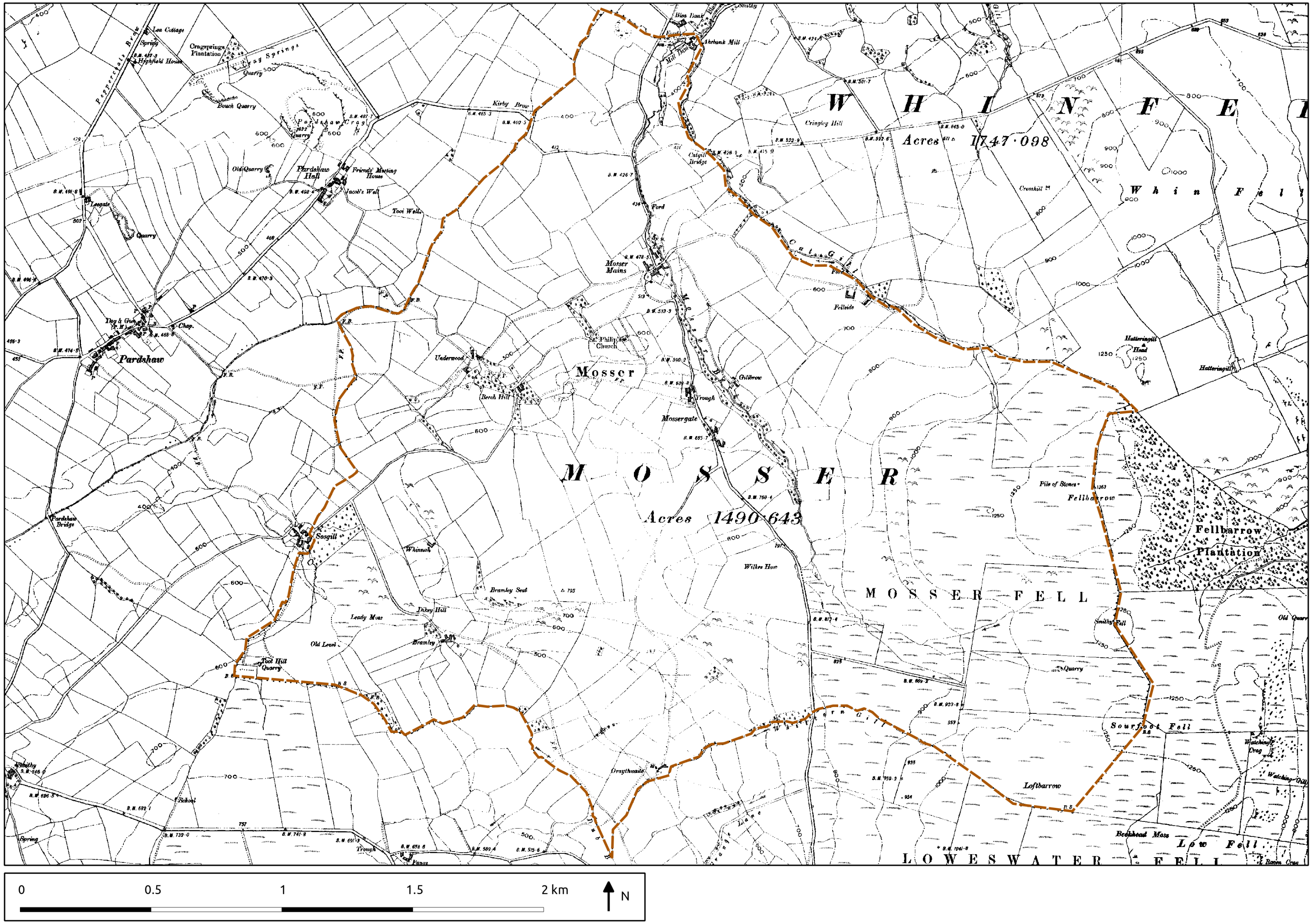

Figure 25: The Ordnance Survey 1:10560 First Revision c. 1900. © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

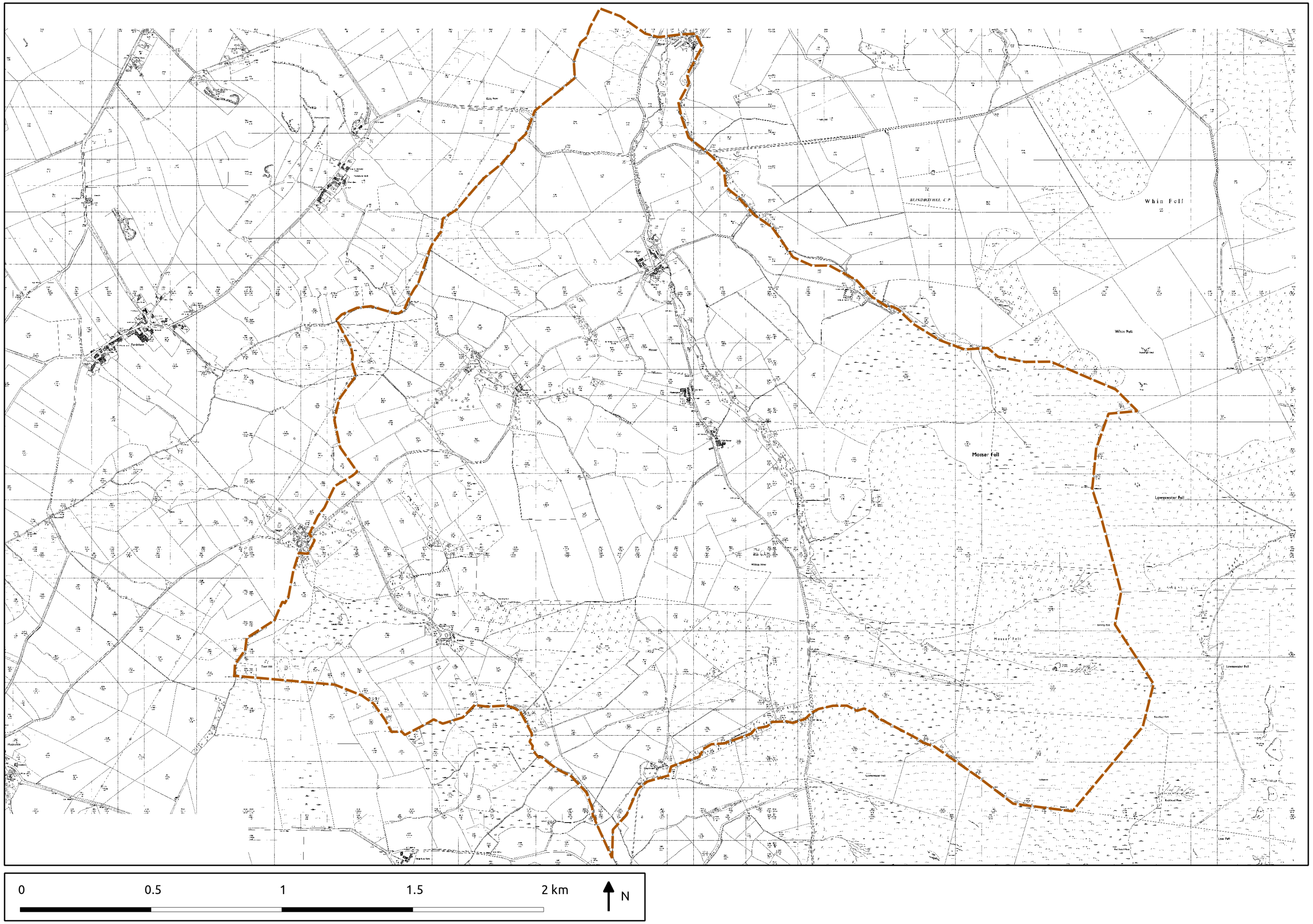

Figure 26: The Ordnance Survey 1:2500 National Grid c. 1970. © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

The earliest map of Mosser as a whole is the 1839 Tithe Map (Wh YPR 30/4, Figure 23). In 1836, Parliament passed the Tithe Commutation Act, which "commuted all tithes in kind and substituted a fluctuating money payment known as a tithe rent-charge adjusted each year on the basis of the seven-year average price of wheat, barley and oats" (Kain and Prince 2000: 15). As part of this process, the rent-charge needed to be apportioned to the landowners according to size of holdings and use of land. The resultant maps showed detailed acreages and states of cultivation, and listed fields by their landowners. The Tithe Map for Mosser contains all these details. Many of the boundaries indicated on the Tithe Map are identical to those seen today, although many others have disappeared, or at least are no longer used. The earliest Ordnance Survey maps of the area date to 1863 (Figure 24). Despite being surveyed only 24 years after the Tithe Map, there are some marked contrasts. Large numbers of smaller, piecemeal enclosures disappeared in the intervening period, particularly in the area between Mossergate, Wilkes Howe and Beech Hill. A number of enclosures near Fell Side that border the fell were also removed. In contrast, towards the north of Mosser, on the low-lying land bordering Pardshaw, there was some sub-division of the fields.

The Enclosure Map of 1864 (Ca QRE/1/127) shows the new, large straight divisions within the former common land on the fell, as well as a number of smaller enclosures on Mosser Common, near Sosgill, and odd pieces of land lying outside the township. At this time, the whole township became enclosed and use of the fell was now constrained within the township's boundaries. From this point on, successive editions of Ordnance Survey maps show a landscape broadly unchanged since the mid-eighteenth century (Figures 25 and 26). The small changes that have occurred seem to have been enacted during the last 40 years. For the most part, this pertains to the removal of boundaries, particularly in the marshy lands north and west of the township. There are also considerable areas of new plantation in the area formerly part of Leady Moss, where Mr Coles of Bramley Farm informed us he initiated a programme of planting in the late 1970s. Attention will now turn to the results from the surveys, and how this improves our knowledge of the landscape.

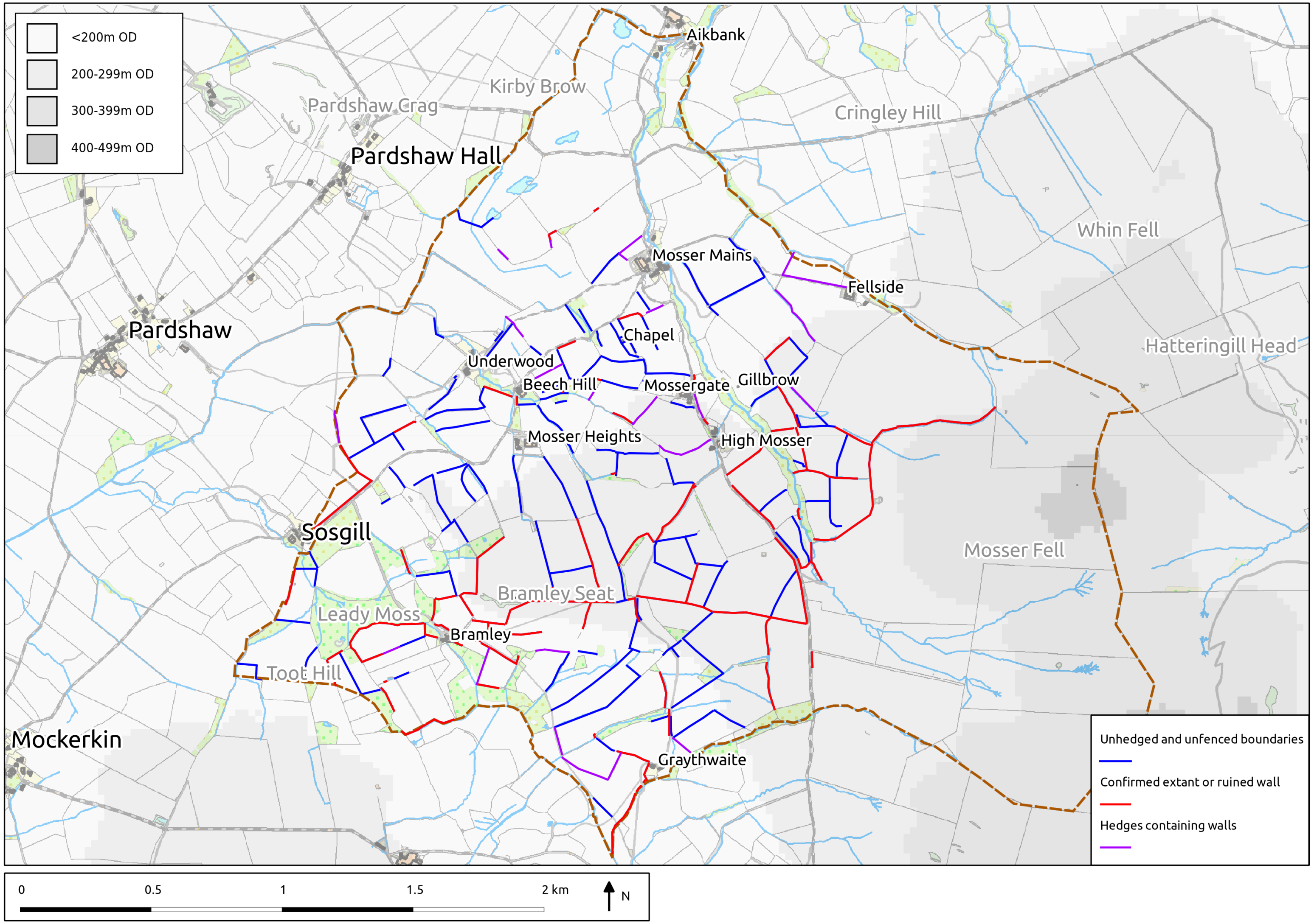

Figure 27: The walls in Mosser. Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

Banks

Where possible, the evidence from banks has been built into the analysis of walls and hedges. This is because it is often not clear whether they form the remains of either a hedge or a wall. This, of course, underlines the fact that many boundaries are not easily categorised: a hedge might have been planted on top of the remains of an old wall, or a wall might have been built along the line of a former hedgerow. Attempts to investigate this in the field can be difficult. For example, a line of stones seeming to jut out from a bank might just be the remnants of field clearance and land improvement rather than the remains of a ruined wall. There are also problems with banks and maps: sometimes a bank might be recorded as an extant boundary, sometimes it is not. Of course, some banks are interesting in their own right: they might form lynchets or shore up steep escarpments. Some banks in the lower lying areas around Graythwaite and Dubb Beck, and in the former swamp land around Underwood, are likely to have functioned as dykes, protecting the land from flooding. Despite these examples, the general complexities of interpreting banks precludes a more detailed analysis here.

Walls

During the lowland survey, 217 unhedged and unfenced boundaries were recorded. Of these, 145 were banked in some way and 94 had definite signs of either an extant or ruined wall. A further 23 boundaries recorded as hedges showed evidence of stone walls (Figure 27). Walled boundaries are concentrated on the higher lands out near Fell Side and across the ridge of high land extending east to west from the fell, across Wilkes How to Bramley Seat. There is also a cluster of stone walls amongst the lands adjacent to Bramley Farm, despite these being lower lying. Boundaries with banks or lynchets are located throughout the area, but are less concentrated in the low, marshy land to the north and west. Only 6% of the unhedged and unfenced boundaries identified in the survey are not visible on 1839 Tithe Map. Most of these newer boundaries are located on the former Mosser Common, between Toot Hill, Sosgill and Bramley Farm.

Martin Wildgoose's (1991) typology of drystone field walls at Roystone Grange in Derbyshire is a seminal article in landscape archaeology. Creating his typology from the morphological characteristics of extant field boundaries, Wildgoose (1991) was able to loosely link different wall types to different phases of boundary construction. As a result, it was possible to reconstruct the development of landscape from the prehistoric period onward. It was hoped that a similar methodology could be applied in Mosser. Given Wildgoose's typology was developed on the limestone landscape of the Peak District, it is not surprising that wall types in Mosser do not conform to the typology. Arguably, most of the walls in Mosser can be likened to Wildgoose's (1991: 212) type 1 – the most recent phase of construction – but there are no other similarities. These straight walls have two straight-edged faces, with voids between filled with small stones or slate scree. Shorter but squatter than the Roystone walls, Mosser's walls are generally 1-1.2m high, 0.6-0.8m wide at the base and 0.4-0.6m wide at the top.

Despite being unable to directly transpose Wildgoose's (1991) typology, some patterns do emerge from the survey. For example, there is a difference between walls capped with stone 'jumble' and those with a row of transverse stones, set on edge. On average, the walls capped with jumble are shorter (1.07m compared to 1.16m) with a much wider base (0.61m compared to 0.48m) than the walls capped with a course of transverse stones. Walls with jumble capping are concentrated in the area around Bramley Farm, stretching from Leady Moss up to Bramley Seat (Figures 28 and 30). The walls with rows of transverse capping are much less concentrated, and can be split into further, less well defined, categories. One such category groups together the walls in the best state of repair. These tend to be situated on the high ground near Wilkes How or up on the fell itself (Figure 29). There are two possible reasons for this. Firstly, the maps show that post-enclosure, in the latter part of the nineteenth century, the fell border just south of Wilkes How was moved up-slope to its current position, lining the trackway running from Mossergate to Loweswater. On the ground, the old boundary is clearly seen as a bank and line of stone, with a clear difference in vegetation on either side. Walls built up-slope from this boundary are likely to be some of the newest in the area. In particular, those that form the long, straight boundaries of the large fell enclosures are certainly dated post-1864. Secondly, walls on higher ground are more likely to be repaired on a regular basis. They are more exposed and at risk from bad weather; instead of building fences, farmers are more likely to ensure the walls are kept maintained or rebuilt because they provide valuable shelter for livestock. On the ridge between Wilkes How and Bramley Seat, there is evidence of this process of rebuilding and repair, where in a gap between current, well-built walls, the foundations of a former wall can be seen.

Figure 28: A wall with jumble capping near to Bramley Farm

Figure 29: A wall with transverse capping in a good state of repair near Bramley Seat

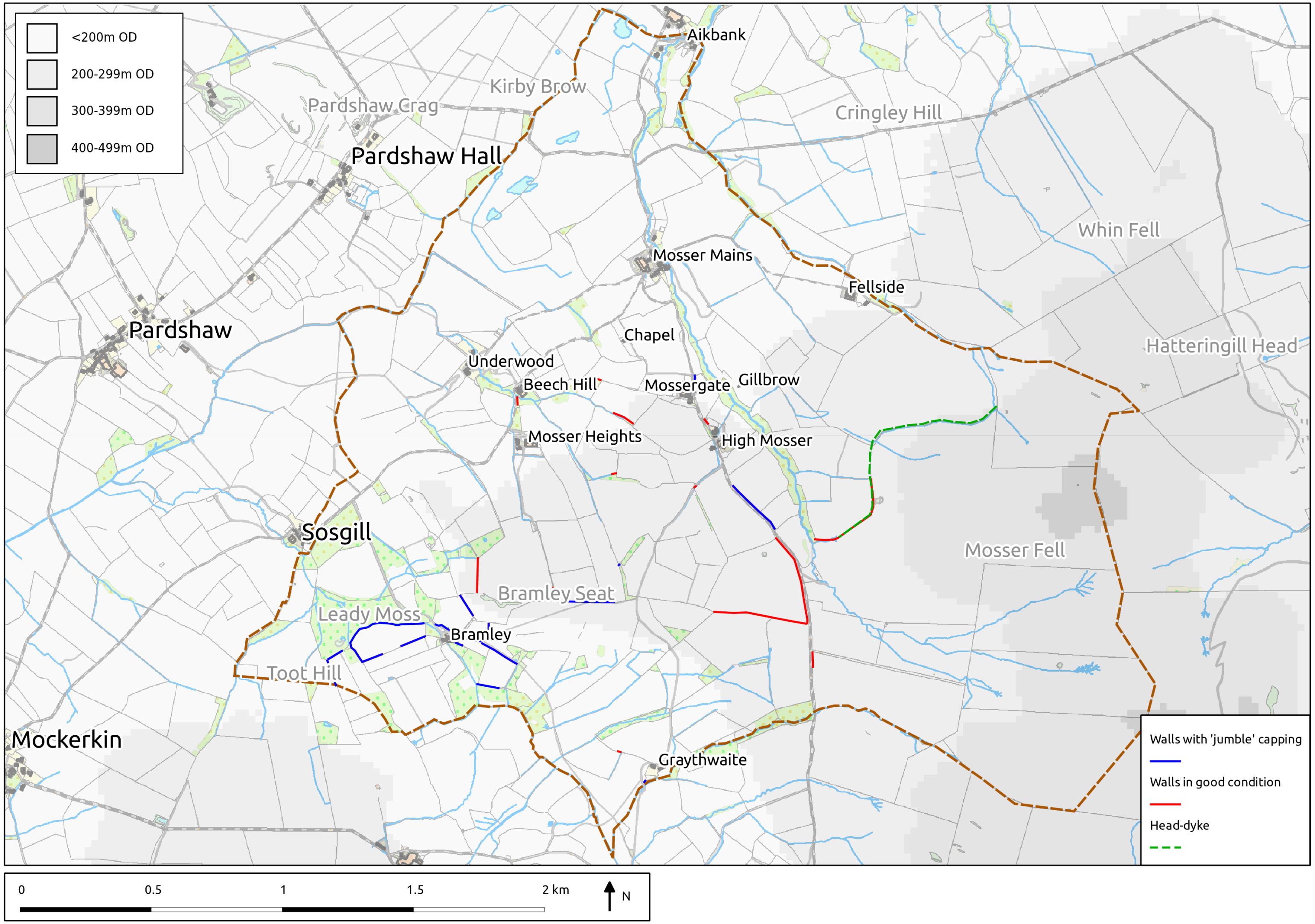

Figure 30: Location of different types of wall and head-dyke. Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

Quality and style of construction also defines other groups of walls. In the area formally part of Mosser Moss, there are walls constructed out of large water worn cobbles, and which tend to be in a fairly poor state of repair (Figure 31). We know from the Isaac Fletcher's diary (Winchester 1994) that these walls were unlikely to have been built prior to 1772, when the Moss was first divided. Along the road near Beech Hill, there are examples of walls constructed or repaired using mortar – the only ones in the area. An inner core of drystone slate and shale is supported by mortared facing on either side, with a capping of alternating large and small transverse stones (Figure 32).

Figure 31: A wall constructed using water worn stones near Mosser Moss.

Figure 32: A wall constructed or repaired using mortar, with an inner core of slate and shale, on the road to Sosgill.

Figure 33:Looking south-east along the 'inside' of the head-dyke near Fell Side.

Figure 34: Looking north-west along the 'outside' face of the head-dyke near Fell Side.

Although not ostensibly part of any typological group, the impressive boundary between the lower enclosed lands and the upland fell is worth mentioning. Near Fell Side, the wall faces the fell on the south-east side, forming one side of a ditch over 1m deep (Figures 30,33 and 34). On the north-west side, a bank of earth completely covers the wall, sometimes reaching up to several metres in height. There is a strong possibility that this boundary, or *head-dyke,* is one of the oldest in the area. As Angus Winchester

(2000: 53) writes, “marking the limit of enclosure and thus the boundary between land appropriated to individuals and the common grazings on the waste, [the head-dyke] was one of the few permanent enclosures in the medieval peasant-farming landscape.” Other candidates for old walls are no longer standing, and often consist of just a few courses of cobbles. On the north-east edge of Mosser, beside Cat Gill, there is a wall that has been completely overgrown by a large mature ash tree. This is adjacent to a hollow-way running down to the brook, probably indicating the position of a former crossing (Figures 35 and 36). Similarly, along the road leading from Mosser Mains to Beech Hill, a short section of wall is overlain by large, mature horse chestnut and sycamore trees. Although not overgrown by trees, similar sections of wall can be seen further along the road between Beech Hill and Sosgill, as well as along Mosser's western boundary, to the north of Sosgill. On the road near the chapel, there is the only example of a wall made entirely of slate fragments. Rather than free-standing, this structure supports a bank with mature ash and hawthorn on top – it is quite unlike any other wall in the area (Figure 37).

Figure 35: Wall overgrown by large ash tree.

Figure 36: Hollow-way leading up from Cat Gill.

In summary, these examples only demonstrate a broad categorisation, and there is very little evidence that would enable us to link wall characteristics to particular periods of construction – all but one of the walls in the area demarcate boundaries that were visible on the 1839 Tithe Map. Nevertheless, the groupings do present a starting point for picking apart the different elements that make up the Mosser landscape. The different construction styles, types of stone, states of repair and their relationship to other features all indicate a deep and textured history of landscape development – one that is only hinted at in the maps of the last 170 years. Angus Winchester (1987, 2000) has written extensively about landscape development during the medieval and post-medieval periods. He states that head-dykes were most likely established 1400-1700, with their importance fading into early eighteenth century due to piecemeal enclosure on the valley bottoms (Winchester 2000: 52). There is no reason to suspect a different pattern of development in Mosser. Certainly, the documentary evidence suggests significant piecemeal enclosure during the eighteenth century. The predominance of walls on the higher ground in Mosser hints at the role of environmental factors in marking out boundaries, although these are of course mediated through the perceptions and choices of their builders.

Figure 37: Bank supported by slate fragments on the road to Sosgill.

Hedges

The use of hedges as a source in landscape history is commonly associated with Max Hooper (1971) and his hypothesis that hedges could be dated based on their species composition. In the most simplified form of Hooper's hypothesis, one species equates to 100 years of age – a hedge containing five species of tree or shrub would be roughly 500 years old. There were, a number of caveats to this, including the assertion that the calculation could "easily be as much as 200 years out either side" (Pollard et al. 1974: 79), but the shorthand version of the hypothesis has remained prevalent. Gerry Barnes and Tom Williamson (2006: 31–40) have examined if the hypothesis stands up to scrutiny. Using a modified version of Hooper's method, they were successful in producing a detailed landscape history from hedge surveys. Although their study went beyond simple dating, the results indicated a loose relationship between species composition and date, with “older hedges … more diverse in composition than younger ones” (Barnes and Williamson 2006: 83). The hedge survey employed in Mosser was designed to emulate elements of their approach, although it was not as extensive, nor as detailed. A number of problems arose when conducting the survey, most notably in the failure to identify some species. This consequently prevents detailed analyses of composition profiles, although more general analyses concerning numbers of species are still possible.

The survey recorded 139 hedges, with 62 banks also showing signs of once being hedged. The hedges are located throughout the enclosed lowlands, except across the ridge of high land stretching west from Wilkes How to Bramley Seat, where walls are more common. There are also no hedges in the area around Leady Moss, formerly known as Mosser Common (Figure 38). The hedge composition was not as varied as in Barnes and Williamson's (2006) example. This reflects the less fertile upland environment in comparison to the rich agricultural land of Norfolk, but there was some variation in Mosser, with the number of species per hedge ranging from 1 to 11. As with the walls, the vast majority of hedges demarcate boundaries that are extant on the 1839 Tithe Map, so it is difficult to build up a catalogue of known hedge dates from which to extrapolate a detailed age-species regression curve (Hooper 1971). Although Isaac Fletcher's diary does record dates when specific fields were hedged, it is hard to discern which boundary he is discussing or even whether that boundary still exists as a hedge (Table 1). It is, nevertheless, possible to identify a number of potential candidates for hedges mentioned in the diary, and these contained a mean of 3.2 species per hedge. From this, and following examples from Hooper (1971; Pollard et al. 1974) and Barnes and Williamson (2006), it can be very tentatively suggested that those hedges with more than 4 species were likely set more than 250 years ago, those with less than 3 species were probably set in the last 250 years, whereas those with 3 or 4 species were most likely set sometime between 350 and 150 years ago.

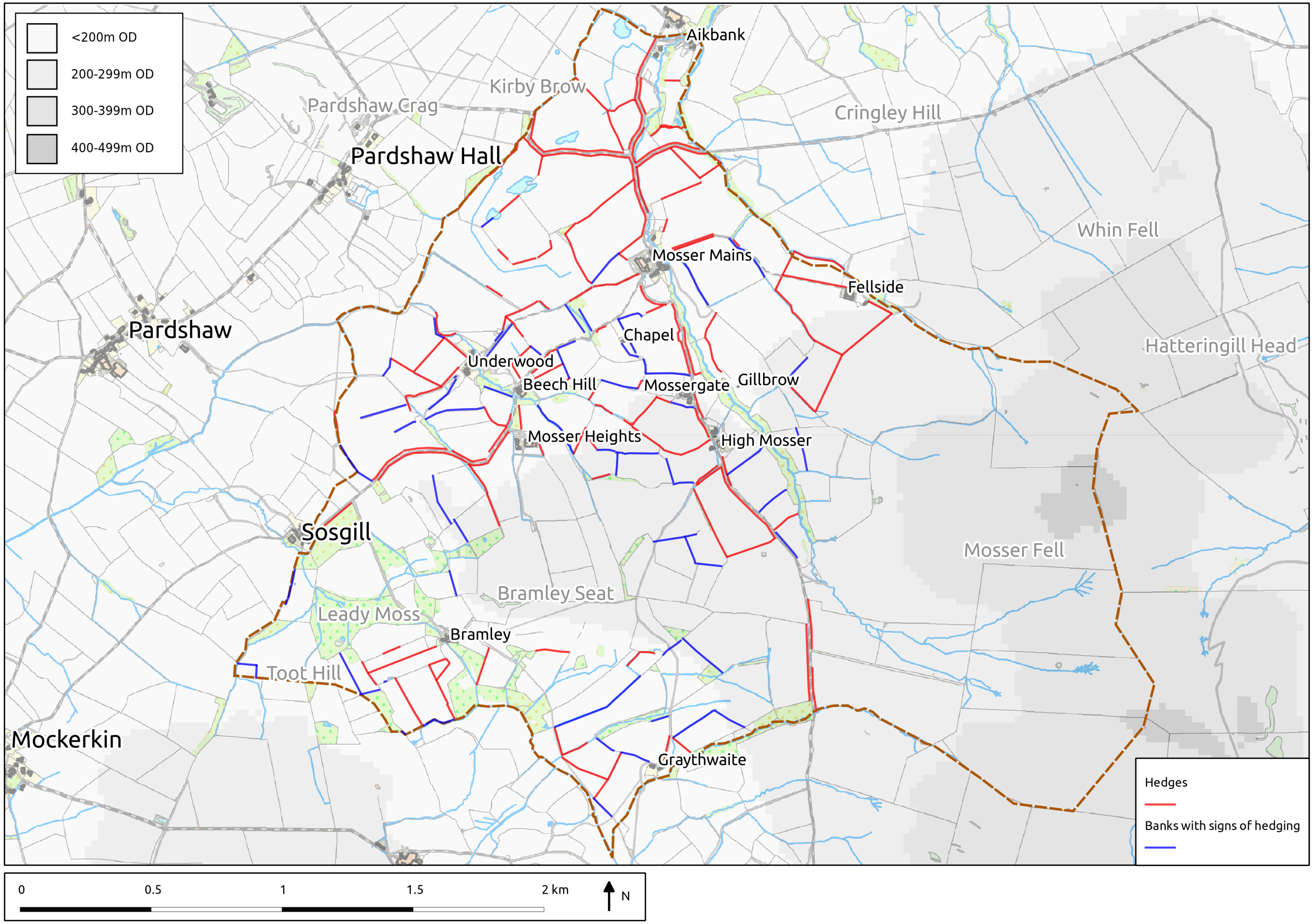

Figure 38: The hedges within Mosser. Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

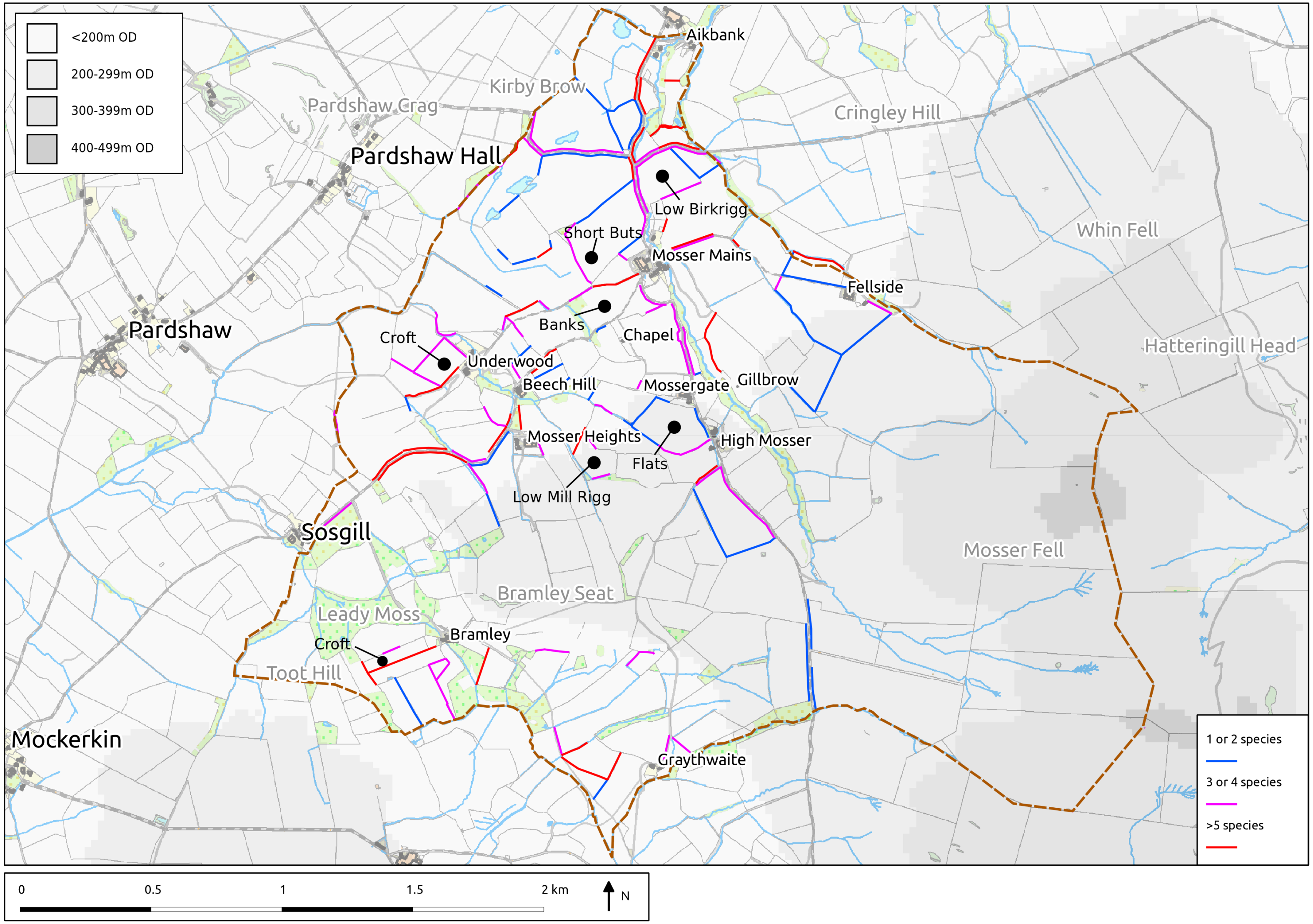

Figure 39: Hedges ranked according to diversity. Species-rich hedges possibly denote older boundaries. Field-names denote candidates for the oldest and most important fields in the area, based on the species composition of the hedges. Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

Field name	Date hedge mentioned	Species composition of candidates
Shortlands	1775	4
		4
		5
Banks	1762	2
Croft	1756, 1765, 1774, 1779	3
		3
		5
		4
Moss	1772	1
		1
		5
		2
		4
		2
		5
Whinney	1767, 1775, 1777	1
Pasture	1764, 1772	3
		3
Pasturehead Close		3
Corn Close	1774	3

Table 1: Dates of hedge-laying, as mentioned in Isaac Fletcher's diary, and the species composition of possible candidates.

Following Barnes and Williamson's (2006: 73) method, we can also infer dates for hedges was dividing them into categories based on boundary morphology. *Straight* hedges are indicative of parliamentary enclosure, kinked or slightly bent boundaries reflect *piecemeal* enclosure and are likely to be older than straight hedges, while *irregular* hedges respect the curves of trackways, roads and administrative boundaries and probably represent the oldest hedges in the area. Again, although the variation was not as great as in Norfolk, there were differences between hedges marking different types of boundary. Straight hedges averaged 2.9 species, piecemeal 3.4 species and irregular 4.3 species (Table 2). This is also reflected in the number hedges that could be classified as being 'mixed' as opposed to containing a single dominant species, as well as in the frequencies of hedges containing hazel, maple or dogwood. These species are considered rare in hedges planted in the last few centuries because they colonise slowly and were unlikely to be planted in newer hedges, where hawthorn, blackthorn and whitethorn dominate (Barnes and Williamson 2006: 84–5). Unlike Barnes and Williamson's (2006: 75–6) Norfolk example, the results show clear differences between irregular and piecemeal types. In the Norfolk example, straight hedges formed a clear group of poorly varied hedges with few slow colonisers, with irregular and piecemeal types forming “barely distinguishable” categories. In Mosser, there is a clear progression from low variation straight hedges through piecemeal to the more varied irregular type. It should be noted, however, that 32 of the 45 irregular hedges are situated by roads or trackways. Although the greater species diversity might be due to age, Barnes and Williamson (2006: 82) found that “shrub species tend to establish themselves with greater rapidity along roadsides”. Possible reasons for this include greater disturbance, and the channelling and dispersal of seeds by traffic.

Type of Hedge	Average No. of Species	Primary species: Mixed (%)	Composition: Containing rare species (%)
Straight	2.87	27.5	18
Piecemeal	3.41	29.63	26
Irregular	4.27	46.67	40

Table 2: The differences between hedge types.

Splitting the hedges into groups based on species diversity, we can see that hedges with one or two species are most prevalent in the higher areas near Wilkes How and along the fell road, and around Fell Side, where the boundaries were rationalised in the late nineteenth century (Figure 39). There is also a cluster of low diversity hedges on the low ground to the north of Mosser, possibly representing the late enclosure of the wetter, poor quality ground that made up Mosser Moss. As mentioned above, it is striking how hedges with three or more species dominate the routeways, particularly out from Mosser Mains to Underwood and along the road to Sosgill. It is also interesting to note how these hedges tend to cluster near farmsteads. It would be in these areas that farms' primary arable fields would be located. It is tempting to suggest, therefore, that fields demarcated by species-rich hedges – Croft near Underwood, Croft near Bramley, Low Mill Rigg near Beech Hill, Flats near Mossergate, and Banks, Short Buts and Low Birkrigg near Mosser Mains – were some of the most important and oldest arable fields in the area (Figure 39). Certainly, the importance of Underwood's Croft is underlined in Isaac Fletcher's diary as one of his most cropped fields (see following chapter).

On balance, the categorisation of hedges based on their boundary morphology does support the hypothesis that the diversity of hedges increases with age. Despite this, defining chronologies based on species counts remains fraught with difficulty, and subsequent interpretations should be approached with caution. Field descriptions of the species-rich hedges around Aikbank and Bramley, for example, note the possibility of additional, more recent planting. At the other end of the scale, although a hedge might contain only one or two species, those trees and shrubs might be well-grown and mature, suggesting greater antiquity. Similarly, although hawthorn is most commonly associated with species-poor hedges, they may actually contain a large amount of hazel – a species recommended for hedges by early writers, not least because the nuts can be harvested (Barnes and Williamson 2006: 65). Evidence of hedge management can also be an indicator of age. Date of planting cannot be directly inferred from the presence or absence of hedge-laying or plashing – the process of cutting and bending shrub stems to form an impenetrable barrier – but in Norfolk the practice "had largely been abandoned by the end of the eighteenth century" (Barnes and Williamson 2006: 67). If this is true of Mosser, then it sheds new light on a number of single-species hawthorn hedges that show signs of laying in the piecemeal enclosures between Beech Hill and Mossergate. Furthermore, if large mature trees show evidence of laying, this might be indicative of a particularly old hedge. There are two impressive examples of this: one along the track that leads down to Graythwaite from the road near Mossergate, and another along the northern edge of a field bordering the road to the east of the chapel (Figure 40). Only a few examples of pollarding and coppicing were found, although this could be due to a failure to recognise instances in the field.

Figure 40: Mature tree showing evidence of laying near Mossergate.

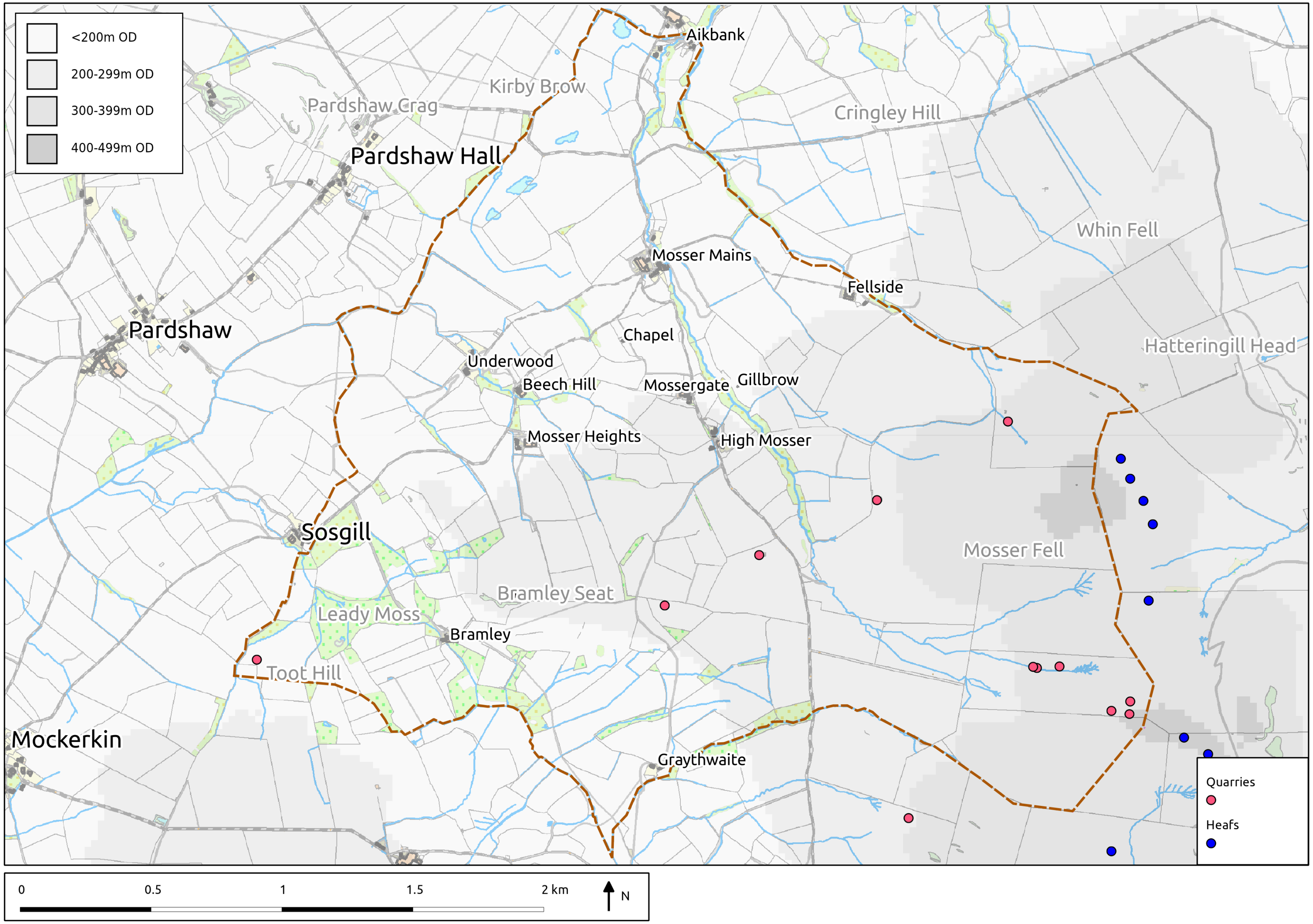

Figure 41: Quarries identified during the field survey. Heafs marked according to W. Mitchell in 1827 (Wh DWM 1/106). Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

The evidence from hedges, like that from walls, is in many cases limited. Attempts to define detailed hedge chronologies are particularly tenuous. There are a range of factors affecting the species composition of hedges, ranging from soil type and surface wetness to variations in seed supply and farming practices (Barnes and Williamson 2006: 79). Whilst variations in environmental factors might not be so significant in a small township in Cumbria compared to the whole of Norfolk, we should not discount them. The fact that hedges are rarely found at the highest elevations would seem to confirm this. Despite these problems, the balance of evidence does appear to suggest that the composition of a hedge is partly related to its age. Across the highest and lowest, most recently enclosed lands, species variation is poor. Along irregular boundaries and where old, piecemeal enclosures dominate, that variation increases markedly. It is thus possible to tentatively suggest which routeways and fields are the oldest in the area, bearing in mind the considerable caveats discussed above. In particular, the species-rich hedges demarcating fields clustering around the farmsteads were probably some of the earliest enclosures. All this adds another dimension to Mosser's landscape history, hinting at a deep history of piecemeal enclosure that progressed from the immediate vicinities of the farmsteads, to the well-drained mid-altitude lands, and then up out to the fell edge and down into the wet lowlands.

The Fell

The upland survey identified a range of features. These included scatters of large stones, shallow depressions and small quarry sites, which tended to be concentrated between Sourfoot Fell and Smithy Fell. The survey also located the larger quarry sites noted in the Historic Environment Record (HER) and on the Ordnance Survey (OS) maps (Figure 41). Two cairns were located, one near the summit of Sourfoot Fell, the other near the OS triangulation point on Fellbarrow. These mark the bounds of the Mosser township, but they are of unknown date. A number of 'mounds' marked on along the boundary of Mosser on the first edition OS maps are not visible today. However, some 50m to the west of the cairn at Fellbarrow is a ring of stones 3.3m in diameter and 0.7m high. This feature is recorded as a pile of stones as far back as the first edition OS maps, and it is possible that it is a small, prehistoric kerb cairn – a number of bronze age axe finds in neighbouring Whinfell could support this interpretation (Figure 42). A further

3.3m diameter semi-circle of stone was found slightly down-slope to the west, but this could also be associated with a 13m section of ruined stone wall. The poor condition of the feature implies great age, although it would be speculation to attempt to define a more precise date or period of construction.

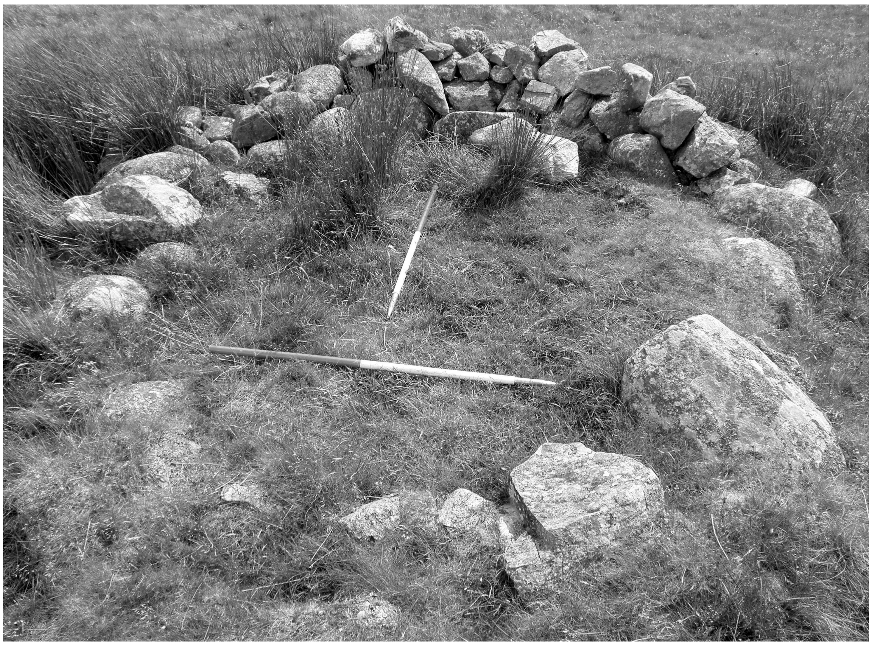

Figure 42: Possible prehistoric kerb cairn on Fellbarrow

Surprisingly absent from the survey results are confirmed examples of sheep management structures. Sheep folds and long-tailed runs are normally quite common in upland environments, and during the cursory walk around the surrounding area, a number of these features were identified (Winchester 2000). There are only two folds visible in Mosser's section of the fells. The main one is situated by what would have been the old entrance to the fell, where the road ascended above the head-dyke. The fold is roughly 9m by 7m, with one north-west facing entrance. The walls stand to about 1.2m, with one of the gateposts 1.8m high. After the enclosure of the fell, this was one of the few areas that remained publicly accessible. With Loweswater operating a pinfold – a pen where trespassing animals were rounded up (Winchester 2000: 117) – down in the valley, it is possible that this was Mosser's pinfold, although this cannot be confirmed. An 1827 map of Mosser Fell (Wh DWM 1/106), surveyed by W. Mitchell, shows the location of quarries, heafs and folds (Figure 41). Although the map is not to scale, all the marked features appear to be located outside the bounds of the township. Although the old grant of land allowed Mosser's inhabitants to graze their animals as far south as Crabtree Beck in Loweswater, they had no rights to graze on the eastern slopes of the fell, yet this is where their heafs are located. Although a heaf need not leave any material remains, the map is supported by anecdotal evidence for more sheep management structures outside Mosser's boundary.

Figure 43: Example of iron fence-post on Mosser Fell

The survey did not identify any field boundaries that were not already marked on the post-enclosure maps. The form of the boundaries varies. Wire fencing predominates, and the survey identified a number of cast iron fence-posts. Some of these are marked with the name and place of manufacture, and likely date to the late-nineteenth or twentieth century (Figure 43). Where stone walls have been constructed, they tend to be large, in good condition, and capped with transversely aligned stones. The largest examples reach up to 1.2m high and over 1m wide. Apart from a seeming aversion to building walls on the wettest ground, there is no discernible pattern to which boundaries contain walls and which are just fenced. Perhaps one of the most interesting features observed on the fell is the pattern of ditches and ridge and furrow adjacent to the lands of Fell Side, implying crop cultivation beyond the limit of the head-dyke. This is discussed in more detail in the following chapter. There is evidence of linear ditches in other areas of the fell, particularly near to the fell road, but as these are ruler-straight and respect the field boundaries, it is thought that they are fairly recent attempts at improvement (Figure 44).

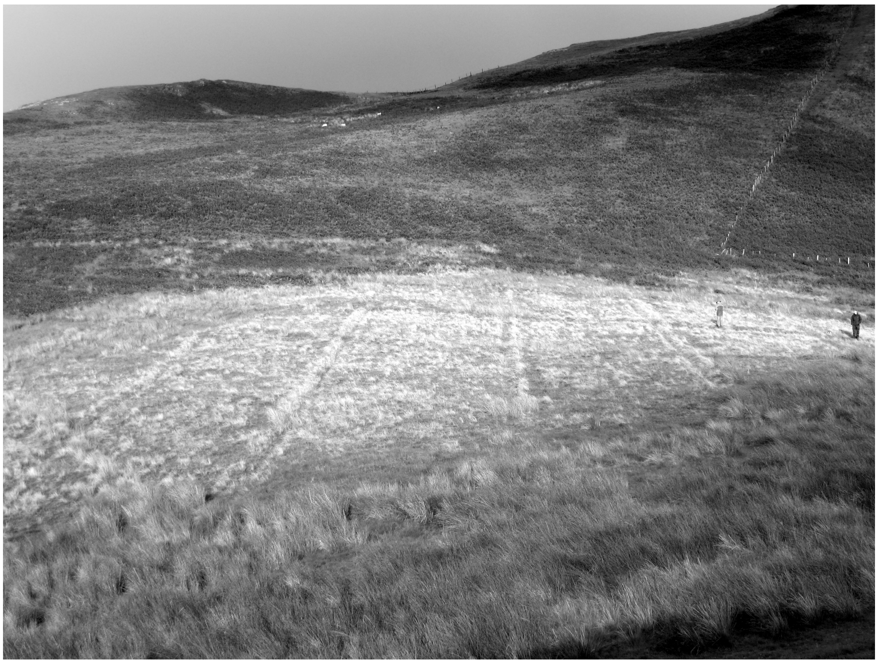

Figure 44: Attempt at draining land on Mosser Fell

Overall, an analysis of the upland fell has revealed a sparse landscape dotted with former quarries. Apart from a relatively small section of land near Fell Side, there is no evidence for division and enclosure of the land beyond the parliamentary enclosure of the mid-nineteenth century. It was not possible to determine the age of the cairns marking the boundary of Mosser, but the possible kerb cairn and line of stone on Fellbarrow could be some of the oldest features on the fell. The lack of sheep management structures is surprising, with archival evidence suggesting that herds were kept beyond the boundaries of the township. If this was the case then a possible explanation could be that the eastern slopes provided more shelter from the weather. With enclosure, the fell was divided into large fields, some of which were then drained – clearly with little success. Field boundaries were demarcated with both walls and metal fencing, but there is little to suggest a pattern for where which was preferred.

Conclusion

Taken together, there is a great deal of data concerning the landscape of Mosser. Interpreting it, however, is problematic for a whole host of reasons. Maps present a comprehensive account of boundary development from 1839 onwards, but the recent history is fairly uninteresting. Aside from the parliamentary enclosures formed after 1864, there has been remarkably little change to the field structure of the landscape. Most significantly, the last 40 years have seen the removal of many boundaries to create larger fields. There had been a number of similar, minor changes prior to this, but the overall picture is one of continuity. The evidence from the boundary survey has quite a different emphasis. Of course, the inferences from maps are observable in the field, as the species-poor hedges and well-built walls in the newly enclosed lands, or as the banks of chopped down hedges and demolished walls of rationalised fields. Loose typologies of hedges and walls indicate a more textured history than that observed in maps, however. While not confirmed, there are hints at features which are particularly old, whether through a piece of overgrown wall or an ancient tree that shows evidence of hedge management. Dating hedges by the variation in species composition is not an exact science, and there are clearly a great range of factors affecting how many species form a particular hedgerow. Nevertheless, supporting to some extent Barnes and Williamson's (2006) findings, there does seem to be a relationship between the age of a hedge and its composition. When species variability is examined, it is possible to highlight candidates for the oldest enclosures and routeways.

This analysis indicates a deep history of enclosure during the medieval and post-medieval periods, which reflects much of what has already been written about the nature and timing of enclosure by historians such as Robert Dilley (1991), Ian Whyte (2003), and Angus Winchester (1987, 2000). One of the oldest and most prominent boundaries in the area is the head-dyke. This was probably established by the end of the seventeenth century, but could be much older. Initially, hedges and walls probably marked the boundaries of routeways and early arable and stock enclosures around newly established farmsteads. From there, a process of piecemeal enclosure first divided the well-drained, better, more accessible lands, before moving on to the higher pastures up to the fell edge, and down into the wet lowlands. This process was likely completed by the end of the eighteenth century, with Fletcher recording the enclosure of the Mosser Moss in 1772–3. In contrast to the piecemeal enclosure of the lowlands, the landscape of the fell is dominated by nineteenth-century parliamentary enclosures. There is evidence for limited amounts of earlier, perhaps even prehistoric, activity up on Fellbarrow, and there are the remains of cultivation beyond the head-dyke near Fell Side's lands. Beyond these features and the small quarries dotted around, there is only sparse evidence for human modification of the upland landscape during the early modern period. Although attempts have been made to drain some of the fell fields, it seems likely that the post-enclosure history is similarly sparse.

The landscape survey has hinted at two ways in which human activity was influenced by the environment: firstly, the predominance of walls on higher ground perhaps reflects the need for solid structures in places where wind and weather could quickly destroy hedgerows. Their continued usage is in part due to the need for shelter for livestock in the exposed hillside, where the weather blows in directly from the coast. Secondly, in the past, the desire for shelter could have led the inhabitants of Mosser to site their sheep heafs on the east side of the fell, out of the westerly winds, but in an area where they had no grazing rights. In the following chapter, these findings from the landscape survey are put in to the context of a more thematic analysis of Mosser during the eighteenth century.

Chapter 9: Landscape Narrative III – Mosser Landscape History

Introduction

The landscape survey can only reveal fragments of how the land in Mosser was owned and used, and how it was transformed over the years. The result is a useful, but very broad outline of landscape development that is not chronological well defined. This chapter continues to construct an independent landscape narrative by combining evidence from field and archival research. The aim is to produce a thematic landscape history of Mosser, centred on the late eighteenth century. The chapter will cover a range of topics, including land ownership, living and working in the landscape, agriculture and landscape change. Inevitably, this analysis will draw upon the two historical diaries as primary sources, yet the emphasis in this chapter will primarily be on characterising the local farming regime and economy. A subsequent chapter will develop an experiential narrative based on Fletcher and Robinson's personal relationships with the land.

Owning the Land

Unusually in eighteenth-century Cumberland, "the farms in Mosser had been enfranchised to their tenants in 1625 and were thus freeholds" (Winchester 1994: xvi). This was an area of the 'yeoman' farmer, where the men "in a broad sense owned the land and the buildings [they] occupied" and often felt secure in their holdings (Marshall 1971: 34). This does not mean that there were no changes in demography and land ownership over the years. The description of Mosser in Mannix and Whellan's (1847) *History, Gazetteer and Directory of Cumberland* records the population in 1841 as 107, by 1881 this had dropped to 76, and by 1931 it was 56 (Great Britain Historical Geographical Information System 2011). Reconstructing earlier demography is problematic, but we can at least say that the farms of Whinnah and Gillbrow, which held lands in 1839, are no longer in existence, their ruins recorded during the field survey. Unfortunately, it is not clear precisely when these farms were abandoned, but prior to the turn of the twentieth century seems likely. The old mill at Mill Dam is also in ruins (Figure 45), but historical notes relating to Aikbank Mill (Wh YDX 159/5/1) suggest a date for its abandonment: “Water Corn Mill at Mosser Mains known as Briscoe Mill & two closes called Swineriggs (perhaps also called Birkrigg) bought by Jonathan Dixon on 7th Dec. 1762. This may be the present Mosser Cottage. Machinery was removed to Aikebank Mill.” The mill at Aikbank could harness a much greater volume of water compared to the Mill Dam site by combining the flow from Mosser Beck and Cat Gill. However, the reference to “the present Mosser Cottage” implies a site within Mosser Mains itself, and so Mill Dam might not be the old Briscoe Mill.

Figure 45: A line of vegetation marks the route of the old mill tailrace. The ruins of Mill Dam can be seen in the background.

One further potential dwelling is marked as 'High Houses' on the Tithe Map, but becomes 'ruins' on the Ordnance Survey 1:2500 first edition, and then disappears on all subsequent maps. It is not clear whether this building was a farm, cattle shed, temporary dwelling, or something else entirely. The field survey recorded a roughly rectilinear arrangement of low earth banks 7m x 11m, with accompanying semi-circular enclosure 10m at the widest part and over 15m long. Field name evidence from the Tithe Map lists adjoining fields as 'Fore Doors', literally meaning land in front of the building's entrance, and 'Scale Croft', suggesting arable land adjoining a hut. In particular, the use of the word 'scale' is indicative of seasonal residences, used when livestock is brought to graze on the fells (Winchester 2000: 90). Such an interpretation implies transhumance of distances over a day's travel, but Winchester (2000: 92) points out that a “key function of many of the huts which were termed 'shield' and 'scale' may well have been to enable milking animals to be herded and tended on open pastures within a couple of miles of the home farm.” The dimensions of the rectilinear feature suggest that this was not a major residence, and the semi-circular enclosure could be indicative of stock management. Without further archaeological investigation, however, interpretation of the building's function remains speculative.

In 1839, there were 12 principal landowners, and 20 primary occupiers (tenants) (Wh YPR 30/4). The vast majority of fields, by this time, appeared to be held in severalty. Five fields – High Mill Rigg, Outfield, Fisher Outfield, Margery Close and Low High Close – were still held jointly, but were all rented by the same person, William Green of High Mosser (Mossergate). The only exception to this is in Low High Close, where the field was shared between William Green and John Alderson of Beech Hill. Reconstruction of ownership further back in time requires detailed examination of the archival sources. With this in mind, Land Tax records for Mosser (Ca QRP/1) were sampled for the years 1768, 1772, 1778, 1783, 1796, 1804, 1817, 1823 and 1829. The rates for land tax changed very little throughout the period, so it is possible to reconstruct how ownership changed over time by examining how individuals' taxes fluctuated. This analysis is a painstaking process that is aided both by Angus Winchester's (1994: 464) excellent topographic notes on Mosser, and Court Leet records from the court at Egremont (Wh D/Lec/247), where the inhabitants of Mosser had to register changes in tenancy (Winchester 1994: xvi).

J.M. Neelson (1996: 331–41) has written about the difficulties in using Land Tax returns for the study of landholding. In particular, the problems in calculating the sum of tax paid per acre often preclude detailed assessments of the structure and size of landholdings based on taxed values. These problems are compounded because not all the tax for land in a parish will be recorded in the returns for that area, and because Court Leet records for transfers of ownership are sometimes incomplete. For example, in Mosser, taxes for the land at Fell Side only start being recorded in 1778, but the Court Leets show Fell Side was in existence in 1768 because it was bought by Henry Allason. Only after Allason's death and a transfer of ownership in c.1774 did the property appear in the tax records. Allason lived outside Mosser, in Seaton, and this possibly accounted for the tax not being recorded in Mosser's returns. An alternative explanation is that the taxes on Fell Side's land were payable by John Robinson in one of the Mosser Mains properties. The rates at Mosser Mains were similar to those at Fell Side, and the property disappears from the records around the same time that Fell Side begins to be recorded. The distinction between these two scenarios is important because, on one hand, Fell Side is acting as a reasonably sized farm throughout the period, on the other, Fell Side is only acting as a small residence, with its lands being farmed by another property. The subsequent transfer of landholding (or perhaps land occupancy) from Mosser Mains to Fell Side would have been one of the largest in the period.

Despite these problems, it is possible in some instances to use the tax returns to track parcels of land as they change hands. That being said, most holdings show a remarkable degree of continuity throughout the period. The farms of Whinnah, Gill Brow, and other properties at Mosser Mains and Mossergate, show little change in terms of size. This mirrored a low turnover of ownership, with properties often transferred down family lines. Overall, 18 holdings were liable for Land Tax in 1768, whereas in 1829, there were 17. It seems the overarching structure of ownership is not radically different at the end of this period compared to the beginning. There is little here to support Wordsworth's assertion that between 1770 and 1820 the number of 'statesmen' with freehold land was halved while the size of such holdings doubled (Bouch and Jones 1961: 237). Nevertheless, there are some examples of fragmentation and consolidation. Three holdings in Mosser Mains were consolidated under one owner in the late 1780s or early 1790s, but not before one of the holdings was split into two and let out after the death of its owner, Jane Burnyeat, in the mid 1770s. Alternatively, one holding at Mossergate fragmented into three after the death of Joseph Fisher, prior to 1796, before being consolidated again into two holdings at some point between 1804 and 1817. Isaac Fletcher was at the centre of many of the changes. As Winchester (1994b: xi) writes: “his financial difficulties forced him to mortgage his Mossergate property in 1764, and Underwood in 1769, and to sell three fields at Underwood in 1769 and the whole of his Mossergate property in 1772”. If we ignore Isaac Fletcher and his personal difficulties, born in no small part by illness, most of the changes in ownership occur from around 1775 to 1805. It is not certain to what extent this is attributable to the overseas wars and poor harvests of this period (Beckett 1990: 65; Whyte 2003: 26).

There can be little doubt that landholdings in Mosser became more consolidated over the course of the late eighteenth and early nineteenth centuries. Eighteen principal landowners in 1768 were reduced to only 12 in 1839, but this is scarcely the halving of ownership described by Wordsworth (Ca QRP/1; Wh YPR 30/4). Indeed, despite a flurry of land sales from 1775 to 1805, the structure of landholding changed very little during the period covered by the Land Tax returns. This implies that landholders were whittled down in the intervening period, prior to the tithe survey and during a time of post-war agricultural depression (Whyte 2003: 27). It should be remembered, however, that two of the major changes, the abandonment of Whinnah and Gillbrow, happened only after 1839. Without data for the first half of the eighteenth century, it is difficult to judge whether Mosser was tied into wider regional processes that show the decline of the small upland farms throughout the eighteenth century (Dilley 1991; Searle 1983). Certainly the tradition of freeholding would have distanced the people of Mosser from any class struggle that might have dominated social relations in the areas controlled by systems of customary tenure. Indeed, the drivers of social transformation – the practice of partible inheritance and the growth of a market economy – as argued by Searle (1983, 1986), would have been unimpeded and perhaps accentuated by the system of freeholding. But although the Land Tax returns do show how inheritance practices can result in the fragmentation of estates prior to subsequent consolidation, overall change from this was limited.

The only real indicator of class conflict concerns the unsuccessful attempt by the inhabitants of Mosser to buy Mosser Common from the Earl of Egremont, but even this cannot be held as an example of the "peasantry's attempts to gain a freehold in the land and set up as a peasant proprietary class" (Searle 1986: 106 summarising Brenner 1976). Dilley (1991: 488) describes the Earl at the time as a "genuine champion of enclosure", and although we do not know why the purchase attempt failed, it is was as likely thwarted by the people of Mosser or Sosgill as it was the landowner. Overall, it is clear that the elements argued by Searle (1986: 109) to demonstrate the resilience of the feudal mode of production in eighteenth-century Cumberland – "large-landed property tied to a small peasant production by relations of extra-economic coercion regulated by custom and law" – had long since been extinguished in Mosser.

Making a Living

In Mosser, the feudal economy probably dissolved in the seventeenth century with the enfranchisement of its tenants. This was an area of the 'yeoman' farmer, where the men “in a broad sense owned the land and the buildings [they] occupied” and often felt secure in their holdings (Marshall 1971: 34). At Isaac Fletcher's farm in the eighteenth century, labour was supplied by two live-in servants, a maid and man, as well as occasional day-labourer help throughout harvest time. Fletcher's diary records a range of other regular tradesmen, including miners, wrights, tailors, wallers, hedgers, drainers, wrights and slaters. Fletcher himself was a legal clerk, merchant and farmer. The impression is that the people of eighteenth-century Cumberland were linked together in large networks of business, friend and family relationships. These were integral to the growing market economy (Searle 1986). Farms were the centres of activity, and the following analysis explores the diverse ways in which they used the land to make a living.

Farm Economies

Using archival sources in combination with Isaac Fletcher's diary, a detailed picture can be constructed of how the individual farms operated during the late eighteenth century. The Mosser arable system can, for example, be compared with the regional assessment contained in the 1801 Crop Return and a range of contemporary observations (Bailey and Culley 1794; Bouch and Jones 1961; Dilley 1991; Hutchinson 1794). Consistent in these sources is the emphasis on oats as the main grain crop, followed by barley, with wheat considered a rarity. The Parshaw Monthly Meeting Sufferings Book (Wh YDFCF/1/116) records taxation through tithe during the latter part of the eighteenth century, when Quakers maintained a strong presence in Mosser. The Quakers refused to pay church taxes to what they regarded as the false church, so every year they were convicted and ordered to pay the original tithe plus an associated court fee (Dandelion 2007). Debt collectors were allocated to 'farm' the debt, and this resulted in bailiffs forcibly removing farm products to the value of the amount owed. The sufferings record this process, and often contain valuable information on crop taxation that can surpass the detail of the tithe records themselves. This is because the Quakers not only noted the monetary value of the tax, but also the quantity of each grain product taken. Because the tax on grain was paid in kind, and because the tax was the same for each type of grain (approximately one tenth of total produce), this data can be used to reconstruct the changing crop balance over time. Difficulties arise when attempts are made to compare tithe data across wide areas, but such records are a valuable source of information for individual farms or localities (see Dodds 2007 for a detailed analysis of the pitfalls of using tithe data). Unfortunately (for these purposes), the people of Mosser were exempt from paying a tax on grain, but the Sufferings Book does record the small tithe – a tax on secondary products that will be discussed later in the chapter.

Without data from Mosser itself, the sufferings of Elihu Robinson – the second eighteenth-century diarist, living in Eaglesfield, 3km north-west of Mosser – can be used instead as a guide to agricultural activity at this time. With data recorded from 1761 to 1792, it is clear that oats do indeed dominate production at this farm. Only in 1787 were they not the most taxed crop, when only 8 shocks[3] were taken in payment, compared to 10 shocks of barley and 47 shocks of wheat. For the most part, however, oats accounted for between 50% and 90% of the quantity of grain crop taken, with a mean over the period of 63%. Perhaps surprisingly, wheat was the second most taxed crop at the beginning of the period, but barley had taken over that role by 1771. Nevertheless, wheat continued to be favoured occasionally, with more wheat taken in 1774, 1782, 1784, 1787 and 1792. No wheat was taken in 8 of the 32 years. Conversely, no barley was taken in 3 years at the beginning of the period. The average proportion of wheat taken was 15%, compared with 17% for barley. These figures compare well with the proportions recorded in the 1801 Crop Return for (55% oats, 18% barley, 10% wheat). The slightly greater emphasis on wheat at the expense of oats is probably a result of Eaglesfield's lowland location. Of course, this source only accounts for the grain crops, there is no detailed information on the quantities of root and other crops that Robinson might have farmed. And because the tithe is a tax on grain produced, rather than sown, the figures may not reflect Robinson's intentions. There could have been years, for example, when the barley crop was ruined and the wheat very successful.

3 Shock: “a number of sheaves of corn, often twelve” (Winchester 1994: 457).

Information about the arable regime within Mosser comes exclusively from Isaac Fletcher's diary. Angus Winchester (1994: xvii) summarises: “the diary records a rotation which began by ploughing the ley for oats. The following year the ground was manured before being sown with barley and/or planted with potatoes. A crop of wheat was taken in the third year, followed by one or more grain crops before the ground was put down to grass again.” Winchester has drawn figures for corn sown and harvested out of the diary's text. Where there are quantities for both oats and barley, on average, 70% of the harvest is of oats, compared to 27% barley. 1761 is the only year where the yield for all three crops is recorded, with oats making up 60% of the harvest, barley 28% and wheat 12%. Although wheat is under-represented in Winchester's table, the preference for barley over wheat seems clear. Wheat was sown frequently as a winter crop, especially towards the latter end of the diary's record. The sowing of rye was recorded only once, again as a winter crop. Only one non-grain crop is recorded, and that is potato. There is no mention of turnips, despite Bouch and Jones' (1961: 226) claim that they were introduced to Cumberland around 1750. These findings show that, in Mosser, the crop regime of Isaac Fletcher is broadly reflected in contemporary observations. Perhaps surprising, however, is the prevalence of winter-sown wheat, although this does seem only to be a minor crop.

The existence of the 1773 and 1775 Mosser tithe assessments (Ca D/Ben/1/372) – official calculations of tax liability – makes livestock numbers a little easier to reconstruct. These record numbers of livestock held by each taxable owner, as well an assessment of the tithe value and prescriptions. In 1775, 25 people were assessed for tithes, and 16 of these owned sheep flocks ranging from 18 to 100 sheep and 5 to 30 lambs. Amongst the sheep owners, the mean number of sheep owned was 55, and the mean number of lambs 19. Isaac Fletcher had 48 sheep and 18 lambs. Only three farms owners had more than 100 sheep, and the combined Mosser flock was 1189. Supporting the assumption that sheep were the principal livestock, numbers for cattle were much less. Seventeen people owned cows or calves, with both cow and calf herds ranging from 3 to 14. Amongst cattle owners, the mean herd size was around 6 cows, and 5 calves. Only one person had more than 10 cows, and the combined Mosser herd was 177. “Between 1776 and 1778 Fletcher kept a bull from which he received an income for serving cows on neighbouring farms: there were over 60 bullings in 1777 and 114 in

1778" (Winchester 1994: xviii). Fletcher further extended the value of his livestock by producing cheese on the farm. Pigs are not mentioned in the tithe assessment. Judging by Fletcher's diary, these were not particularly significant: "Fletcher appears to have fattened only a single pig each year to 1765 but kept two thereafter" (Winchester 1994: xviii).

The tithe assessment also records foals (but not horses) owned by two people, bee hives owned by one person, flocks of geese ranging from 15 to 30 birds owned by 5 people, and every residence appears to have owned a quantity of hens. It is not certain whether these figures are wholly accurate, and there are hints that they are not. For example, of the 16 sheep owners, none owned an odd number of sheep, and only two owned an odd number of lambs. Nevertheless, as an official document calculating taxation, we can be reasonably sure that it at least provides a good approximation of livestock numbers. The results again support the claims of the secondary sources in that sheep dominate the livestock holdings, but there is no evidence for whether cattle farming was more profitable, as was suggested by Dilley (1991) and Bailey and Culley (1794). Overall, the picture is one of mixed farms with a diverse range of products. Of course, the histories of Cumberland commonly emphasise the primacy of pastoralism, but it is difficult to judge the relative importance of livestock simply using the diary and tithe assessments (Bouch and Jones 1961; Dilley 1991; Marshall 1971; Whyte 2003; Winchester 2000). Moreover, a longer term perspective might provide an indication of whether that importance changed through time.

Garden Economies

In Fletcher's case, farm produce was well-supported by fruit and vegetables grown in his orchard and garden, and there is no reason why this could not have been the case at other residences: the Tithe Map records 28 gardens or orchards, with 12 of the 20 occupiers owning one or more of either (Wh YPR 30/4). Fletcher's garden produce ranged from cabbage and cauliflower to carrot and peas. Interestingly, it also consisted of turnips, showing that the root crop was known of, even if it was not farmed on a larger scale. Winchester (1994: xviii) also notes the planting of "strawberry plants and cherry, apple, pear, plum, and walnut trees in 1760 and 1761." The local market at

Cockermouth was important for the buying and selling of livestock and produce throughout the span of the diary, although Fletcher did also make regular trips to the fair at Carlisle. In the 1770s, the urban markets of Whitehaven and Workington were also becoming important, with Fletcher sending cheese, butter, cherries, plums and tomatoes to be sold (Winchester 1994: xviii). At the end of the 1790s, the servants undertook this task on an almost weekly basis, but it is not clear whether this demonstrates the increasing role of the urban markets in general, or simply a diversification of the Fletcher household economy as age and infirmity inhibited his involvement in farming.

Industry and Transport

The water mill at Aikbank and another former mill site at Mill Dam would have been the centre of the farming community, probably only supplying milling services to the local population. Other aspects of the Mosser economy include the quarrying of stone, primarily for building houses and barns, but also for walls. The upland and lowland surveys revealed a wide range of quarrying sites both on the fell, in what would have been common land, and on the private, enclosed lands. After the fell was enclosed, one site adjoining the former Gillbrow lands remained in public hands. Just outside the township, at Pardshaw Crags, Isaac Fletcher built a lime kiln, which “appears to have produced a regular supply of lime for his own use and for sale locally” (Winchester 1994: xix). Winchester speculates that this may have made Fletcher a local leader in the application of lime in land improvement, but we cannot be sure if this amounted to the “abuse of lime” that Bailey and Culley (1794: 30) observed when producing their report. In terms of fuel, peat and coal are mentioned throughout the diary. Certainly coal was used in the lime kiln, but whether it was a household fuel at the beginning of the diary's record is unclear. Anecdotally, at least, peat does seem to be mentioned less towards the end of the period, and this could represent its decline as a primary fuel, but three 'stack yards' – places for drying peat – were recorded on the 1839 Tithe Map. Wood was certainly used as a fuel, as well as for construction and hedging. The Tithe Map records 50 blocks of land containing either wood or plantation, amounting to 5% of the surveyed land area.

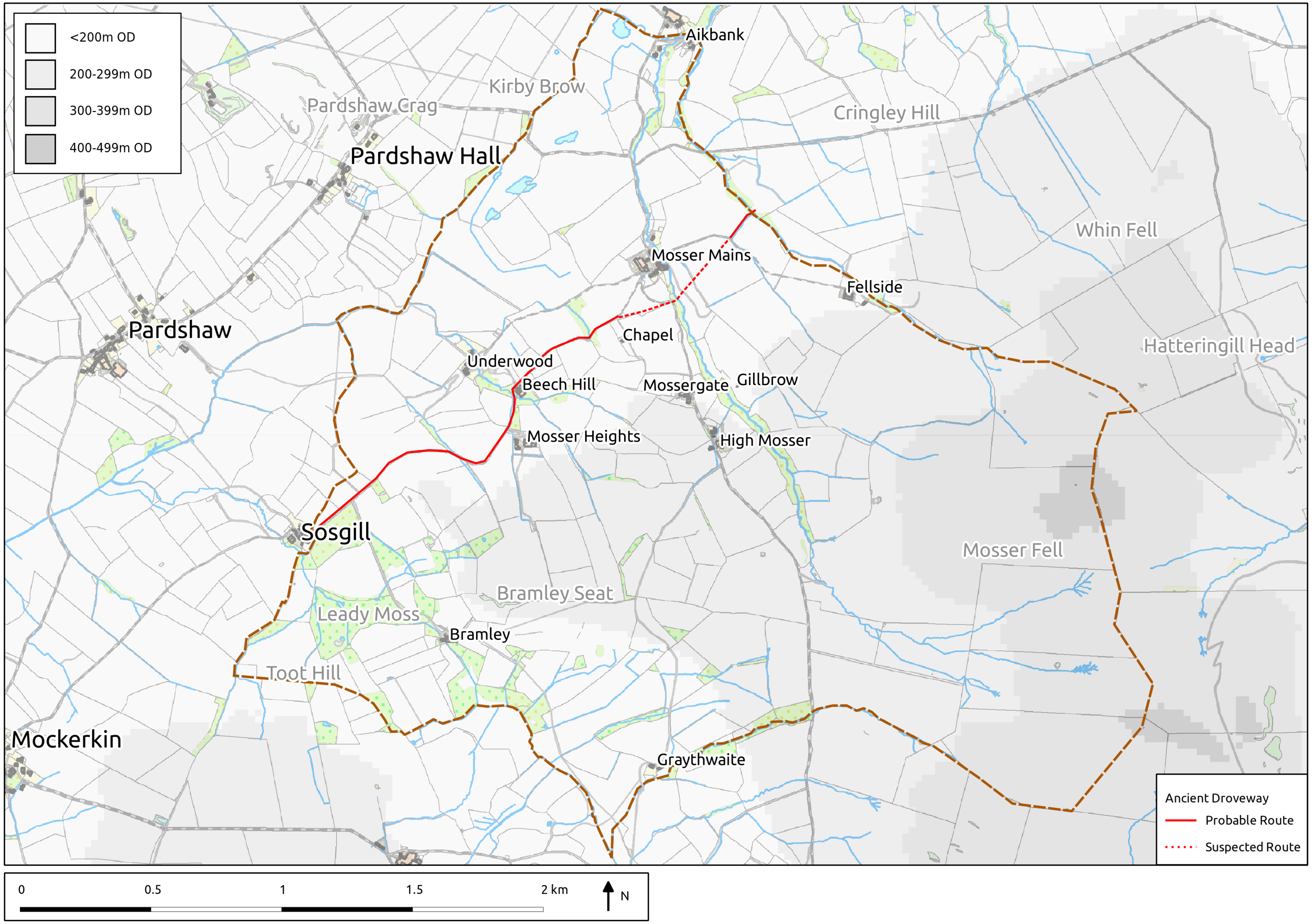

Figure 46: Possible route of an ancient droveway, according to historical notes on the Dixon Estate (Wh YDX 159/5/1) and investigations in the field. Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

Other attempts at industry include Fletcher's efforts to find lead, but “the diary makes little mention of any work revealing ore minerals and there is no suggestion of anything saleable being mined” (Young in Winchester 1994: 483). The Historic Environment Record notes the remains of a lead level in Leady Moss, but there is very little information about this. At the northern tip of Mosser, there is the site of a former tile kiln. Described as the 'old kiln' on the OS first edition maps, it is not certain when the site was in operation. Similarly, the HER notes a bloomery near Whittern Gill as it heads under the fell road, again of unknown date. Outside of Mosser, Isaac Fletcher had a diverse mix of business interests, ranging from law and teaching to textiles and mining. How typical this was amongst the rest of Mosser's inhabitants is hard to say. Winchester's (1994: xxiv) opinion is that “the diary demonstrates … the involvement of the lesser fry, including yeoman like Fletcher himself, in attempts to establish new commercial and industrial enterprises.” However, this has to be “viewed in the context of unrealised expectations” as the rapid economic growth experienced in Cumberland began to falter towards the end of the eighteenth century.

The drove trade is one aspect of the regional economy that remains absent in this analysis. John Jackson, a travelling cattle buyer, is mentioned in Fletcher's diary, but there is no discussion of a burgeoning trade in sheep and cattle being driven down from Scotland, and this is despite Marshall's (1971: 82) map, which shows a major drove road running directly through Mosser. It is possible this was an earlier route, and this is supported by a short note written in historical notes pertaining to Aikbank Mill (Wh YDX 159/5/1):

> The road past Toddell was part of the ancient road to Egremont (called the King's Highway). From Toddell up the road to Yeat Ends (the gate leading into the croft belonging to the Wood Farm). The road was very narrow and only wide enough to a single cart to pass along at a time, the old road diverged from the present one at Yeat Ends & went up through the croft belonging to the Wood Farm, past the oak trees still remaining in the middle of the field (which formed part of the roadside hedge) & along the eastern side of the High Toft (where a portion of the road still remains) then across to Gillcroft where the road crossed the end of the wood & from there to Catgill. A portion of the road still plainly to be seen at the south end of Catgill Wood; here it crossed Catgill Beck & up through a small plantation on the other side of the beck belonging to John Dodgson of Mosser Mains, then it crossed the road leading Mosser to Fellside, & crossed Mosser Beck

> above Low Mosser & out the gate on the present road between Low & High Mosser; then straight up along the south hedge of the 'Banks' under Mosser Chapel then past Beech Hill & Sosgill to Egremont. The road between Toddell & Yeat Ends was widened about the time my father was born (W.W.D). Written by W.F.D.

Despite the detailed explanation, locating the route of a road is a difficult process, although there are hints within the landscape. The overgrown wall and hollow way near Cat Gill, for example, almost certainly denote the “small plantation” where the road enters the township. The route of the road is then lost as it crosses Mosser Beck, but it can be picked up again as it moves along the “south hedge of the 'Banks'” (Figure 46). Here, a large, laid sycamore is indicative of a particularly old hedgerow, but there is no sign of a levelled roadway near the boundary. Assuming the above description is correct, the ancient road probably joins the route of the current road near where the path heads up to the chapel. The field survey found sections of ruined wall along this road that look particularly old, and this lends weight to this aspect of the described route. Of course, this is only anecdotal evidence, and no other historical sources that describe the presence of an important roadway in this area. It is, therefore, still unclear if there was ever a major drove route through Mosser. Nevertheless, transport links were certainly important during the eighteenth century: Fletcher made numerous road journeys to London in his capacity as a senior Quaker, as well as business trips to Scotland, Ireland, Bristol and Manchester, often by ship. The diary records references to road mending, and from 1768 onwards men and equipment were often sent to work on the highways for a few days in June. In 1769, this was described as “statute work”, suggesting that it was required by law.

Summary

The economy of Mosser was, of course, dominated by farming. Evidence for the latter half of the eighteenth century compares well with contemporary and secondary sources that describe the farming regime. In terms of crops, oats were predominant, with barley and winter-sown wheat playing a lesser role. Wheat was more important on Elihu Robinson's farm than it was on Isaac Fletcher's, but this could reflect Robinson's lowland location. Sheep were the most numerous livestock, but cattle were also farmed, with Isaac Fletcher's list of 'bullings' implying an emphasis on breeding. The farms were supported by garden and orchard produce, which ensured a good supply of fruits, vegetables and nuts. The most important locally sourced construction materials were wood and stone, with the Tithe Map and surveys locating a number of woods, plantations and quarries. It is uncertain what fuel was the most important, but peat, coal and wood are all mentioned in Fletcher's diary. Aside from the workings at Leady Moss, for which there is little information, attempts at locating a profitable lead source were unsuccessful. The thriving market economy is demonstrated in a range of gentlemanly business interests that reflected the regional growth of the textile and mining industries, as well as the proximity to the busy West Cumberland ports. These wider interests required travelling around, and it is possible that this reflects a rapidly improving transport network that connected Mosser with the South, Scotland, Ireland and North America. There is very little evidence in the late eighteenth century for the prolific drover trade described by Marshall (1971), although there is mention in the archives of an old, major routeway that is tentatively supported by evidence in the landscape.

The Importance of Crops

Thus far, the evidence suggests that the Mosser economy was dependent on mixed farming, supported by household and garden produce, as well as outside mercantile business interests. It is unclear which of these was most important: livestock or crop farming. Historians typically emphasise the pastoral component of farming (Bouch and Jones 1961; Dilley 1991; Marshall 1971; Searle 1983), but is this supported by the evidence from Mosser? There are a variety different sources that be can utilised for exploring this question.

The Tithe Map contains a wealth of information relating to each field, including what the fields were being used for in the early to mid nineteenth century (Wh YPR 30/4). This was an important consideration when the new rent-charge was being apportioned because some land uses were more profitable than others. Kain and Prince (2000: 24) write that regularly ploughed and cropped land was worth about one-fifth of the value of the rent, while permanent grassland only one-eighth the value. There were, of course, many regional variations and local idiosyncrasies, but when “there was no way of assessing the probability of lands being converted to other uses … the only alternative to rating all lands alike was to differentiate them on the basis of their observed state of cultivation" (Kain and Prince 2000: 23). A number of different terms of land use classification were used in the tithe surveys, but the ones most common in Mosser were 'arable', 'meadow' (mowed for hay) and 'pasture' (used purely for grazing). 83% of all fields with usages marked are labelled in this way. Interestingly, the majority of categorised enclosures (68%) fall within the arable category, and this accounts for 329ha or 82% of the 401ha of enclosed lands (Figure 47). Not all fields containing arable were wholly cultivated – there are many instances of fields with mixed usage recorded in the tithe survey. Of the 186 fields with arable usage, only 132 were solely arable, accounting for 48% of the total enclosed area, and it should not be forgotten that the large area of fell and common land that was almost certainly used exclusively for grazing. Despite these caveats, there is, nonetheless, clearly a disparity between the Tithe Map where arable land predominates and the historical accounts emphasising the primacy of livestock.

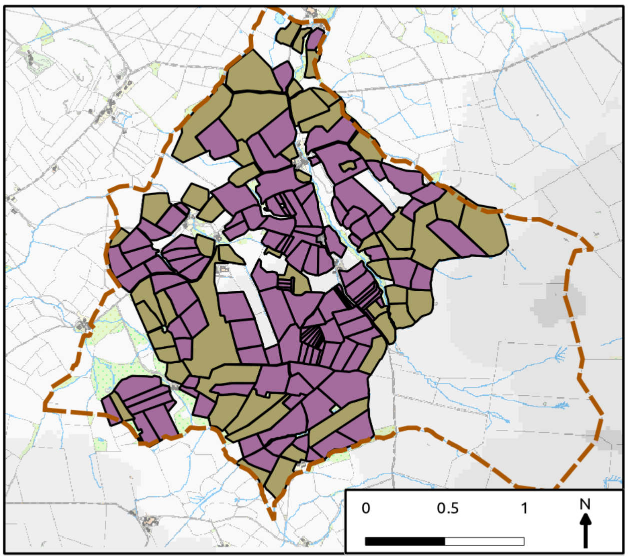

Figure 47: Arable in Mosser according to the 1839 Tithe Map (Wh YPR 30/4). Fields with only arable (purple), fields with mixed arable and pasture/meadow (beige). Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

To explore this problem further, data from the field survey can be used to identify which fields might have been cultivated in the past, based on the evidence of lynchets, ridge and furrow, and modern day ploughing. Even counting those identified with the lowest degree of confidence, the coverage of suspected arable fields is far less (23% of the enclosed lands) than on the Tithe Map, and it is not certain that these were cultivated at the same time (Figure 48). Alternatively, further map-based sources of information come from two estate maps for sales of land in 1901 (Wh YDX 384/11) and 1907 (Wh D/Cu 5/277m). Like the Tithe Map, each field was categorised according to land use. There are stark differences when these are compared to the earlier map. In 1839, 113ha of the 136ha area comprising the combined estates was defined as arable, compared to 40ha (or 29% of the combined estates) in the 1900s (Figure 49). There was a concomitant rise in the area defined as pasture or meadow, from 64ha to 94ha, over the same period. Such a large change in land use seems rather improbable, especially as the 29% figure compares well with the 23% of past arable land identified as a result of the field survey.

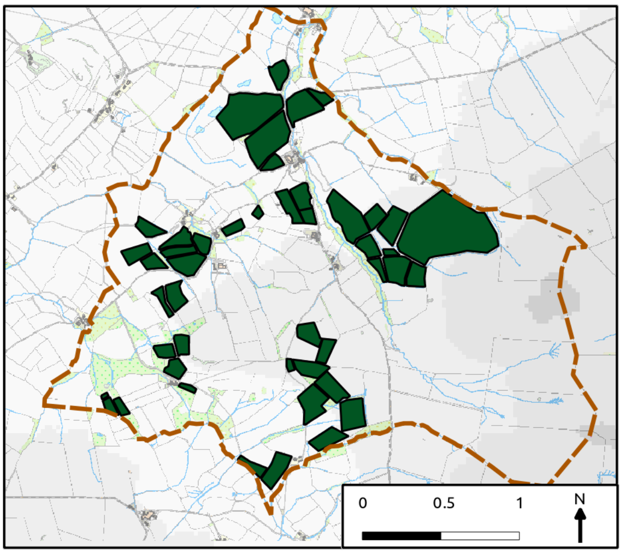

Figure 48: Fields identified during the landscape survey as showing signs of arable cultivation. Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

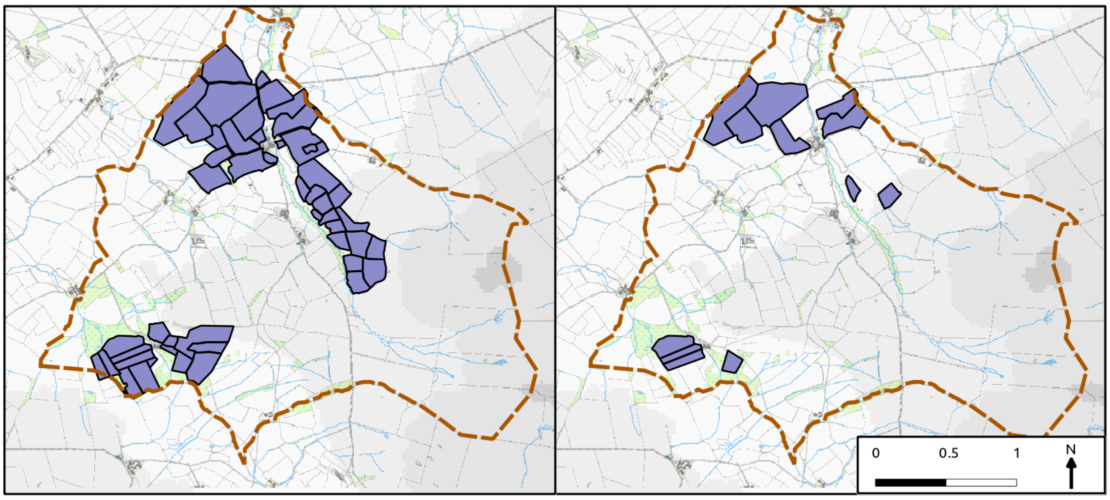

Figure 49:Arable on two estates in 1839 (left) and early 1900s (right). Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

One explanation for the high proportion of arable fields recorded in the tithe survey may lie in the knowledge that "in the west of England and Wales, 'arable' appears also to have included all ley grasses" (Kain and Prince 2000: 24). Ley grasses are fields that have been left fallow during the crop rotation. We saw previously that farmers in eighteenth-century Cumberland favoured long rotations, with the "barbarous and unprofitable system of taking two or more white (cereal) crops in succession" (Houseman in Hutchinson 1794; Bailey and Culley 1794). This practice can be confirmed using evidence from Isaac Fletcher's diary for his farm at Underwood (Winchester 1994). By collating entries regarding farming, it is possible to construct biographies of how each field was used. These reveal practices that seem to vary markedly depending on the fertility of the fields (Winchester 1994: xvii). For example, three important arable fields – Croft, Corn Close, and Middle Close – are cropped four or five years in a row, while others only one or two. Ley periods also vary, with the important fields left for four to seven years, while others, such as the Whinneys, are left for up to 11 years. So although crop cultivation may have focussed primarily on only a select few fields on each farm, there was a practice of cropping many fields with long ley periods. If this practice extended into the 1830s, it could account for the widespread coverage of arable fields on the Tithe Map.

Agricultural Change throughout the Eighteenth Century

The notion of a change in farming practices cannot be discounted entirely. There are several more sources of evidence that can be looked at. The Pardshaw Monthly Meeting Sufferings Book (Wh DFCF/1/116), for example, not only records the tax on grain, or great tithe, but also another 'small tithe'. Tithe practices varied across different areas, but in Mosser this seems to have been a tax on livestock (Kain and Prince 2000: 3–5). Here, the sufferings book records the 'value' of the goods taken from each Quaker household, which appears to equal the amount of debt needing to be 'recovered' plus the court 'costs', a tax on land, and the labour costs of the bailiff. Reconstructing production from the small tithe is more complicated than using the great tithe: the products taken in payment of the small tithe were not necessarily the same products that were being taxed. Furthermore, because there are a number of different elements comprising the 'value' of the tithe that might not be fixed, that figure cannot be used as a direct proxy for productivity. Farm fortunes are also inextricably tied to the health of their owners and the time that they're willing to invest in farming, making it difficult to link changes in productivity to overarching external influences, such as climate change or macroeconomics. Taxed values at Isaac Fletcher's farm, for example, increase throughout the 1750s and 60s, reaching their peak in the 1770s when he was most focussed on his farm, instead of his legal work, but production is clearly low in 1769, when his diary shows he suffered from a serious illness (Figure 50). Similarly, production declines in the last few years before 1781, when Fletcher's health begins to fail.

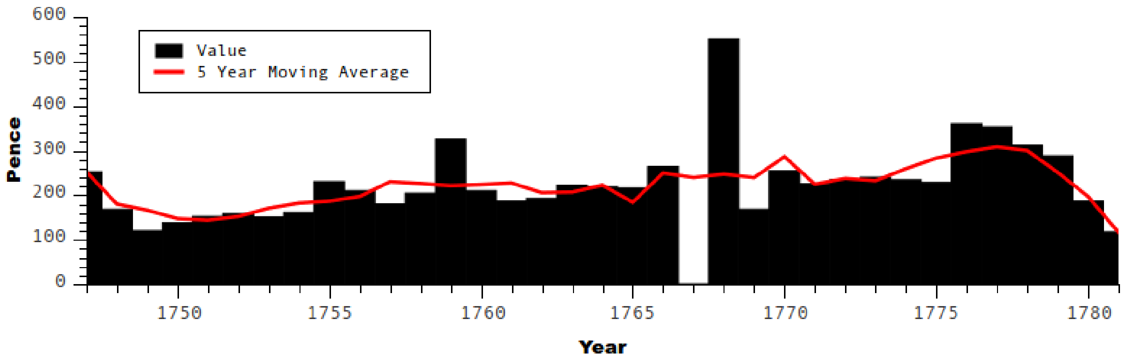

Figure 50: The yearly value of the small tithe, as recorded by Isaac Fletcher in the Pardshaw Monthly Meeting Sufferings Book (Wh DFCF/1/116).

Despite these problems, some useful economic data can be extracted from the small tithe sufferings. In particular, using a selection of the bigger farm holdings, it is possible to chart how the types of product taken in payment varied over time. In Mosser, this becomes difficult after 1775, when the number of suitable Quaker farms to compare falls to two, but prior to that the types of products taken varied markedly. There is a clear trend away from crop produce, such as malt barley, oats and wheat, towards cheese and sheep. If dairy and animals are combined in a single 'animal products' group, then the change is even more pronounced (Figure 51). In 1747, nearly 90% of products taken in payment for the tithe were listed as crops, by 1775 this had dropped to under 40%. More startlingly, in 1772 no crop products were taken for the tithe at all. There is a danger of over-interpreting this data. The products taken in payment may bear no relation to the things that were actually produced and taxed. Indeed, it is quite possible that this changing emphasis from crop to animal products was as much a function of what the farmers were willing to give, and what the bailiffs were willing to take, as it was a reflection of changing farming practices. Nevertheless, we saw earlier that historians have calculated that livestock numbers perhaps doubled over the course of the eighteenth century in response to increasing urban demand, particularly for dairy products (Dilley 1991; Searle 1983). With this in mind, it seems probable that the trend recorded in the Quaker sufferings book is evidence of this process impacting upon the local population.

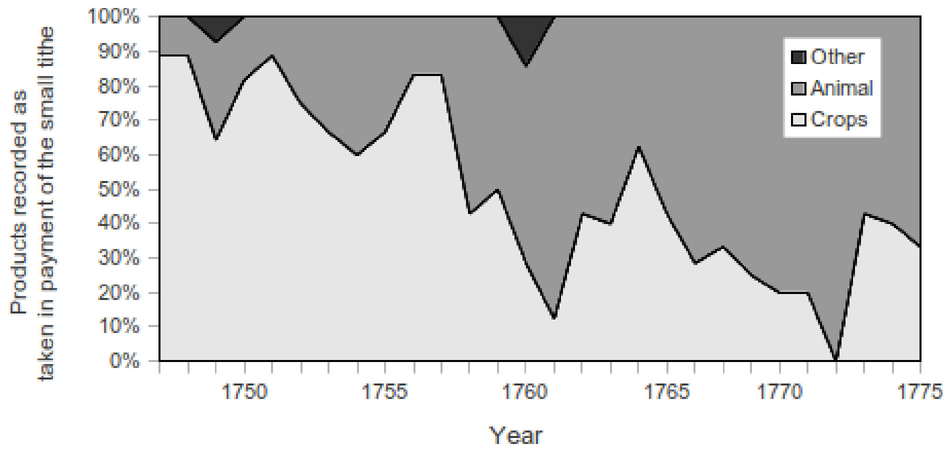

Figure 51: The changing proportions of different product types taken in payment of the small tithe.

Problematically, Isaac Fletcher's diary provides no direct support to this interpretation: discussion centres more on crop farming than on livestock, and Angus Winchester (1994: xvii) notes that “how many cattle he owns at one time is almost impossible to ascertain”. Although Winchester manages to reconstruct some of Fletcher's purchases and sales of stock, it is difficult to draw an overall trend from the data. Certainly Fletcher is selling more calves in the 1770s than he is in the 1750s, but that is not in itself indicative of a radical rebalancing of farming towards livestock breeding.

Usefully, fluctuations in livestock numbers can be observed over a short period using the assessment of Mosser tithes from 1773 and 1775 (Ca D/Ben/1/372). Across a selection of farms recorded in both years, the assessment shows around a 20% increase in sheep and lambs, a 7% increase in cows, and a 38% increase in calves (Figure 52). With so little evidence about the context of the assessment and changing fortunes in individual farms, it is difficult to judge whether this is a reliable indication of a long-term increase livestock production. This evidence is not, therefore, an unambiguous confirmation that that there was an increased reliance on livestock from the late 1740s onwards, but it is perhaps a hint in that direction.

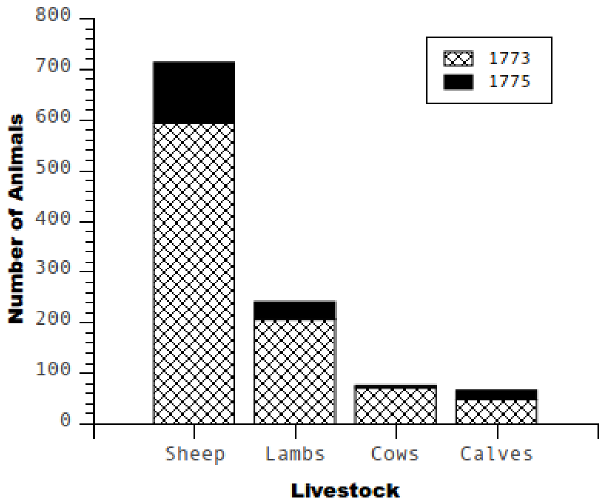

Figure 52: Chart showing the increase in livestock numbers in Mosser 1773-1775 according to Mosser tithe assessments (Ca D/Ben/1/372) .

Figure 53: Ridge and furrow extending up the steep slope to the head-dyke above Fell Side.

Profiting from War

One final indication of how land was utilised for farming comes from Elihu Robinson's diary. In 1801, Robinson comments that there was "perhaps ye most [ground] in tillage within memory". For two years prior to the entry, the people of Britain had suffered extraordinarily high food prices as war with France starved the country of grain imports. Ian Whyte (2003: 26) emphasises the importance of these years for farmers in Westmorland, who remembered it as the 'Bonneyparte Time', and ploughed up thousands of acres of land to take advantage of the high prices. As a consequence, historians have often highlighted the role of increased crop farming in the passing of the Enclosure Act of 1801, and the subsequent flurry of enclosures (Bouch and Jones 1961: 222). During the field survey, ridge and furrow was observed on the steep slopes leading right up to the head-dyke bordering the fell, as well as in one small area beyond (Figure 53). Of course, it is impossible to be sure, but it seems likely that these relict features date back to this period, when arable profitability was at its highest. Certainly, the time and effort required to plough these steep slopes would appear to necessitate the prior knowledge that a good return could be made.

Summary

The secondary sources are all but unanimous in highlighting the primacy of livestock in the upland farms of the Lake District. The 1839 Tithe Map, however, suggests a much greater role for crop cultivation at the time of its survey, and Isaac Fletcher comments far more on growing crops than he does raising livestock. Despite this, the field survey and a range of other archival sources, including Isaac Fletcher's diary, indicate that less than a quarter of the enclosed lowlands were cropped at any one time. This need not always have been the case, but it does support that idea that ley grasses inflated the figures for arable in the tithe survey. The Quaker sufferings book presents a different perspective, allowing us to tentatively reconstruct productivity across a range of farms in Mosser during the late eighteenth century. The types of product taken in payment of the small tithe display a definite trend towards animal products from 1747 to 1775. Tithe assessments from 1773 and 1775 also show an increase in livestock. Whether this is a true reflection of an increased emphasis on pastoralism is still in question, but it does seem to support the historical narrative of greater demand for animal products from the growing eighteenth-century urban centres. Finally, although evidence from the field is unsuitable for directly inferring land use at particular points in the past, it is clear that at some time crop cultivation was deemed so important that the farmer at Fell Side ploughed up the steep slope to the head-dyke. Elihu Robinson's comment is revealing, in that it shows that farms in the region were able to expand crop cultivation at the beginning of the nineteenth century. It follows, therefore, that the balance between crop and livestock farming was not fixed at a certain ratio, but changed over time in response to changing political and economic circumstances.

Conclusions

Historians of eighteenth and nineteenth-century Cumberland have described the county's agricultural practices as “distinctly backward” (Dilley 1991: 224), and yet the area was tied into national trends of rapid industrialisation, increasing population and an improving transport and communications network. Debate has centred on Cumberland's tradition of customary tenancy, and how this relict feudal society was eroded with the rise of a market economy and the drift of smaller landholdings into fewer, larger farms. As a result, the process of enclosure and the decline of common rights is seen to be the manifestation of a range of inter-related social, economic and political processes. Despite these changes, however, Ian Whyte has argued that the social fabric of rural Cumberland remained in-tact. In this chapter, a range of primary sources were examined to evaluate this wider historical narrative in the context of Mosser. In particular, research has centred on the relationship between people and the land: how they owned it, made a living from it, and structured it to their needs.

The results show that Mosser contained a community of yeoman farmers that were enfranchised in the seventeenth century. This tradition of freeholding distanced the people of Mosser from the class struggle described by some historians as characterising social relations in early modern Cumberland (Brenner 1976; Tawney 1912). It also means that the feudal mode of production had been extinguished in Mosser well prior to the eighteenth century. As such, it is difficult to tie Mosser in with Searle's analysis that the market economy was gradually eroding the pre-existing class structure. The wider trend of landholdings becoming more concentrated is evidenced in Mosser, but from 1768 to 1829, the overall pattern of landholding changed very little, despite some fragmentation and consolidation observed across a couple of the estates.

The people of eighteenth-century Mosser relied on a mixed farming economy that was supplemented by garden produce as well as wider mercantile business interests. The markets at Cockermouth, Whitehaven and Wigton provided an outlet for surplus, and links to southern England, Scotland, Ireland and North America can be seen as good evidence for an improving transport and communications network. Mosser was by no means isolated from the rest of the country. Nevertheless, descriptions of Fletcher's cropping regime, which was dominated by long rotations, do little to counter the notion that agricultural innovation in Cumberland lagged behind the rest of the country. In terms of livestock, sheep dominated but cattle were farmed, and a range of other livestock were also kept. It is difficult to gauge the relative importance of each type of animal in terms of profitability. Investigations suggest that less than a quarter of the enclosed lowlands were cropped at any one time, and that recording practices inflated the figure for arable in the tithe survey. An analysis of the Mosser Quakers' sufferings showed animal products appearing to become increasingly important from 1747 to 1775, and tithe assessments from 1773 and 1775 also show an increase in livestock. Although these sources are not wholly reliable, the results do support the claim that there was greater demand for animal products from the growing eighteenth-century urban centres.

Overall, this detailed examination of Mosser does broadly fit with the descriptions of Cumberland produced by historians and contemporary commentators, although there are some contradictions. The late eighteenth century clearly saw a number of wide-ranging social and economic changes, but although farm holdings did become more consolidated in the early nineteenth century, Ian Whyte's claim that social fabric remained broadly unchanged seems to hold true. Interestingly, however, the fact that Mosser was tied into a growing market economy meant that land use was responsive to political and economic change that extended far beyond the borders of Cumberland. The location of Mosser on the foothills of the fells, with its mixed farming regime, means that this change is probably most clearly expressed in the changing balance between crop and livestock farming.

The Landscape Narrative

In response to claims that landscapes are the material manifestation of human-environment relations, these past three chapters have aimed to produce a landscape narrative for Mosser that characterises how the landscape was transformed during the eighteenth century. Crucially, this narrative has been produced separately from the environmental narrative in order to facilitate an analysis of the strengths and weaknesses of each approach. Of course, central to this evaluation will be the questions of how and whether the narratives shed light on people's interactions with climate and weather.

Although there are some slight hints of prehistoric activity on the fell, and place names suggest early medieval origins for many of the settlements in the area, the narrative starts in the twelfth or thirteenth century with a charter granting Adam of Mosser land rights within Mosser. At this time, Bramley Seat was probably already a site for seasonal stock grazing, but at some point, probably between the fourteenth and sixteenth centuries, a more permanent mark was made in the landscape with the construction of the large head-dyke boundary wall and ditch along the edge of the fell. Down-slope from this, individual farmsteads were established, and these undertook the first enclosures of nearby fields. The routeways between farms and settlements were probably also subject to early boundary marking, and it is possible that the road to Sosgill was one of the major droveways to Egremont. By 1700, the head-dyke would have lost much of its importance as the dividing line between communal upland grazing and the more regulated arable and meadow lands. Much of the cleared, well-drained land with good soils would have already been enclosed this time. However, enclosure of the pastures and wetlands continued well into the eighteenth century. Unlike elsewhere in Cumbria, this process had very little to do with the decline of customary tenancies, as the land owners of Mosser were freeholders. Instead, the process was more likely a result of rationalising existing arrangements and deriving greater profit from the farms.

On the farms, oats were the most important crop, but the degree to which barley was favoured over wheat probably depended on the farm's location: wheat was more important on Elihu Robinson's lowland Eaglesfield farm compared to Fletcher's in Mosser. Contemporary commentators emphasised the rarity of wheat, so it is slightly surprising to see Fletcher cultivating it in the Lakeland foothills. In Mosser, sheep were the most numerous livestock, but a number of other animals were also kept, of which cattle were probably the most significant. Prior to parliamentary enclosure, methods of stock management were unlikely to have changed since the medieval period: during summer livestock were grazed on the communal fell lands – the sheep around their heafs – whereas during winter they were brought down to the meadows and arable fields. Documentary evidence suggests that the farms and gardens afforded the inhabitants a degree of self-sufficiency, but that also the local markets were gaining importance as places to sell produce towards the end of the eighteenth century. Historians describe an increasing demand for meat and dairy products as the Cumbria's urban centres expanded rapidly as a result of mineral wealth and overseas trade. There is evidence that herd sizes grew in the late eighteenth century, perhaps as a result of these pressures. Certainly, the people of Mosser were engaged in the blossoming mercantile economy. Isaac Fletcher had overseas trade interests, initiated a programme of lead prospecting, and set up a lime kiln at Pardshaw Crags. His various travels and personal correspondence show that Mosser was far from isolated from the rest of the country, but there is strong evidence that farming developments lagged behind the rest of the country.

Moving into the nineteenth century, the economic developments on the north-west coastal fringe appeared not to have had a great impact on the social structure within Mosser. Although six landowners were lost in the period 1768-1839, there was not the abandonment observed elsewhere. Where it did occur, it was probably attributable to the period of post-war agricultural depression that decimated rural England in the early nineteenth century. Although inheritance practices have been suggested as a cause of social transformation, there is little evidence from Mosser that implies the impacts from this were major. Nevertheless, it is not certain what caused abandonment of the large farmsteads at Whinnah and Gillbrow, which came some time after 1839.

The parliamentary enclosure of Mosser Fell in 1864 was the culmination of the processes of enclosure that began with boundaries such as the head-dyke in the medieval period. Despite earlier attempts by the inhabitants to buy Mosser's common lands from the Earl of Egremont, the late date of parliamentary enclosure seems to suggest that there was little impetus for change during the early nineteenth century. Nevertheless, the division of the hills into large, regular enclosures perhaps prompted some farmers to attempt land improvements. Aside from the resultant land drains, however, there is little evidence of activity beyond stock grazing and light quarrying on the fell. Since the parliamentary enclosure, there have been few changes to Mosser's landscape. Although the last 40 years have seen a number of changes in land tenure and ownership, as well as significant tree planting, the narrative from the mid-nineteenth century onwards is one of continuity rather than change.

Overall, the landscape narrative describes a slow and steady development over the past six hundred years. Nevertheless, there were undoubtedly a number of significant social and economic changes during the eighteenth and nineteenth centuries, that did make some impact on the landscape. However, despite some hints about practical decisions that may have been made – the prevalence of drystone walls on the higher, more exposed ground, and the location of sheep heafs on the eastern, more sheltered side of the fell – absent from this narrative is an understanding of the environment, and how climate and weather might be implicated in some of the processes of change. For example, Mosser's location in the foothills of the Lake District means that it was suitable for both crop and livestock farming, and there is evidence that the relative importance of each changed over time. The growing urban centres required meat and dairy products in the late eighteenth century, but observations in the field highlight a time when crops were of critical importance – so important that the farmer at Fell Side ploughed up the steep slope to the head-dyke and beyond. It is thought that this reflects the 'Bonneyparte Time' of high cereal prices during the Napoleonic Wars, and it shows that the way in which the landscape was used was very much dependent on changing political and economic circumstances. Tantalisingly, however, it might also be possible to relate the changing crop and livestock balance to changes in climate. The next chapter will investigate these issues by comparing landscape and environmental narratives, exploring the extent to which results from the two studies can be reconciled in a more holistic understanding of past Mosser.

Chapter 10: Comparing Narratives I – Landscape and Environment

Introduction

Previous chapters have explored the history of Mosser from two different perspectives, generating two separate narratives of change. Each narrative was developed from a range of datasets and different kinds of study. In terms of the environmental narrative, existing palaeoecological analyses presented a generalised overview of Cumbria, over a long time-scale that reaches deep into prehistory. In contrast, the eighteenth-century focus facilitated the use of instrumental weather records. These informed a 'retrodictive' model of environmental change that can be tested against the historical reality of landscape change. The landscape narrative first employed a literature review, examining historical writing on eighteenth-century Cumbria in order to get a sense of the main themes and debates. The results from subsequent archival research and archaeological survey then provided a detailed picture of Mosser that could be contextualised in relation to these wider historical themes. Ideally, it should be possible to connect these two narratives and produce a seamless, holistic history of Mosser that takes into account historical, archaeological and environment sources of information. Of course, we have already seen in previous chapters that this is not a simple task. Issues surrounding chronology and causation can result in generalised overviews, where environmental and social explanations for change are considered mutually exclusive. The landscape narrative has helped define a series of trends and processes important to the development of Mosser's landscape and the history of its inhabitants, but is it possible to assess whether climate and weather played a role in these processes?

General Trends

The poor chronological resolution of much of the environmental evidence inhibits detailed comparison with the landscape history. Many of the interpretations are only afforded a low degree of confidence, with authors stressing the qualified nature of their statements. Often the techniques involved in procuring and analysing proxy evidence contain a range of potential sources of error. As a result, statements are more general in character, often providing a contextual background to elements of the landscape narrative. In the case of Mosser, evidence suggests that cereals and sheep farming were present since the early medieval period, and that the landscape was primarily pastoral in nature. Focussing on the eighteenth century, peat records indicate increasing wetness, but Coombes (2003: 271) was not able to link this regional assessment with evidence from the Mockerkin cores. In terms of land use, Coombes (2003) saw a marked shift in the ecology of Mockerkin Tarn, seeming to indicate declining land use intensity during the eighteenth century. Conversely, however, Bennion et al. (2000) noticed a shift in nutrient levels in Loweswater around 1750, which possibly reflected more intensive farming practices in the catchment area.

With confidence in initial interpretations so low, it is not surprising when the evidence appears to be contradictory. Coombes' suggestion that land use intensity was declining throughout the eighteenth century seems particularly doubtful, given that the process of piecemeal enclosure recorded in Isaac Fletcher's diary implies increasing intensity. At other times, a detailed appraisal of contradictory claims can help identify plausible explanations for inconsistencies. For example, while the landscape narrative implied a significant role for arable agriculture, we need not make too much of Coombes' (pers. comm.) claim that Mockerkin Tarn was surrounded by pastoral landscape. Even if the majority of the enclosed lands were under arable, sizeable uncropped areas would remain in the commons on the fells. Sometimes elements from the different narratives do support one another. The establishing of a lime kiln at Pardshaw, and Winchester's (1994: xix) speculation that Fletcher was local innovator in terms of liming fields, compares very well with the environmental evidence from Loweswater that implies increasing land use intensity. Similarly, the metal pollution observed in Loweswater during this period could be related to Isaac Fletcher's prospecting, or it may be an indication of the workings at Leady Moss. That said, the Loweswater catchment extends well beyond Mosser, and there are other workings that increased pollution could be attributed to – correlation, of course, does not necessarily equate to causation (Coombes and Barber 2005).

Getting More Specific

The instrumental series provide a more precise chronological structure through which to compare narratives. Wider trends can be analysed through close examination of individual years. For instance, the process of piecemeal enclosure was critically important in the development of the eighteenth-century landscape, and is reflective of wider social processes. Dilley's (1991: 439) research has linked environmental factors with the pace of upland enclosure, although there are questions as to what extent these can be defined.

Isaac Fletcher records several specific dates for the division and enclosure of land in Mosser. There was the unsuccessful attempt to buy the Mosser Commons from the Earl of Egremont in 1758/9, Mosser Moss was successfully divided and enclosed in 1772-3, and Fletcher also notes agreements regarding the division of Mossergate Outfield and Pasture from 1757-9. This process could have been driven by a number of potential causes, but the landscape narrative cites growing urbanisation of north-west Cumberland as the primary factor. This, combined with an improving transport and communication network, linked the Lake District with increasing urban demand for meat and dairy products (Dilley 1991: 128). Analysis of small tithe records in Mosser appears to support this picture, with a growing role for animal products indicated from c.1747-1775. As G. Elliott (1973: 72) says: "a rise in the price of corn during the second half of the eighteenth century, growing specialisation in agriculture, increased returns from improved land, the accumulation of capital and the willingness to invest it in land, and the expansion of industry all contributed to the increase in enclosing activity." Here are a clear set of complex socio-economic processes that might have brought about farming regime and landscape change. As farmers sought to satisfy urban demand and maximise profits, common rights were eschewed in favour of greater control over landholdings. This is a characterisation of the past in which weather and climate are either forgotten or ignored. Economics is seen as the prime mover, not the environment. However, using comparisons with the synthesised instrumental data, it is possible to generate a different interpretation.

Analysis of the NRT showed that the period from 1751-1774 is characterised by relatively stable annual temperatures, with a run of particularly warm years around 1760. The period from 1775-1806 is more variable, with a period of warmth around 1780 quickly descending into a run of cold years. The flurry of land enclosures in the late 1750s correlates with the period of warm, stable weather. This would increased the likelihood of good harvests, perhaps providing the stability and capital that would allow farmers to focus on improving their farms (Figure 54). Conversely, in the 1770s, the division and draining of Mosser Moss – an area of low-lying boggy ground – for pasture came after a run of wet autumns and cold springs (Figure 55). It is possible that this increase in pasture area was designed to help the people of Mosser maintain both livestock herds and crop yields in face of this adversity by turning their better drained pasture to arable. This hypothesis is supported, to a certain extent, by examining the field biographies derived from Fletcher's diary. It shows that two fields – Shortlands and Back of Wood – are cultivated for the first time soon after the division of the Moss.

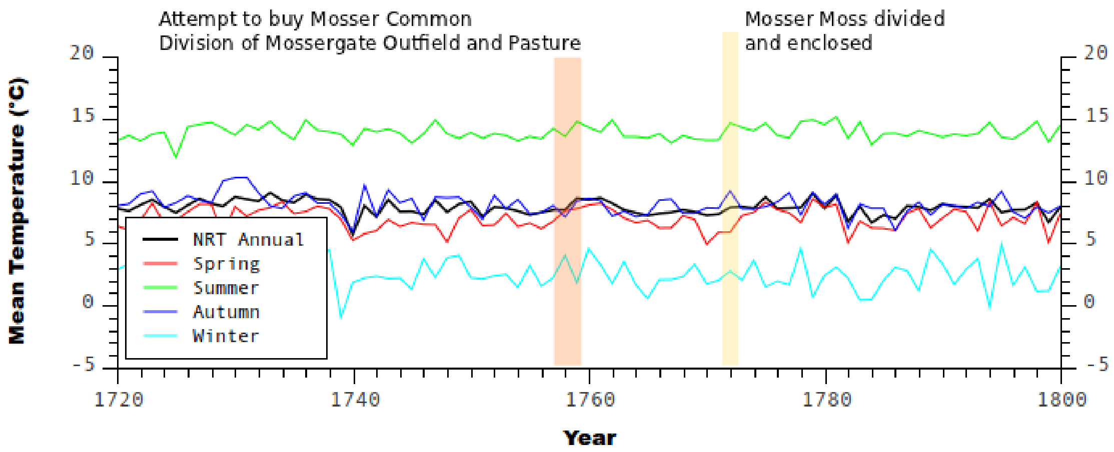

Figure 54: Combined Newton Rigg Temperatures, with dates of piecemeal enclosure from Isaac Fletcher's diary. After Parker et al. 1992

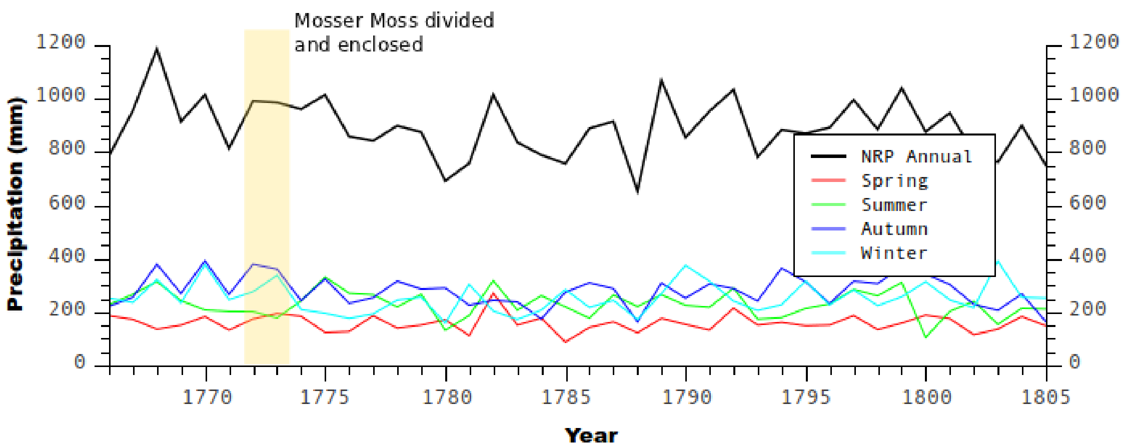

Figure 55: Combined Newton Rigg Precipitation, with dates of piecemeal enclosure from Isaac Fletcher's diary. After Alexander and Jones 2000

By combining narratives it is now possible to explain elements of widespread landscape change in late eighteenth-century Cumberland in two ways: either as a result of climatic influence, or as purely a socio-economic process. Given the evidence discussed so far, however, even if it is assumed that both social and environmental explanations played a role in driving the process of piecemeal enclosure, there is no means of deducing the relative influence of each. For that, a finer grained analysis is required. Fortunately, the landscape narrative has established that the balance of the farming regime between crops and livestock may have been sensitive to various social and economic changes in the region. It is certainly possible that that changes in climate would also have had an effect. This is something that can be examined in more detail using the instrumental series and economic data drawn from the archival sources.

Statistical Techniques

Weather, Yields and Prices

The sufferings records for Elihu Robinson in Eaglesfield present an excellent source of data that can be compared with instrumental weather series (Wh YDFCF/1/116). His records of the great tithe are particularly useful because they contain a record of the value of produce taken, as well as physical quantities and proportions of the different types of grain. The value of the tithe and the total number of shocks taken each year, 1761-1792, were compared against values for mean annual, spring, summer, autumn and winter temperature and precipitation from the NRT and NRP series.

The results show a moderate negative correlation between the value of the great tithe and mean spring (rho = -.416, n = 34, p = .014) and summer (r = -.353, n = 34, p = .040) temperatures from the NRT. There are moderate negative correlations between the total number of shocks taken for the tax each year and mean annual (rho = -.382, n = 34, p = .026) and spring (rho = -.458, n = 34, p = .006) temperatures (Table 3). There were no other significant correlations between variables. As spring and summer temperatures decrease, the value of the great tithe increases. This does not necessarily mean the market prices per shock have increased, because as annual and spring temperatures decrease the amount of produce taken in payment of the tithe also increases. This is a surprising result. Considering Martin Parry's model defines bad harvests through a lack of summer warmth, not excess, one would have expected warmer summers to bring increased yields. The lowland location of Elihu Robinson's farm may provide an explanation. According to Parry's method, only the highest slopes around Loweswater would not have received enough warmth for subsistence cultivation. It could well be that in the lowlands, cool summers only had a minor influence on the harvest. Here, drought could have been a greater worry. Of course, ideally, it would then be expected that summer precipitation would positively correlate with the size of the harvest (through total number of shocks tithed), but the lack of correlation here could be due to a number of factors. Indeed, it is not even certain that the NRP presents a good approximation of rainfall trends in this particular area. Generally speaking, however, we saw earlier that increased temperatures tend to result in decreased rainfall, so linking increased summer temperatures to increased incidence of drought seems a valid proposition.

Newton Rigg Temperatures

		Year	Spring	Summer	Autumn	Winter
Great Tithe	Value		-X	-X		
	No. Shocks	-X	-X			
	Oats Price		-x			
	Barley Price		-X			
	Wheat Price		-x			

Newton Rigg Precipitation

		Year	Spring	Summer	Autumn	Winter
Great Tithe	Value					
	No. Shocks					
	Oats Price					
	Barley Price					
	Wheat Price					

Table 3: Matrices showing correlations between Elihu Robinson's Great Tithe sufferings and instrumental weather records. X = statistically significant correlation, x = practically significant correlation.

Unfortunately, this hypothesis is thrown into question by results from a further set of correlation tests. Price data for oats, barley and wheat at the local markets were extracted from both Isaac Fletcher's and Elihu Robinson's diaries. Where there was more than one price recorded per year, an average was taken. Of course, the prices on one day cannot be fully representative of prices across a whole year, but it was hoped that the reconstructions could at least give an indication of supra-annual trends. A number of correlations registered within the $p<.05$ level of confidence, suggesting that there are links between the price of grain and weather. Interestingly, the prices of oats (*rho* = -.323, *n* = 30, *p* = .082), barley (*rho* = -.436, *n* = 32, *p* = -.013) and wheat (*rho* = -.352, *n* = 31, *p* = .052) negatively correlate with spring temperatures, although only the result for barley was statistically significant. The results suggest that warmer springs resulted in lower prices of grain, probably as a result of increased yields, or the prospect of a good harvest. The effects of drought are not visible here. Interestingly, there is no relationship between the size of Robinson's harvests and prices at the markets, perhaps underlining the point that one farm cannot be held to be representative of a whole region.

Importance of Cereal Crops

Thus far, the analysis has centred on how weather might have affected the size of crop harvests and the prices of grain at the markets. The Quaker sufferings books also record the amount of each crop tithed. It is possible, therefore, to examine whether changes in the weather altered the balance of crops produced. To do this, the number of shocks of each product was translated into the percentage proportion of the total amount tithed. Years when no shocks of a particular crop were taken were ignored on the basis that this probably meant that Robinson chose not to plant that crop. When the resultant values were compared with the weather data, a number of statistically significant correlations were identified. Barley seems most sensitive, demonstrating a moderate negative correlation with summer precipitation (*r* = -.463, *n* = 27, *p* = .015), and a strong positive correlation with mean yearly (*rho* = .513, *n* = 29, *p* = .004) and summer temperatures (*rho* = .775, *n* = 29, *p* = .000) (Figure 56). Similar relationships were identified when using instead the number of barley shocks tithed for comparison. The correlation between the proportion of wheat taken in tithe and mean summer temperatures (*rho* = .-404, *n* = 23, *p* = .056) is possibly of practical significance, as are the correlations between the proportions of barley (*rho* = .373, *n* = 27, *p* = .055) and oats (*rho* = -.351, *n* = 29, *p* = .069) taken and autumn temperatures (Table 4).

The results of these tests suggest that barley yields more in warm, dry conditions. The lack of sensitivity observed in oats supports its dominant position in the farming regime operating in Cumberland at the time. Earlier we saw that barley appears to have been less important on Elihu Robinson's farm in comparison to Isaac Fletcher's in Mosser.

Nestled at the edge of the Lakeland fells, the climate in Mosser might be expected to be slightly cooler and wetter than that at Eaglesfield. It is interesting to note that Isaac Fletcher might have been farming a climatically more sensitive crop in a climatically more marginal location. In an attempt to identify whether the weather had an effect on Robinson's planting choices the following year, a one year lag was introduced to the weather data. The tests found no identifiable relationship between the previous year's weather and the tithed harvest.

Newton Rigg Temperatures

		Year	Spring	Summer	Autumn	Winter
Proportion of Tithe	Oats				-x	
	Barley	X		X	x	
	Wheat			-x		

Newton Rigg Precipitation

		Year	Spring	Summer	Autumn	Winter
Proportion of Tithe	Oats					
	Barley			-X		
	Wheat					

Table 4:Matrices showing correlations between Elihu Robinson's Great Tithe sufferings and instrumental weather records. X = statistically significant correlation, x = practically significant correlation.

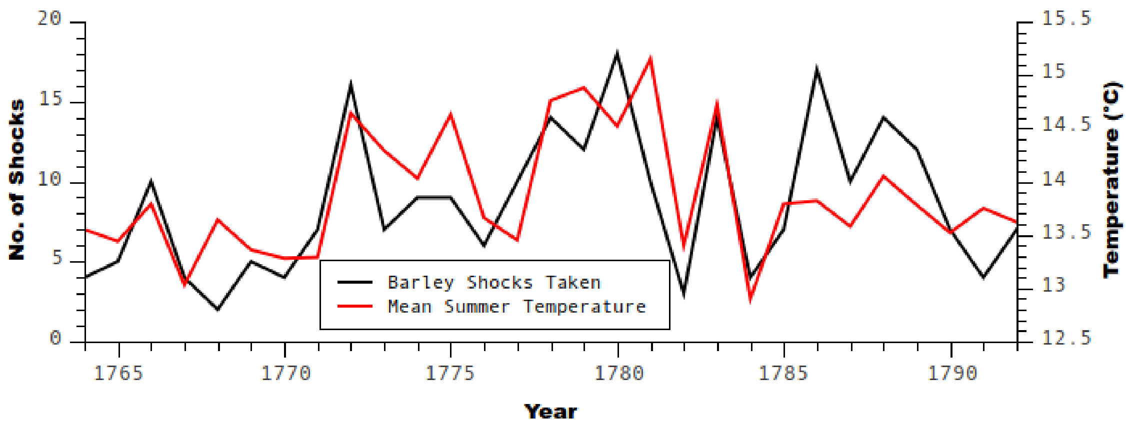

Figure 56: The number of barley shocks taken from Elihu Robinson's farm in payment of the Great Tithe appears to correlate well with mean summer temperatures. After Parker et al. 1992

A similar set of correlation tests were also used to examine whether the changing crop and livestock balance identified in the small tithe sufferings for Mosser was related to changes in the weather. The changing proportion of crop products relative to animal products taken in payment for the small tithe, 1747-1775, was tested against various weather variables, but this showed no statistically significant correlations. Testing the influence of precipitation was hampered because the NRP could only be synthesised back as far as the start of the EWP in 1766. Once again, a one year lag was introduced to the weather data to see if the previous year's weather had an influence, but no discernible correlation was revealed. Consequently, it can be concluded that increasing predominance of animal products relative to a declining emphasis of crops in small tithe records was probably not related to changing weather conditions. However, from 1766 to 1775 progressively warmer weather in the spring coincided with crops becoming more prevalent in the small tithe records (rho = .840, n = 9, p = .005). Nevertheless, with the number of paired cases so low, wider conclusions cannot be drawn from this. These results in no way contradict the suggestion that it was increasing urban demand that drove an expansion in livestock farming. Furthermore, it should be remembered that interpretation of the small tithe records is problematic, and they cannot be used as conclusive, unambiguous indicators of farming practices.

Summary

Results from statistical tests show remarkably few correlations between economic and instrumental weather data. There are numerous possible reasons for this. It is not certain, for example, that the synthesised instrumental series are good reflections of weather around Mosser, and similarly the economic data for Elihu Robinson's farm may not be representative of farming across the entire region. There is no way to know how reliable the sufferings data is, or how thorough the tax collection process was: we do not know to what extent the tithes were reflective of farm production. These caveats add an extra level of complexity to an already complex set of results. Surprisingly, the statistics show that the amount and value of grain taken for the great tithe increased as summers and years got colder, perhaps reflecting the adverse affects of drought conditions on harvests. But as summer temperatures increased, the price of wheat tended to fall. These are somewhat counter-intuitive results, and any explanation would necessarily be quite complicated. It is, perhaps, sufficient to say that there is no clear relationship between wheat prices, harvest yields, and the weather. At Robinson's farm, barley appears to have been most sensitive to the weather, with more of the crop tithed during years when the summers were warm and dry. At Isaac Fletcher's farm in Mosser, where barley represented a greater proportion of the grain crop, this sensitivity would have been accentuated. Conversely, it is plausible that Mosser was also less susceptible to drought.

The overall lack of sensitivity exhibited by oats to the weather perhaps explains its predominance in the eighteenth-century Cumbrian agricultural regime. There is a relationship between the changing emphasis from crops to livestock during the late eighteenth century and the weather, but this was only found by arbitrarily restricting the period analysed.

Parry's Model

Earlier, Martin Parry's (1975, 1976b, 1978, 1981; Parry and Carter 1985) climate change model was applied to Mosser. This showed climatic limits to cultivation moving up and down the fellside in response to warm or cold years. From 1700 to 1749, the marginal area extended out across the central spur of high ground, towards Bramley seat. From 1750 to 1799 it shrank, such that the lower limit only extended out as far as Wilkes Howe (Figure 57). This small expression of the marginal zone reflects a cooler period, but one where the bad years were fairly moderate. Unfortunately, the archival sources assessed in producing the landscape narrative were primarily focussed on the period post-1750. This means that information regarding the period 1700-1749 is limited. With no great tithe applicable in Mosser, it is also difficult to compare the model's 'retrodictions' with data on grain yields during the period. However, the ridge and furrow observed during the landscape survey are evidence that the lands at Fellside were cultivated up to and beyond the head-dyke. It is thought that this didn't happen until the early nineteenth century, when the upper limit to the marginal zone moved down the around the head-dyke, while the lower limit extended out towards Bramley Seat. Taking the model at face value, this suggests that under normal circumstances growing crops on the upper slopes of the enclosed land would have been economically risky during this period. It further emphasises just how extreme the circumstances were that caused the farmers of Mosser to plant crops right up to and beyond the head-dyke.

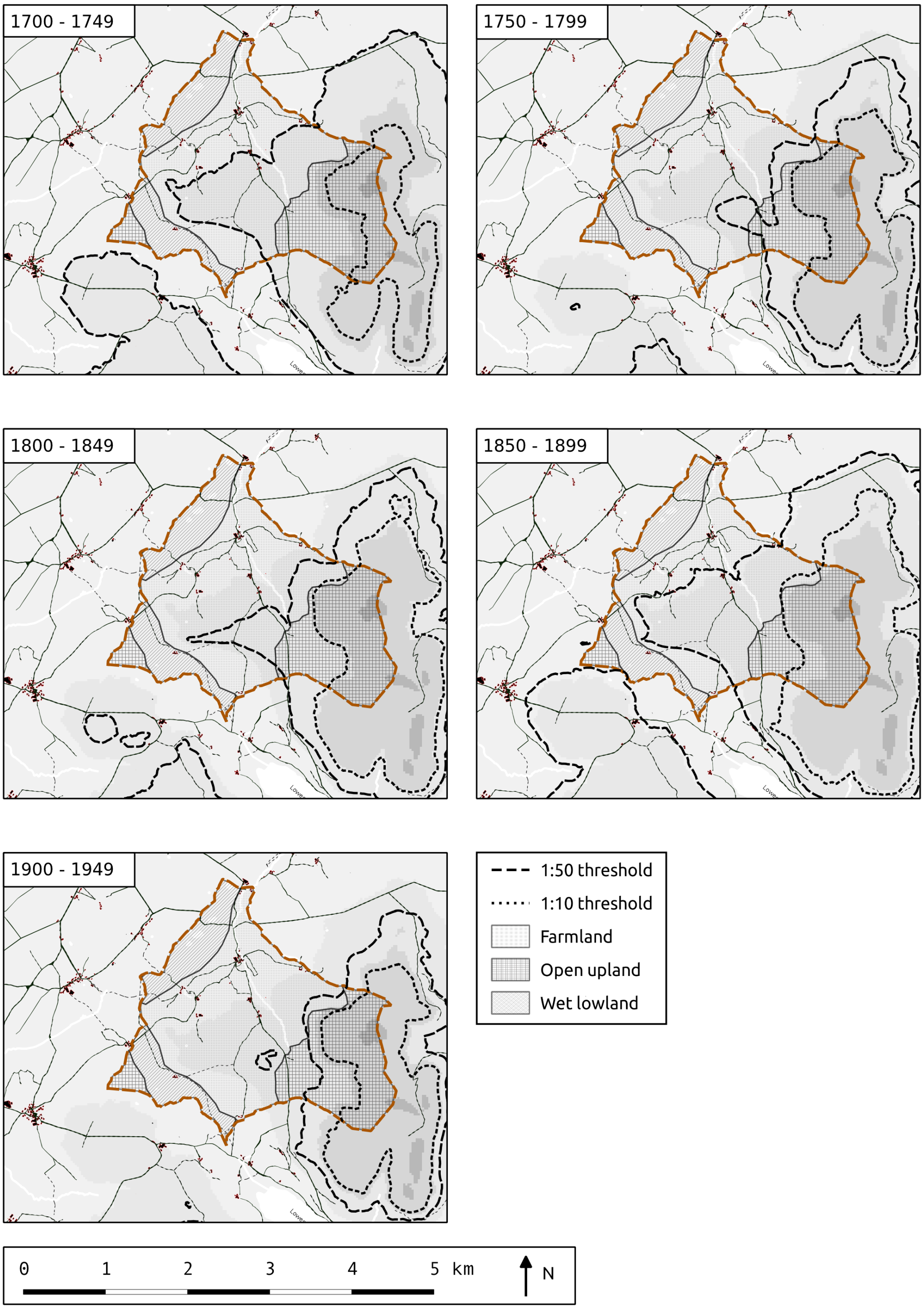

Figure 57: The size and position of the marginal zone varies from period to period. Based on harvest failure occurring during years when accumulated warmth failed to reach 1110 GDD.

According to the model, much of the higher land in Mosser was climatically marginal for cereal cultivation. This suggests that the lowland farms were more likely to have engaged in profitable crop farming. The higher lying farms at Fellside, Mossergate, Gill Brow, and possibly Beech Hill, were probably more focussed on livestock. Assuming information from the small tithe sufferings is an indication of farming practices, this hypothesis can be tested against economic data. The results are broadly supportive: at the lower lying farms of Graythwaite and Underwood, crops made up 64% and 62%, respectively, of product types taken in payment of the small tithe. At two of the biggest holdings at Mossergate, that value drops to around 25%, and at Beech Hill crops only make up 29% of the confiscated product types (Figure 58). Similarly, evidence from the tithe survey shows that most fields with names associated with arable tend to be located on the lower lying land. It is, however, plausible that in this area the name 'croft' is associated with crops, as it is on Fletcher's farm. The location of these fields does not support the hypothesis, with a number of crofts on the slopes above Mosser Beck. It might not, however, be a coincidence that several of these crofts belonged to Gill Brow and Mill Dam – farms since abandoned (Figure 59).

It has been suggested that one of the means by which people responded to climatic stress was to alter subsistence strategies (Halstead and O'Shea 1989; De Vries 1980). This evidence suggests that the people of Mosser were well placed to move between pastoral and arable farming regimes, and that climate could have played a role in deciding which was predominant at any given time. There is a problem, however. Analysis of the tithe data has already established that barley was likely to be particularly sensitive to changing weather conditions, preferring warm and dry summers. It is surprising, then, that even at the higher lying farms, where the climate would be cooler and wetter, barley or malt barley was frequently taken in part-payment of the small tithe. It suggests that even though arable was not as profitable on these farms, the weather did not preclude them growing barley. It seems the model can only provide a broad indication of how changes in the climate might affect farming. Certainly the limits to the marginal zone cannot be considered absolute thresholds.

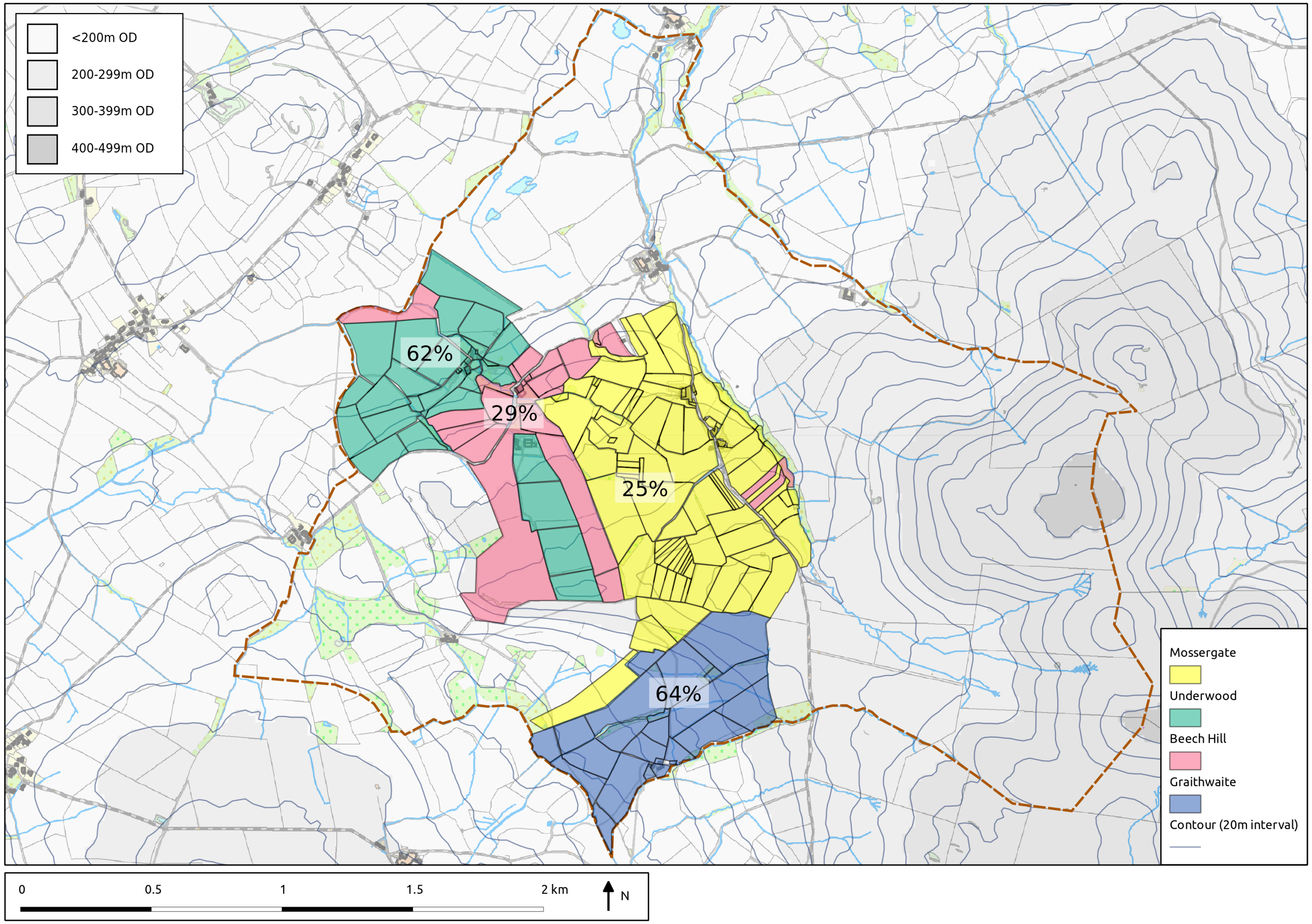

Figure 58: The percentage proportion of crops taken in payment of the small tithe across four different farms: Underwood, Beech Hill, Mossergate and Graythwaite. Farms on higher ground appear to farm less crops. Map data: © Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

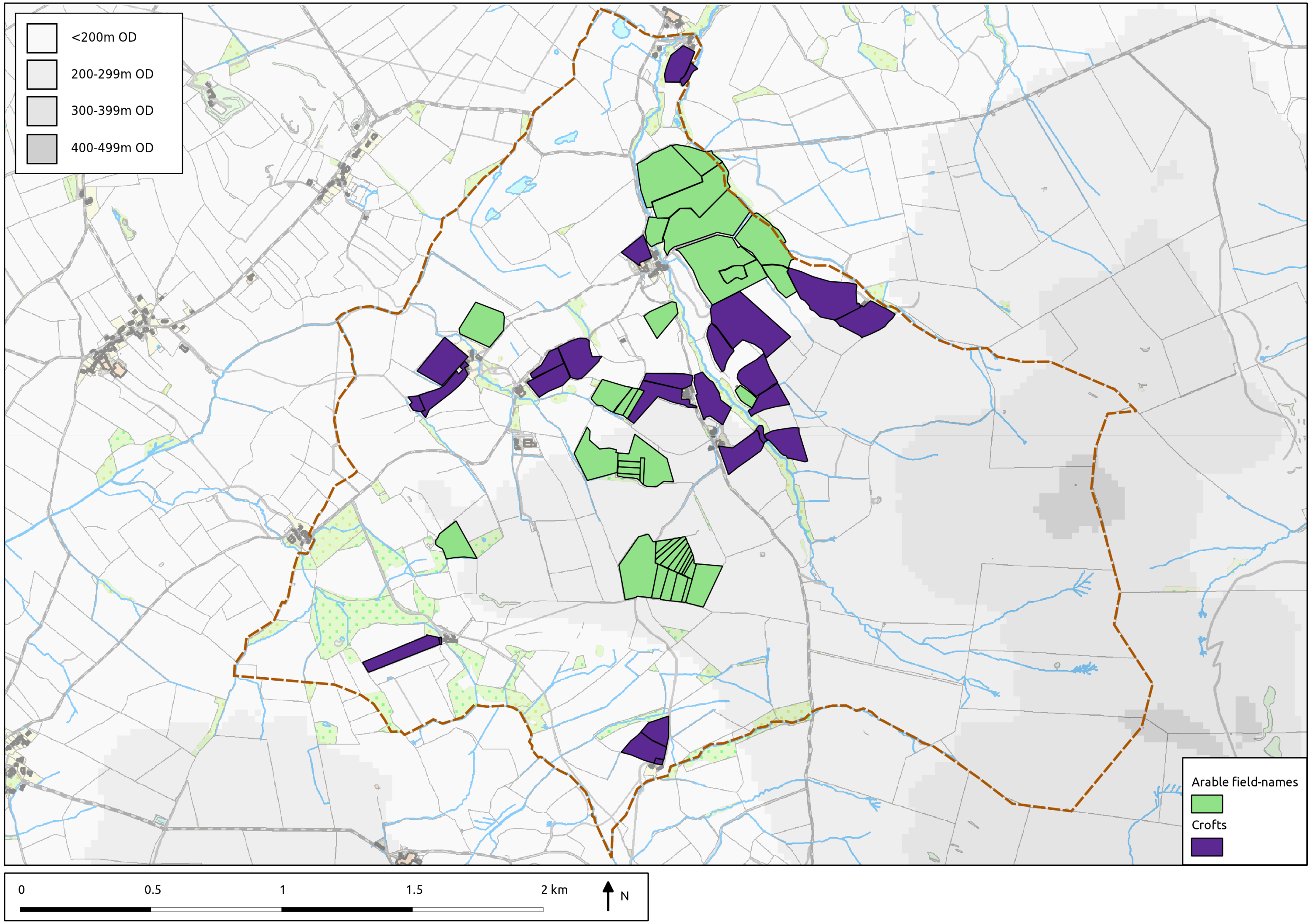

Figure 59: Fields with names associated with arable. Map data:© Crown Copyright/database right 2012. An Ordnance Survey/EDINA supplied service.

Updating the Model

Using results from the field survey it is possible to define the actual limit of cultivation in Mosser at 300m OD. If it was assumed that this better reflected the absolute climatic limit to cultivation than the phenological data mobilised by Parry, the model could be recalibrated to this new level. However, this would require further assumptions being made about the years in which the weather was suitable for growing at this altitude. In years when the weather was worse or grain prices lower, it probably was not profitable to grow crops at these elevations. As such, a farmer's decision to grow crops at this level was probably also dictated by knowledge of recent years' weather, so to produce a GDD limit of cultivation, it would be necessary to define precisely what circumstances enabled cultivation. Although Elihu Robinson's observation suggests that 1801 is a likely year when arable fields would have extended far up the fell, it cannot be confirmed. After all, the pressures (and financial rewards) of the “Bonneyparte time” lasted for more than one year, and there could have been a number of years when farmers attempted to extend cultivation up-slope. Although the resultant model could potentially be more accurate, it cannot be built without this key data.

More fundamental changes to risk modelling could take into account a range of other factors. With profitability and risk a core concern, an improved model could consider the effect grain prices might have on decision-making. Additionally, further refinement of the model could incorporate topographic factors, such as slope and aspect. In the Derwent Valley, Samuel Eyre (1954) has calculated that medieval farmers preferred slopes with gradients ranging from 1:6 to 1:20 to improve water run-off. During the field survey in Mosser, it was indeed noted that most fields with ridge and furrow were sited on fairly steep slopes, but this could reflect a preservation bias towards areas unlikely to have experienced more recent ploughing.

A number of other problems still persist. Certainly, the weather experienced during fieldwork suggests that rain and wind were at least as important as warmth in governing the limits to cultivation. The importance of water management is implied by the modern field drainage systems that can be observed in a number of places in the township, particularly around the ridge leading to Bramley Seat, as well as in some of the fell enclosures bordering the road. A question remains as to whether variations in precipitation and wind exposure are likely to have materially affected the altitudinal limit to cultivation, above and beyond the influence of temperature variation. Unfortunately, this project is not well placed to provide a suitable answer. It might, however, be possible to re-examine the model in the context of the earlier analysis, which has suggested that the role excessive warmth, or drought, plays in inhibiting harvests may also be an important consideration. With more information on bad, drought affected years, it might well be feasible to invert the method and produce a model that charts a marginal zone moving altitudinally in relation to droughts rather than cool years.

Discussion

Ostensibly at least, the two narratives each employ a similar handling of scale. In each case, a more general overview is contrasted with more specific, chronologically well-defined details. Although the overview is helpful in following trends over long time-spans, the resolution is poor. In this respect, the correlations, comparisons and interpretations that can be drawn between the two narratives tend to be fairly general in character. Where, for example, the boundary and upland walkover surveys recorded features that date back prior to the mid-eighteenth century, these are undated. Without a chronological framework for the landscape narrative that extends back into deeper past, it is not possible to compare it against the environmental evidence that extends back to the first millennium BC. As a consequence, the environmental narrative is limited to providing a supporting role, highlighting background context, but it does not help form the landscape narrative. This is precisely the kind of approach that Richard Tipping (2004) warns against. Palaeoecological data should “speak for itself”, not merely support observations made elsewhere. Unfortunately, the kind of detail advocated by Tipping (1999, 2004) is not available for Mosser, although Coombes' (2003) work indicates that a more detailed land use study might be possible. In terms of understanding how land use was impacted by climate changes, Coombes suggests that disentangling causality is likely to be extremely difficult no matter the level of detail observed in the palaeoenvironmental data. This is because “the epistemological and statistical tools used in palaeoecology are poorly suited to the task” (Coombes 2003:

328). Nevertheless, palaeoenvironmental data can be used to support or refute existing hypotheses, and Coombes' discovery that upland communities may have been better prepared to cope with climatic stresses warns against assumptions concerning marginality.

The landscape analysis from the eighteenth century onwards utilises detailed economic data and, with the help of the diaries, the chronological resolution is very good. This allows fairly in-depth comparison with high resolution instrumental records, but the data only covers a relatively short period of time. Attempts to link events observed in the historical documents with the instrumental records were partially successful. It is possible to explain the process of piecemeal enclosure as a result of climatic influences, but there is an equally if not more convincing interpretation based upon a coalescence of social and economic processes. Ultimately, with the evidence reviewed thus far, there is no clear way of discerning between these competing hypotheses. If both explanations are valid, then there is no way of determining the relative influence of each. Problematically, the climatic hypothesis was predicated on a fairly simple, economic mechanism of causation linking coincident events. Although we have seen that researchers have often over-relied on the assumption that correlation equates to causation, this is not in itself an argument against finding patterns of changes that overlap spatially and temporally (Anderson 1981; Coombes and Barber 2005; Ingram et al. 1981; Schulting 2010; De Vries 1980). It is not unreasonable to expect some degree of causality when this occurs, but that hypothesis ought to then be rigorously investigated. As Anderson (1981: 339) points out: "'explanation' on the basis of correlation is simply rationalisation." A correlation is not an explanation in itself. Here, the problems Coombes identified when using palaeoenvironmental data to discern climatic impacts on land use are, in part, replicated using instrumental records and historical documents. Increasing the level of detail has not increased the level of confidence in the implication of climate as a factor in social and landscape change.

Statistical examination of the datasets provides a separate means by which correlations can be identified and explored, but this involves making a number of assumptions as to the validity of the harvested data in representing the kinds of processes under examination. It is not particularly surprising that statistical tests showed very few correlations, and this might not necessarily reflect a lack of weather influence. Interestingly, where correlations have been found, they have helped re-evaluate some preconceptions. For instance, the suggestion that hot and dry summers may have been a more limiting factor for farm cultivation than cool conditions, contrasts markedly with Parry's analysis. The sensitivity of barley to the weather is not that surprising, but its prevalence in Mosser, where it appears to comprise more of the harvest than in Eaglesfield, means that the farmers of the township are potentially taking greater risks with what they cultivate. As with the palaeoecological studies, detailed analysis can help confirm or refute hypotheses: the results here suggest that the greater emphasis on livestock during the late eighteenth century was only partially driven by climatic changes, if at all. It is clear that correlation, or lack of correlation, observed in statistical tests is only one element in a whole body of supporting evidence that might explain how various farm activities were influenced by the weather.

Parry's method was developed as a means by which social and environmental narratives can be bridged. Tests of the model against the historical actuality have been broadly successful: the upper edge of the marginal zone coincides with the edge of the enclosed lands; economic data shows differences in the farming regime that could reflect the marginality of the Mosser landscape for cereal cultivation. So although the supposed limit to commercial crop cultivation was never conceived of as an absolute boundary, it could well have relevance as a guideline. In contrast to the results from the statistical tests, the model suggests that changing climatic conditions may have had a role in the changing crop and livestock balance after all. It should be remembered, however, that the method requires that a number of pre-assumptions are accepted. Although Parry (1981) advocates re-examining these assumptions when the model does not reflect the historical actuality, when there is correlation, questions of risk perception, the impact of warmth on high altitude crop cultivation and the importance of cereals are left under-explored.

Conclusion

The links between the two narratives of environmental and landscape change are primarily articulated with recourse to economic processes and physical limits. In this sense, the analysis is necessarily rational and formalist. In 1981, Ingram et al. (1981: 11) judged that "only detailed local climate information will suffice for rigorous analysis of climate-society links." The results of this study only partially confirm this view. It is true that the more highly resolved data yield the most in terms of developing further areas of investigation and supporting or refuting certain hypotheses, and the problems of poor resolution are compounded where information is missing and assumptions are made. Yet across both instrumental and palaeoenvironmental data, and no matter the level of detail, causality remains difficult to establish. Thus although proposed climate-society links can be analysed, the inferences drawn from such investigations are always partial: there are few, if any, simple or deterministic links between the two narratives.

Historical ecologists and anthropologists regard the landscape as the medium through which human-environment relations are played out and made visible (Crumley 1994a; Ingold 2011). Ostensibly, the results here support this. Evidence for responses to environmental change are rendered in economic data for farming and the development of the landscape. However, in these interpretations, the human perspective is only poorly understood. To go further we perhaps need to stop thinking about social processes in terms of economics and landscape ecology. Although analysis has focussed on the farms of Elihu Robinson and Isaac Fletcher, their perspectives on weather, farming and national events have not been considered. A more holistic appraisal of influence of climate on societies would need to examine how these farmers' experiences on an individual level structure, and are structured by, the historical narrative. An analysis of the historical diaries might help us get at this perspective, and thereby transform our understanding of the climate-society dialectic.

Chapter 11: Experiential Narrative – Historical Diaries

Introduction

The third element of this project is to examine the late eighteenth century from the perspective of those living at the time. Although the work thus far has focussed on a small area during a short period of time, the interpretive emphasis has principally been on how the farm economy might have been influenced by longer term changes in climate. Chapter three explained how the last few decades have seen a move away from understanding human-environment relationships through a purely economic perspective, to considering how responses to environmental change are embedded in social practice. As a result, contemporary landscape archaeology has been strongly influenced by the philosophy of phenomenology and a desire to employ inhabited perspectives on the past. This chapter aims to develop a historical narrative for late eighteenth-century Cumbria that goes beyond the abstractions of economy to focus on individual lives. As anthropologists have shown, the cultural engagement with the weather and the environment can be bound up in a society's ideology, identity and sense of place. Using the two historical diaries, it should be possible to develop these themes and question how weather impacted upon daily life.

The Diarists

Running from 1756 to 1781, Isaac Fletcher's diary was a valuable source of information when constructing the landscape narrative, because it gave a detailed insight into Fletcher's farm and merchant businesses. His diary can reveal much more than this, however. Described by Angus Winchester (1994: xi) as performing "functions that would later become the preserve of the country solicitor", Fletcher was involved in the management of legal and financial affairs for a number of clientèle. As such, although his entries are short, Fletcher's diary ranges through farming, weather, law, money and faith. Through these, Fletcher's social aspirations can be seen clearly. He had a style of living that was "comfortable without being opulent", a substantial library and a small selection of exotic luxuries (Winchester 1994: xv). At the peak of his life, he owned two properties at Underwood and the large farm at Mossergate. "In short, Isaac Fletcher's life demonstrates that the concept of eighteenth-century English as a 'polite and commercial people' extended to the farmhouses of the quiet countryside on the edge of the Lake District" (Winchester 1994: xv). Despite this, Fletcher frequently found himself losing out financially, through illness and misfortune. The diary documents the decline of Fletcher's legal work, as age and infirmity forced him to focus more on his farm. In 1769, an unknown illness caused a 14 month break in diary entries, which followed a decade of financial troubles. These had forced him to mortgage his properties and sell fields, culminating in the sale of Mossergate in 1772. This is not to say Fletcher died a poor man, but he did not quite achieve the gentility he so obviously aspired to.

Many of Fletcher's numerous business and social contacts were related to his involvement in the local Quaker community: "The meeting at Pardshaw Hall was one of the 'mother churches' of Quakerism in Cumberland" (Winchester 1994: xx). Fletcher became a prominent member of the Pardshaw Meeting, performing the role of clerk from 1744 onwards. He was also clerk of the Cumberland Quarterly Meeting, and visited London as part of a Quaker delegation in 1761. Regular worship meetings at Pardshaw were integral to Fletcher's social life. Attending on Sundays and some weekdays, excitement was often provided by visiting ministers, who sometimes stayed and dined at Underwood. Winchester (1994: xxi) counts 96 travelling ministers mentioned in the diary, with some coming from as far away as America. This underlines both the importance of West Cumberland in the Quaker movement, and the mobility required to bind such a large network together. Despite its common characterisation as a quiet time in Quaker history, the mid to late eighteenth century saw an increasingly strict approach to behaviour (Dandelion 2007). Against this backdrop, Winchester (1994: xxii) highlights rising theological tensions, with the competing ideas of Quietism, Deism, as well as a new Evangelical movement all contributing to a sense of uncertainty within the Quaker community. For Fletcher, a number of altercations damaged his reputation, with one fellow member, Elizabeth Wilkinson, accusing him of mishandling financial affairs and mistreating some Quakers (Winchester 1994: xxiii). Fletcher successfully rebutted these claims and remained clerk of the Monthly Meeting until his death, but following this and a number of related incidents, his standing was somewhat reduced.

It was through the Quaker community that Fletcher met the second diarist, Elihu Robinson. For a while at least, they were good friends, going fishing and practising astronomy together. Like Fletcher, Robinson was a prominent member of the Quaker community, and even took over Fletcher's clerical duties at the Monthly and Quarterly Meetings. His diary runs from 1779 to 1805, and although it is not as wide-ranging as Fletcher's, his entries contain much more personal reflection and opinion – they are not such a dry record as Fletcher's systematic cataloguing of events. There are, for example, frequent exhortations extolling the virtues of patience and charity. These portray a man of deep and compassionate religious faith. Like Fletcher, Robinson was a farmer with numerous other financial interests in mining and overseas trade. He was probably more wealthy than Fletcher, and there is no indication of Robinson experiencing the kinds of difficulties Fletcher did towards the end of his life.

In 1776, Elihu Robinson took the young John Dalton into his house. Dalton was later to become a famous chemist and meteorologist, for whom Robinson was his first patron (Winchester 1994: 441). It is this Quaker network of scientific contacts that makes both diaries so suitable for this study. The gentlemanly dabbling in scientific pursuits meant that both Fletcher and Robinson kept detailed meteorological records. This interest is then reflected in Dalton's work, whose measurements at Kendal are mentioned several times in Robinson's diary. Whilst Fletcher kept an almost daily record of temperature, precipitation and wind, Robinson's discussion tends to consist of a more reflective summary of weather occurring over the course of a week or month. Together, these records provide a perspective on eighteenth-century weather through the eyes of people living at the time. Using Robinson's diary to extend the analysis up to the turn of the century allows us to examine perceptions of the weather during a time of war, soaring food prices and widespread change across the landscape. Although the diarists did begin to make use of instruments, description of the weather is not reduced, like so many other purely scientific accounts, to simply cataloguing instrumental measurements (Jones 2001). As highlighted by the link from Fletcher, through Robinson, to Dalton, this was a time in which people were trying to reconcile the sensual every day experience of the weather with traditional wisdom and new scientific apparatus – a process for which weather records were deemed essential (Golinski 2007; Janković

2000). Therefore, in attempting to make sense of how weather was important in their own time, the diarists have provided an insight into the relationship between weather and society in the past.

Historical Climatology

Isaac Fletcher's diary contains over 8000 entries, with over 3800 of these containing some sort of information about the weather. Typically, a weather entry might contain a brief summary of the day's weather, and occasionally an instrumental measurement might be noted: "Showry weather with a great quantity of snow on the hills. Wind ditto; mercury 28.5" (IF 11/02/1778). A detailed reading might allow one to make a rough assessment of the weather over a particular season, but analysis of the whole 25 year span requires a more holistic assessment of the entries. Researchers in historical climatology have long understood how diary entries can be used to produce high resolution climate reconstructions (Brázdil et al. 2005). Commonly, qualitative statements on the weather are translated onto an ordinal scale, where each integer represents degree of intensity (Brázdil et al. 2005: 378–80). So temperatures, for example, might be rated from extremely cold, -3, to extremely hot, 3. Scaled this way, the weather records are condensed into a format that is readily interrogated.

Temperature		Precipitation		Intensity	
5	Extremely Hot	4	Flood / Great Storm	3	Very Bad Weather
4	Very Hot	3	Heavy Rain / Storm / Very Wet / Very Thick Snow	2	Bad Weather
3	Hot / Very Warm	2	Heavy Showers / Rain / Wet / Snow	1	Moderate
2	Warm	1	Showers / Moist	0	Calm / Fine Day
1	Mild	0	Dry		
0					
-1	Cold				
-2	Frost / Very Cold				
-3	Sharp/Hard Frost				
-4	Very Hard/Severe Frost				
-5	Extreme/Very Severe Frost				

Table 5: Qualitative weather statements were indexed according to the above scales. Scales were chosen after the diary entries were sampled in order to first discover the range of comments likely to be encountered. Comments were then categorised to represent incremental increases in weather intensity.

After an initial appraisal of the style of Fletcher's weather entries, the following scales were developed: -5 to 5 for temperature, 0 to 4 for precipitation, and 0 to 3 for a general indicator of weather impact (Table 5). Entries in which frost was mentioned were also noted. In order to provide an overview of trends, values were averaged at several stages, from monthly, to seasonal[4], to yearly – missing records were not counted. This averaging is problematic because it means that the existing records are being used to stand in for days for which there is no data. With an average of just over 12 records per month, much of the weather has gone unrecorded. Although reasonable confidence can be placed in representations of the weather in months where over 25 days are recorded, the problem is at its most acute when values for one or two days are taken, as averaged, as representative for the entire month. Despite this, and although alternatives were considered, it was thought that this averaging method was the only sensible way of producing a continuous weather record. It is, nevertheless, important to bear in mind this limitation and be wary of placing too much emphasis on trends and values derived from periods of low recording activity. The mid to late 1760s, in particular, contains a number of instances where under 20% of the diary entries mention the weather. Unfortunately, where there is a total lack of weather entries or at times when Fletcher was away from north-west Cumberland, whole months and seasons have to be left out of the analysis. This means that despite best efforts, the weather record is not wholly continuous (Figure 60).

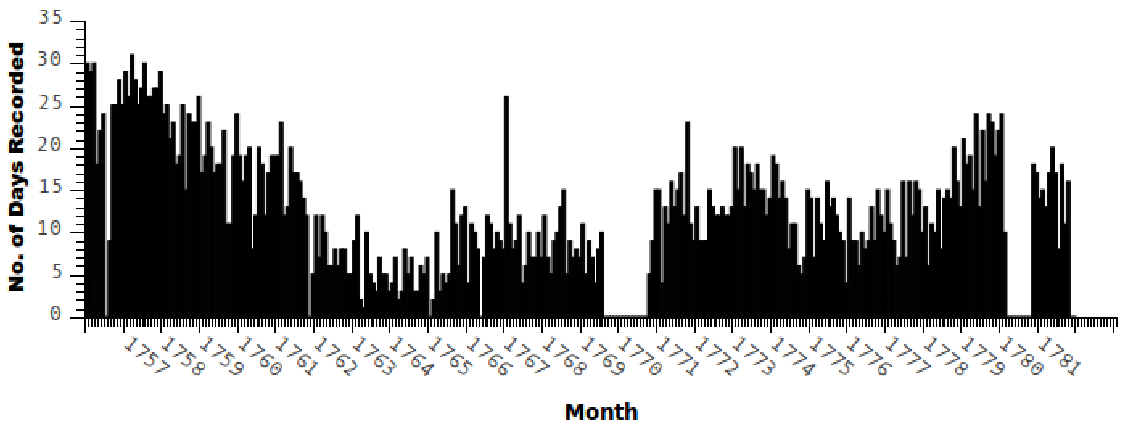

Figure 60: Number of days' weather recorded in each month of Isaac Fletcher's diary. From 1762 to 1770 the record is sparse.

When collated together, the results act as a rough approximation of the weather, seen through the eyes of Isaac Fletcher (Figures 61 and 62). In terms of temperature, 1775

4 Spring: March, April, May. Summer: June, July, August. Autumn: September, October, November. Winter: December, January, February.

sticks out as a particularly hot year, predominantly due to an unusually warm autumn. 1767 was particularly cold, with a summer that was markedly colder than any other. During the best-recorded years, spring temperatures remained broadly stable, although the poorly recorded year of 1763 hints at a fairly warm spring and summer. There also seems to have been a pronounced dip in summer temperatures during 1776 and 1777. The coldest winter was that of 1768/9, although 1771/2 and 1776/7 almost matched it. 1760/1, 1775/6 and 1780/1 saw the warmest winters. In terms of precipitation, 1763 was the wettest year, although this could be a function of the lack of weather records at this time. 1778 was the next wettest year, resulting from an unusually wet spring and summer. Other wet summers included 1766 and 1771, while 1762, 1767 and 1779 were the driest. Interestingly, the dry summer of 1767 was followed by a wet autumn. The autumns of 1757 and 1758 were particularly dry. Ostensibly, the winters of 1763/4 and 1764/5 were by far the wettest, with 1762/3, 1777/8 and 1780/1 the driest.

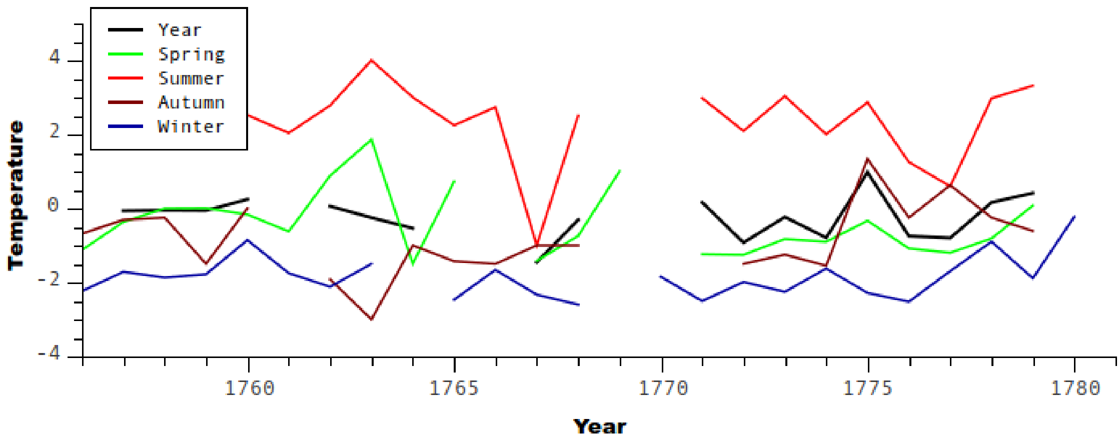

Figure 61: The temperature record from Isaac Fletcher's diary.

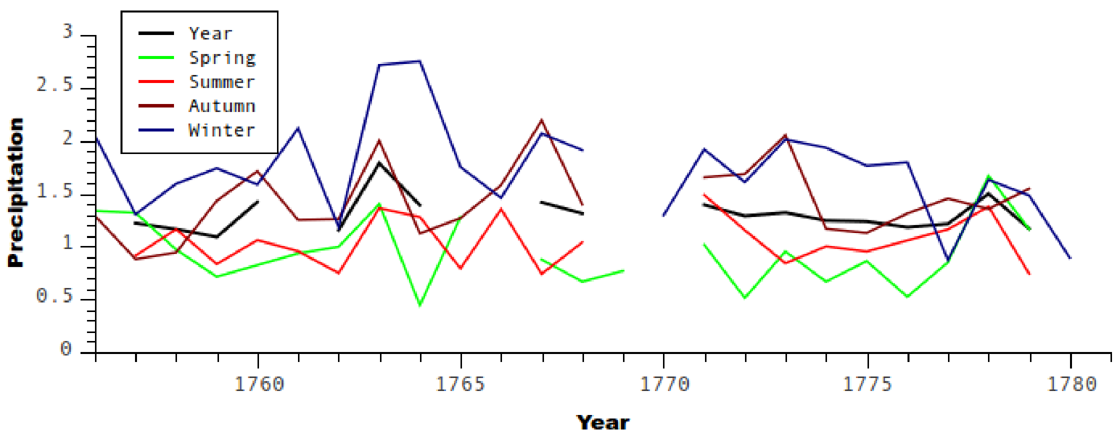

Figure 62: The precipitation record from Isaac Fletcher's diary.

Elihu Robinson's diary is quite different from Isaac Fletcher's. There are no daily entries. Instead, the diary reflects back over the past week or month, noting particular days of interest. Typically, weather is described in a similarly loose manner: “Came on wet about ye 14th:9th month & continued about 16 days mostly wett” (ER September 1779). It is, therefore, often difficult to match statements with the weather on specific days. Despite this, it was considered appropriate that the translation of Robinson's weather statements should use the same system of scales used for Fletcher's diary, and where possible, be mapped onto a daily chronology. For this reason, the translation of weather statements becomes more interpretative, as estimates are made as to how long particular weather conditions lasted for. For example, where Robinson might say “the month came in mostly wet”, the first five days of the month would be marked as wet. At other times, Robinson might say the weather alternated from one set of conditions to another, thereby requiring a judgement as to what values would best reflect this. Although in some ways this means Robinson's record is not as chronologically precise as Fletcher's, the fact that Robinson often comments upon the character of the weather over long periods can mean that a greater proportion of a month's weather has been referenced. Therefore, after the results are averaged, the general character of a month's weather may actually be better reflected in Robinson's record compared to Fletcher's.

The results from translating Elihu Robinson's weather statements show that 1781 was a very warm year, with an exceptionally warm spring and moderately warm autumn (Figure 63). The three years leading up to 1800 were generally cold, although no season within these years stands out as being particularly cold. The springs and summers of 1790 and 1793 appear to have been fairly cool, while the summers of 1785 and 1788 were very hot. 1780 saw the coldest autumn by quite a margin, although the autumns of 1787, 1794 and 1800 were also quite cool. The warmest autumn was in 1804. The winter of 1789/90 was exceptionally warm, and the winter of 1784/5 exceptionally cold. The years with the most precipitation were 1782, 1789 and 1792, while 1797 and 1799 were almost as wet (Figure 64). 1788 stands out as a particularly dry year, after experiencing low rainfall in autumn and winter. The wet year of 1782 was dominated by a wet spring and summer. The driest springs occurred in 1781 and 1783. There were a number of particularly dry summers, with 1779, 1781, 1793, 1794, 1800, 1801 all registering low on the precipitation index. The wettest summers appear to have been

1783 and 1790. Broadly speaking, there appears to have been a decline in autumn precipitation over the period of the diary, with the wettest autumn recorded in 1779 and the driest in 1802. The winter of 1799/1800 was exceptionally dry, while 1781/2 was by far the wettest.

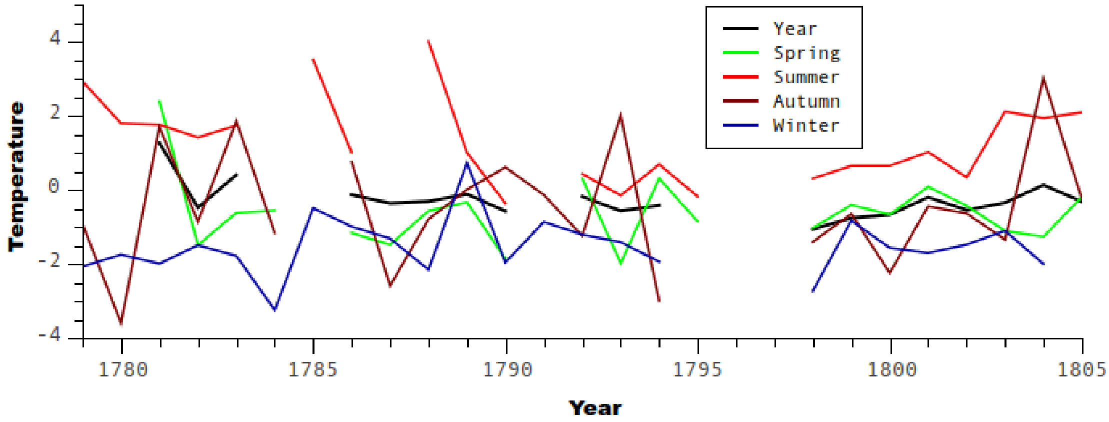

Figure 63: The temperature record from Elihu Robinson's diary.

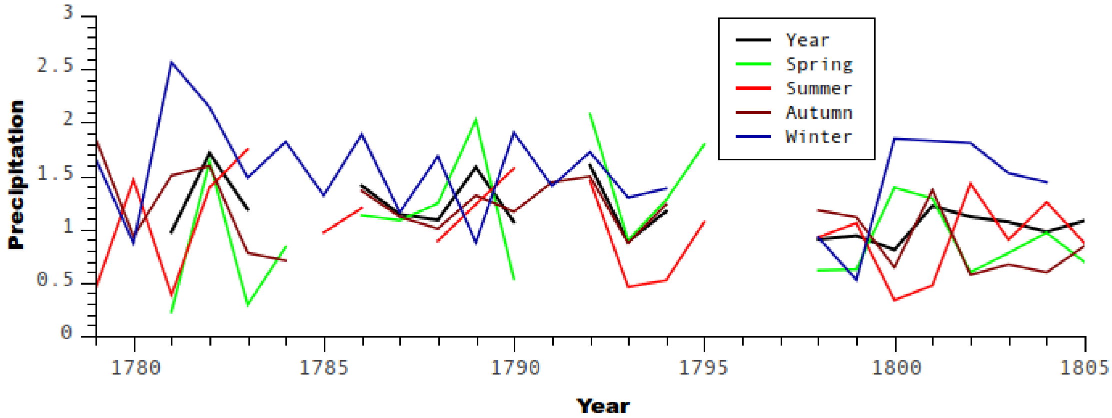

Figure 64: The precipitation record from Elihu Robinson's diary.

Testing the records

As they are both based on the same intensity indexes, the weather records should be broadly similar during the overlapping years, from 1779 to 1781. Statistical correlation between the two diary records would be expected, not least because seasonal changes should over-ride minor discrepancies. The closer the correlation is to 100%, the more confidently it can be asserted that the diarists' records, and the subsequent translation and compilation of the data, accurately reflect the weather of the time. Over the three years, monthly temperature indexes were investigated using Spearman's rank correlation, resulting in a strong correlation between variables (*rho* = .782, *n* = 19, *p* = .000) (Figure 65). There was a weaker correlation between precipitation variables (*rho* = .578, *n* = 24, *p* = .003) (Figure 66). Values for weather intensity were also compared, as these can be considered quasi-independent from seasonal variation, but these did not form a statistically significant correlation. The records show that even the weather records of two similar people, only a few kilometres apart, writing at exactly the same time, do not tally with one another exactly. The reasons for this are numerous. Comparison in the middle of the period is hindered by an eight month gap in Fletcher's diary due to illness, and there were significant gaps in Elihu Robinson's temperature records because he tended to discuss precipitation more. Indeed, if both diarists were to mention all characteristics of the weather when making their reports for a specific day or period, both records would be a lot richer. As it is, often the diarists simply comment on the most notable aspect at that time, whether it be an unusually wet period or a few hot days.

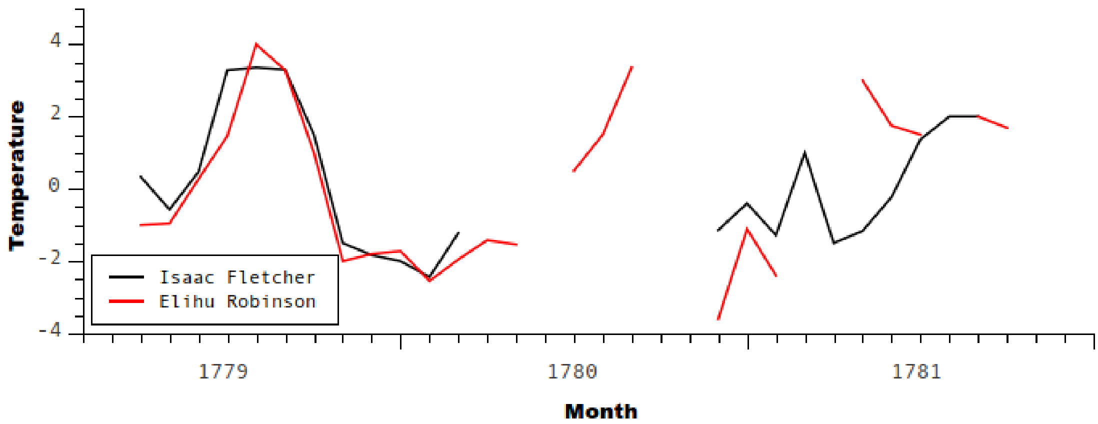

Figure 65: Comparing temperature records from the diaries of Isaac Fletcher and Elihu Robinson. The records correlate well in 1779.

There are some instances where the monthly averaging method and a lack of comments have clearly skewed results. For example, the two '3' values for precipitation in the November and December of 1781 in Robinson's record are derived from only a few comments, covering around one week's weather of the two month period. There are also some occasions where the records do not agree, possibly as a direct result of recording deficiencies. Fletcher, for example, describes the February of 1781 as being fairly dry, with only one day recorded as 'wet'. Robinson, however, claims it was a month of “very wet, windy disagreeable weather”. The frequent instances where the two records do not match warn against uncritical readings of the data. Certainly, the suggestion that the records provide an unambiguous overview of weather conditions should be vigorously resisted. We can, nevertheless, be confident the means by which weather statements were translated to numerical values was effective. This is evidenced by the period through 1799 into early 1800, where precipitation and temperature records both correlate very well. For these months, at least, the same weather was experienced and recorded, and the translation method was then successful in generating similar numerical values from those qualitative statements. At this time, it is reasonably certain that the method has developed a fairly accurate portrayal of the weather, one that can be compared with any other produced in the same way. In confirmation of the problem identified at the beginning of this section, however, it seems clear that most difficulties arise from scaling the daily record to provide monthly, seasonal or yearly averages. This smoothing of the data imperfectly masks the fact that, despite the apparent detail of the diaries, much of the weather went unrecorded.

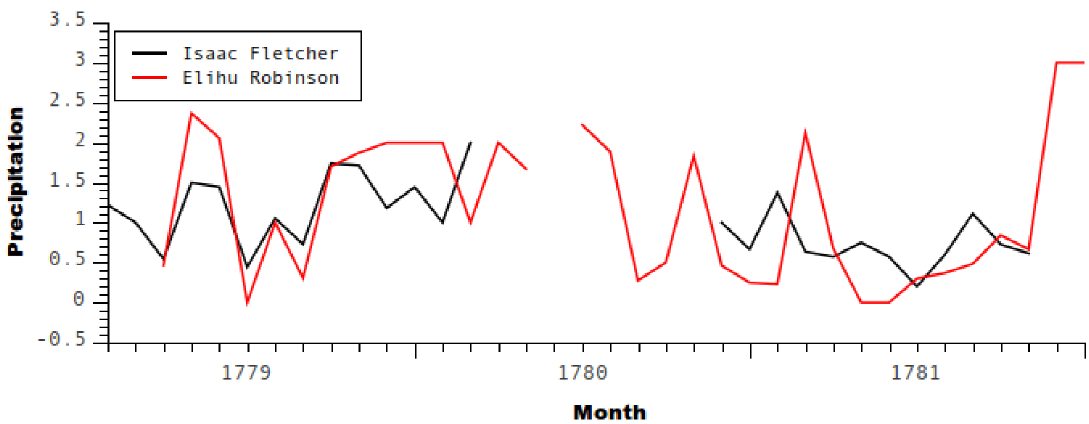

Figure 66: Comparing precipitation records from the diaries of Isaac Fletcher and Elihu Robinson. The records correlate more closely in 1779.

Commenting on the Weather

So far, the analysis has focussed on the diarists' direct comments on the weather, but the sources also contain information about how the weather impacted upon daily life. Most obviously, these relate to activities on the farm, such as when Isaac Fletcher (16/9/1773) records a “great shake & loss in corn” as a result of high winds, or when it is noted that frost stops the spring ploughing, as it did in 1771. Often the impact of the weather is not simply discussed in terms of isolated events. As might be expected, there are numerous comments on the seasons, whether they are 'forward' (early) or 'back' (late), or whether they are good or bad for the crops. The importance of good weather during harvest time is underlined by the frequent mention of showers or wet days that impede progress, and the welcome 'drying days' after a period of damp weather. Incidentally, in this respect, the hay crop receives as much attention as the grain crop, perhaps underlining the importance of hay as a winter fodder. Interestingly, Isaac Fletcher only records one incidence of drought, in the summer of 1765, but this was not one of the driest seasons, as observed in the weather record. Livestock can also be affected by the weather. During the cold winter of 1776/7, frozen snow, three inches deep, prevented the animals foraging. In February of 1777, continued snow meant Fletcher was "obliged to fodder the sheep twice a day". Problems were not restricted to winter. In June 1778, Fletcher commented that the cold and showery weather was "very dangerous for the cattle just put out".

Whilst often characterised simplistically, it is the impact on farming that forms the basis of most interpretations of climate-society interaction. Less considered is how other aspects of daily life were affected. Major floods, for example, damaged Fletcher's properties in 1761, 1764, 1773 and 1777. In November 1767, the floods were so great that water came over the bridges. Violent storms were frequently recorded, and some were particularly bad. On 23rd March 1757, Fletcher notes "a violent storm of wind and rain … which continued for about 24 hours. It blew very hard most of the time with some loud claps of thunder about 2 in the morning & continued lightning most of the night. Very considerable damage is done in many places unroofing of houses & some blown down. Considerable damage done to shipping". The year before, a storm of particularly high winds during harvest time meant that there was "not one shock standing in all the neighbourhood," and much corn was lost in the "shake" (IF 7/10/1756). Winter was, understandably, frequently associated with bad weather. Sometimes the frosts were intense, and on several occasions, the ice on Loweswater was so deep that people could skate on it. Without modern insulation, the frost could get into the houses: in January 1775, Fletcher wrote that "it freezes to the very fire sides." At the same time, Fletcher was forced to fodder the animals due to lack of grazing, while the potatoes were damaged by the frost. The interest in unusual weather events was not restricted to the immediate locality. Fletcher (20/6/1756) records a storm causing £2000 worth of damage in Kent and Essex in July 1755. At the Quaker meeting on 14th October 1764, a collection for the poor was undertaken for the victims of a hailstorm in Sussex.

Although the extreme or unusual weather events make the most interesting diary entries, it is striking to note how often plans were changed as a result of moderately bad weather. Obviously, any work performed outside was under threat, but here again, the theme of transport and mobility arise as central to daily life. Certainly, there are many occasions when ice and snow made the roads difficult or impassable, and even a burst of rain or a particularly cold day was sufficient to make Fletcher reconsider travel plans. In July 1778, Fletcher avoided going to a Quaker meeting simply because it was wet in the morning. Non-attendance at meetings, either by Fletcher or others in the congregation, was frequently attributed to the weather – and not necessarily bad weather. In August 1771, for example, Fletcher comments that a meeting was "very thin on account of a fine hay day" – the implication being that making use of a fair weather day during the hay harvest was more important than fulfilling religious obligations. Although causing people to miss a religious meeting might seem like a rather banal or unimportant intrusion of the weather in people's daily lives, it should not be forgotten that these meetings were the centre of religious and social life. With the Quakers so dependent on the network of Friends for business and social support, it quickly becomes apparent that a sustained period of disruption to the meetings could have had serious adverse effects to individuals and the community as a whole.

One of the most interesting aspects of the above analysis is that incidents of particularly bad weather do not necessarily occur during the most extreme years identified from the weather records. A quick comparison of seven of the most notable flood events, for example, reveals only one that occurred during one of the wettest seasons. Similar results are observed when other events, such as intense frosts, drifting snows and bad storms are considered. It is clearly difficult to move between the perceived impacts of bad weather, as observed by Fletcher in his diary, and the long-term trends and yearly summaries that are essential in producing a comprehensible overview of the weather records. Part of the problem is that this analysis it primarily anecdotal, relying on a random selection of some of the more notable events to characterise Fletcher's relationship with the weather. This problem is even more acute when dealing with Fletcher's overall impressions of seasons or years, which are important to understanding the relationship between weather patterns, people's perceptions and social and economic impacts. A more systematic approach, in part precluded by the shear density of the data, would need present more quantifiable results, in which people's perceptions of seasonal weather and the likelihood of notable weather events can be examined in relation to annual and seasonal weather trends.

The Diary of Elihu Robinson: Qualitative Analysis

The production of a transcript of Elihu Robinson's diary enabled a systematic qualitative analysis of the text using QSR Nvivo 8 software. The document was coded with over 1100 references, specified according to a variety of criteria designed to investigate attitudes to and impacts of weather. As well as being able to count how many times a specific subject is mentioned, references can be ordered chronologically to build up a picture of weather impressions as they changed over time. Although, Robinson's diary covers a slightly later period and moves the focus away from Mosser, it does allow us to look at how the turbulent years of the late eighteenth century were experienced by people in Cumbria. There were two major wars and threats of invasion during this time, and the trauma of the 1790s is plain to see in Robinson's entries. It is interesting to look at how and whether these wider social tensions can be linked with everyday engagements with the Cumbrian weather.

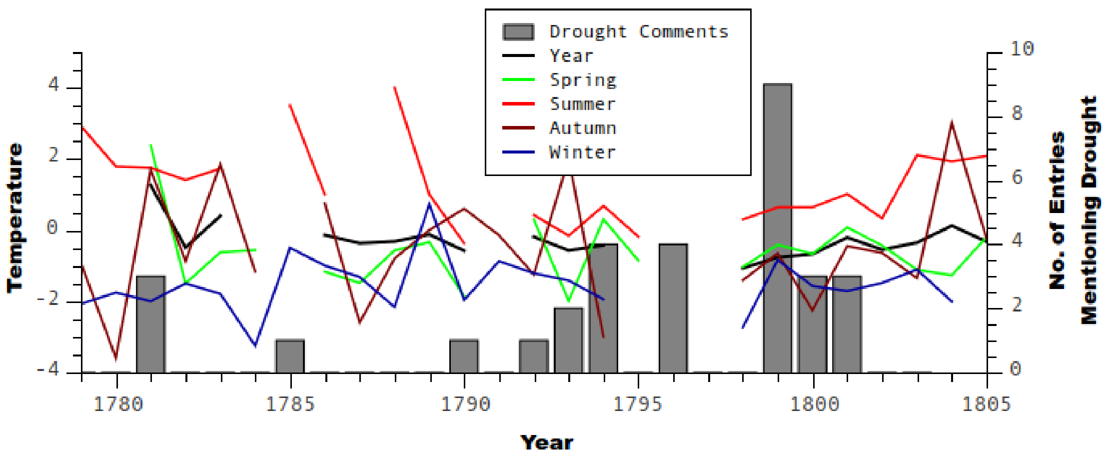

Figure 67: Entries mentioning drought within Elihu Robinson's diary compared with his record of temperature. There appears to be little correlation between temperature and mentions of drought.

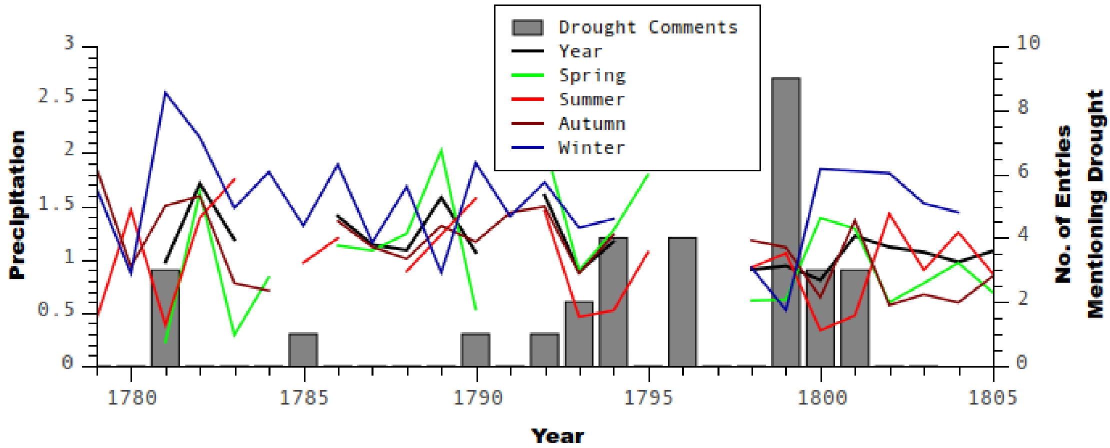

Figure 68: Entries mentioning drought within Elihu Robinson's diary compared with his record of precipitation. Drought is most commonly mentioned in response to dry summers.

Overall, there are 77 instances of remarkable weather in Robinson's diary. By and large, these conform to the familiar themes outlined in the analysis of Fletcher's diary, tending to focus on storms, frosts, or particularly good or bad weather for the harvest. In contrast to Fletcher, who only rarely commented on drought or very dry weather, Robinson's diary contains 31 references to the subject – this appears to confirm the idea that the lowlands were more susceptible to drought. There were three or more references per year in 1781, 1794, 1798, 1801, 1802 and 1803, and these loosely correlate with dry years identified in the climatological analysis (Figures 67 and 68). Interestingly, there are only three years in the 25 year period that contain no mentions of weather damaging the crops. This contrasts with the 19 years when there are no mentions of the weather affecting livestock. As at Underwood, other problems with weather on the farm at Eaglesfield included ploughing stoppages due to snow or frost and wet harvests. Likewise, Robinson often commented on the disruptions to travel and transport, whether by recording shipwrecks at sea, bridges brought down by floods or the poor state of the roads. There is an overall trend of comments regarding negative impacts of the weather growing in frequency during the 1790s, culminating in a period from 1799 to 1802 (but not including 1800), when concerns about the weather were running at their highest (Figure 69).

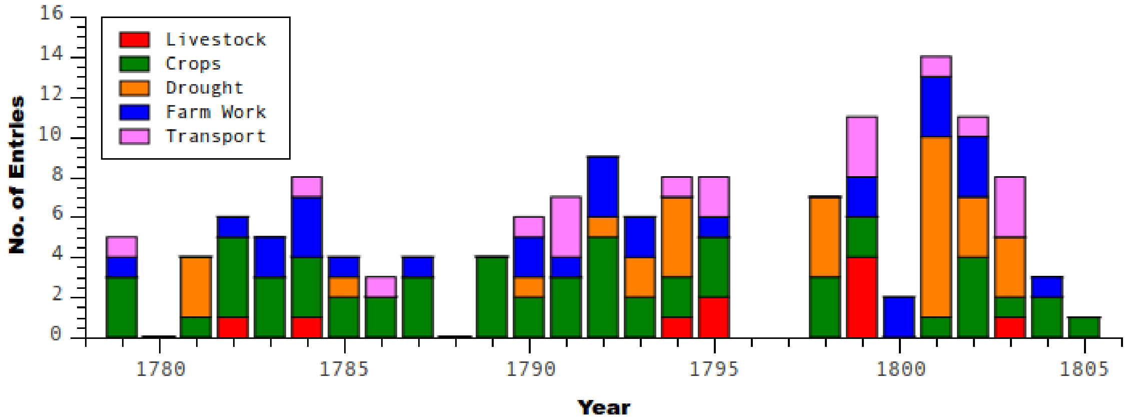

Figure 69: Chart showing the frequency of entries reporting the negative impacts weather. The weather appears to get progressively worse throughout the 1790s.

Seasons

Robinson was very interested in the farming calendar, and made frequent references to particular points within the farming year. These include the first and last sowing, the first and last hay mow, the first and last grain cutting, as well as the dates when the last of the harvest was taken in from the fields. These notes did not just refer to his own farm. In August 1779, he notes: “The first grain I saw cut was wheat at Papcastle on the 17th and that day grain fell in ye market very considerably.” This kind of comment was quite typical, and Robinson clearly found it useful to reflect on how weather affected these dates. This is underlined by tendency to obsess over whether spring, hay-time and harvest-time were 'forward' (early) or 'back' (late). In total, there are 51 references to the timing of spring, comprising 31 late and 20 early, a further 58 references discuss the timing of the harvest, with 33 late and 25 early. With regards to the timing of spring, Robinson had a number indicators on which he relied, year after year. These included noting the date of when he heard the first cuckoo or saw the first thorn leaves. This was not a practice exclusive to Robinson. He frequently mentions discussing these signs with his neighbours, as well as noting down what the local newspapers say on the subject. Given the importance of farming to the nation's health and economy, the arrival of the growing season after winter was undoubtedly an important milestone in the farming year – this interest in 'first signs' reflects that.

Year	Harvest Prospects		Actual Harvest	
	Bad	Good	Bad	Good
1779	1	1	1	1
1780	1	0	0	1
1781	0	0	0	0
1782	1	0	1	0
1783	1	1	0	0
1784	0	0	0	1
1785	0	0	0	0
1786	1	0	0	0
1787	1	0	1	0
1788	1	1	0	0
1789	1	0	0	0
1790	1	0	1	0
1791	1	1	0	1
1792	1	0	0	1
1793	0	0	0	1
1794	1	1	1	1
1795	1	0	0	1
1798	1	1	0	1
1799	1	0	0	0
1800	1	1	0	1
1801	1	1	0	1
1802	1	1	1	1
1803	1	1	0	0
1804	0	0	0	0
1805	1	0	0	0
Total	**20**	**10**	**6**	**12**

Table 6: Years with entries containing comments on the harvest or harvest prospects are marked '1'. Bad harvests did not always follow reports of bad harvest prospects.

When references to the timing of the seasons are combined with statements about the predicted quality of the forth-coming harvest, they show that an early season tended to be associated with a good harvest, and *vice versa*. Using commentary on the quality of the harvests, rather than their future prospects, it is possible to see how often Robinson's predictions were realised. When this is done, it is striking how often bad harvests did not materialise after initially reporting poor prospects. Only six harvests in the 25 year period were described as being bad once the crop had actually been taken in. Conversely, the vast majority of the time, good prospects led to good harvests (Table 69). It is likely that there is a recording or coding bias that has caused bad harvests to be under-represented. This problem is probably at its most acute during the 1790s, when numerous years with poor harvest prospects seemingly did not result in particularly poor harvests. Alternatively, on occasion, Robinson's pessimism is clearly unfounded. In 1801, for example, Robinson was extremely sensitive to the weather, frequently commenting on its adverse affects on the crops and the poor harvest prospects. Taken on these factors alone, 1801 would stand out as by far the worst year for crops. Despite these concerns, however, the summer of 1801 ended with a very good harvest and a lowering of grain prices.

Prices

Robinson's commentary on grain prices is worthy of discussion. At some points, they are recorded so frequently as every week, either from the Cumberland Pacquet newspaper or word of mouth. Later on in the diary, prices from the London Market Herald are also recorded, demonstrating Robinson's keen interest in the subject on a national level. Although it would be tempting to assume that high prices equated to a poor harvest and bad weather conditions, it is important to remember that supply and demand is only one aspect of price volatility. E. L. Jones (1964: 47) has commented that, given the complexities of the subject, “it is hazardous to make assertions about causal connections between weather and the economic fortunes of agriculture.” The prospects of a bad harvest could cause prices to rise, as much as a physical drop in supply or numerous other affecting factors. Furthermore, Jones (1964: 130–1) points out that “even when bad weather seriously damages physical production in agriculture it cannot be assumed that the financial loss is commensurate.” This is because a reduction in supply could easily result in increased prices for the remainder that make up for the drop in quantity. It is, nevertheless, interesting to examine whether Robinson's noting of high prices correlate with predictions or descriptions of poor harvests. The results show several occasions when comments regarding high prices become more frequent: in 1783-4, 1790-1, 1795 and 1799-1802. 1800 stands out as the worst year, with no less than 14 comments about the high price of grain. This underlines the significance of the years from 1799-1801 as being particularly bad, with 1799 also containing a large number of comments remarking on bad weather. The results show that there is a relationship between poor harvest prospects and higher grain prices, but it is only a loose one (Figure 70).

Even if Robinson was not adversely affected, high prices certainly had an impact on the rest of the population, most notably the urban poor. This is supported by evidence from the diary, which records distress amongst the poor in 1784, 1791, 1795 and from 1799-1802 – precisely the years when grain prices were at their highest (Figure 71). This was no mild grumbling: in 1791, Robinson described people as “starved”, and in 1795 following a period of wet weather during the height of the hay harvest, Robinson records “mobs rising in several places!” Worst of all was 1800. In May of that year, food was extremely scarce. In effort to help some of the poor, Robinson sent his maid to Cockermouth with a coup of potatoes, with strict instructions not to ask above 8 pence per stone – well below the market rate that day: “She was soon surrounded by a multitude, agitated by different passions! Some swearing some praying! & perhaps some crying in order to be served: They were soon sold & notwithstanding her care & vigilance, she supposes several did not pay – however she made One Pound, Five Shillings & Nine pence half penny – I think the most I ever made out of one coup – deplorable distress!” Through Robinson's compassionate eye, the severity of the situation is thrown into stark relief. Robinson himself was not unaffected, his comments from 1799 to 1801 become increasingly negative. At the end of 1800, he laments that it is “still a gloomy prospect! Deplorable distress! War & rumours of war! Manufactories dull & trade languid! Provisions exceeding high!” His comments were perhaps justified, as this is the only year within the diary when the prospect of famine is raised.

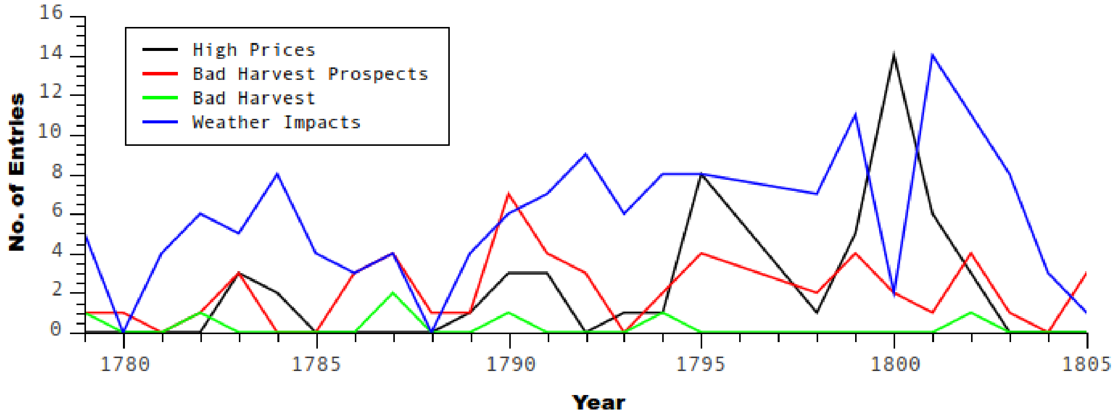

Figure 70: Frequency of Elihu Robinson's diary entries concerning high prices, bad harvest prospects, bad harvests and weather impacts.

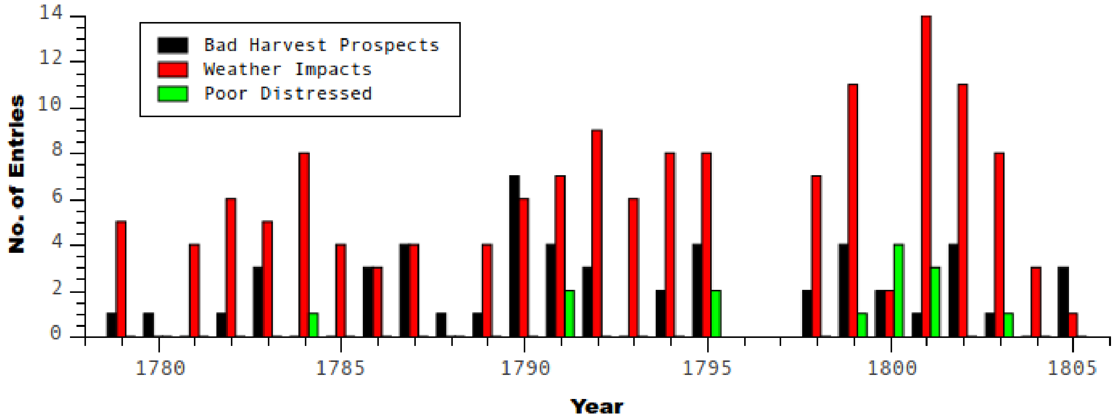

Figure 71: Frequency of Elihu Robinson's diary entries concerning bad weather prospects, negative weather impacts and distress amongst the poor.

Robinson's diary documents a number of attempts to ease high prices and food scarcity. Again, the importance of hay is highlighted by its inclusion in mitigation measures. In 1795, for example, a severe winter caused a scarcity of hay that was compounded by a hot and dry summer, resulting in a prohibition on exports. A month earlier Robinson noted the following: “In consideration of ye extraordinary high prices of wheat, a great number of noblemen of ye highest rank, have agreed to use no wheat flour in their houses finer than all ye wheat ground together the bran or hull only excepted which flour is to weight three fourth part of ye weight of ye wheat”. Similarly, in 1801, “an Act of Parliament passed prohibiting under severe penalties and flour to be made finer than taking out a little bran through a wide sieve”. On some occasions the charitable spirit was more direct. With mobs rising in 1795, a programme of subscriptions were raised in Cockermouth and Workington, in order to sell oatmeal at a reduced rate to those most in need. There can be no doubt that these kinds of intervention were only partially successful in alleviating the suffering that Robinson clearly believed was widespread. His moral indignation at the disparity between rich and poor is highlighted in a short passage where he describes the luxury at which Prime Minister William Pitt dined during an event in London: plates of strawberries, peas and cherries during a “severe and scarce season … did not seem making a feast for ye poor, His lame & ye blind!”

On the farm, there were a number of practical steps taken to deal with bad situations. There is one instance, in 1800, of public advice recommending changes in farming practices. On this occasion planting plenty of potatoes was encouraged, as they were “the most likely of any English produce to supply the want of grain.” Most of the time, however, it was up to farmers to make their own decisions about how to maximise production and profit during times of scarcity. In spring 1800, Robinson remarked that there were the most turnips and that least wheat sown in Eaglesfield than he could remember in the previous 30 years. In contrast, of course, we have already seen how a year later, in 1801, a large amount of oats and barley were sown, resulting in the most land in tillage within memory (see Chapter 9). With grain prices at astronomical levels, the extensification of cultivation at this time was probably guided by the drive for profit as much as it was compassion. Nevertheless, the farmers themselves were not immune to strife. The loss of animals could be particularly devastating. During the summer of 1795, Robinson records one story from Poole on the south coast, where thousands of animals were lost because “the late cold & wet weather has proved very destructive amongst ye sheep that have been shorn”. In 1784, bad weather during lambing time was of great concern to Robinson himself, who described the snow at that time as “very distressing for ye poor lambs”. Fortunately, however, Robinson was never in the position of having to feed cows “the muck of others” or even only “spirit and water”, as was rumoured in parts of the country during the dark days of 1799.

Causality

We have seen thus far that high prices were the source of some of the more troubled periods covered during the course of Robinson's diary. Following Jones' (1964) comments on farming and prices, and looking at the evidence from the diary itself, it cannot be said that all the high prices were related to bad harvests and poor weather conditions. In 1801, for example, Robinson at least partially attributes the high prices to the effects of the war with France. He states: “war & famine now almost united, embargo laid on all shipping from Russia, Sweden, and Denmark. Gloomy indeed! Darkness that may be felt!” There is no doubt, however, that tensions in society made people more sensitive to the weather. 1801 is a case in point: there was near panic over the prospects of a bad harvest, but concerns were proved unfounded. This is not to say that the weather was not a contributory factor to social strife. Certainly, specific weather events could exacerbate already bad situations. In the harsh winter of 1795, Robinson records: “said to be 300 Ships blocked up in ye Thames, thirty thousand cauldron of coals in ye river which cannot be got at. Great Distress!” On a more general level, the bad weather and harvest of 1799 set the tone for the dire situation at the turn of the century. In fact, all of the years identified as being most traumatic for the population either directly followed or were years in which there were concerns about the quality of the harvest. Crucially, discussion of the weather and its impacts also appears to increase significantly during these periods (Figure 71).

There is a dialectic relationship between these various phenomena and the recording of bad weather. As a result, it is not possible to fully disentangle how many of the social problems and high prices are caused by bad weather. Although in some circumstances, bad weather probably was the source of high prices and social tensions, it is equally likely that during times of stress, many of the bad weather comments can be attributed to an increased sensitivity to weather. Using a range of coding categories, including comments on how weather affected travel, work on the farm, animal welfare and the growth of crops, it is nevertheless possible to pick out years that appear to have been particularly eventful. These bad years become more frequent during the 1790s, with 1792, 1799 and 1801 standing out as being the most dramatic. It is striking, however, how the bad years for people tend not to correlate with the worst years of weather, as identified from the weather records – the notable exception being 1799 and 1800. Weather certainly was a contributory factor in social strife at the end of the eighteenth century, but it was not the only one.

Recording the Weather

It is important to avoid viewing the diaries only as a catalogue of events. John Moreland (2006: 143) laments that “there is still a tendency to see texts as providing evidence about the past rather than having efficacy within it.” Drawing on the extensive body of North American historical archaeology (e.g. Beaudry et al. 1996; Deetz 1996; Leone 1996), Moreland (2001, 2006) argues that texts should be treated like any other piece of material culture: “It may never have been intended that the objects (and texts) survive as evidence about the past (the small things probably were forgotten), but we should not doubt that, in the context in which they were produced and used in the past, they were meaningful ” (Moreland 2006: 139). By considering the diaries in this light, we can begin to examine how the process of recording attitudes to weather is intimately bound up in the diarists' worldviews and senses of place and identity. This draws us closer to the anthropological perspectives on how people's relationship the weather was an inherently cultural experience.

Jan Golinski's (2007) *British Weather and the Climate of the Enlightenment* looks specifically at how British attitudes to weather were deeply embedded in the development of Enlightenment values. This relationship found its most cogent expression in the recording of weather: “Most weather diarists conceived of their activity as part of a public program of natural history, a contribution to the collective enterprise of building up knowledge of nature" (Golinski 2007: 79). The regular recording, coupled with adherence to the new Gregorian calendar (introduced to Britain in 1752), established a framework of data collection from which it was hoped that new, progressive understandings would emerge. Writing a weather diary required discipline and patience. To illustrate this point, Golinski (2007: 85–7) draws on the example of John Rutty, a Quaker living in Dublin who kept a weather journal from 1725 to 1766. For Rutty, the process of making weather observations was part of his spiritual improvement: "Repeated and meticulous observation … demanded humility and self-abnegation by the observer" (Golinski 2007: 87), and "its aim was to reveal the regular workings of divine providence in nature, to address what he called 'a common species of blasphemy[:] … crying out against the weather'" (Golinski 2007: 86). Although Rutty was regarded as an eccentric, the spiritual and moral imperative he placed on his work would have been well understood by the Cumbrian diarists, particularly given their disposition as devout Quakers. Indeed, patience was a virtue much lauded by Robinson, who often responded to times of stress with comments like "our best remedy is Patience" (August 1790) or "let us wait with patience & submissive hope" (September 1790). The recitation of such mantras clearly afforded Robinson some degree of comfort, acting as a reaffirmation his spiritual and philosophical world-view in the face of challenging circumstances.

In trying to understand the weather through the process of data collection and diary-keeping, Isaac Fletcher and Elihu Robinson were joining contemporaries in the gentlemanly scientific community. This, as shown in Richard Holmes' (2009) *The Age of Wonder*, was central to the Enlightenment programme of progressive scientific inquiry, and we have already seen how the Quaker network in north-west Cumbria produced luminaries of such standing as John Dalton. The scientific method required a particular mode of working: "personal idiosyncrasies had to be hidden so as not to impede the translation of private records into the common stock of knowledge" (Golinski 2007: 84). This perhaps accounts for some of the dryness of Isaac Fletcher's diary, in particular, whose blunt and concise wording in relation to the weather often bordered on the robotic. However, despite the obvious desire to develop a scientific understanding, there are signs of tensions between the rational enlightenment outlook and more traditional received wisdom. We have already seen how the diarists were keen to take note of traditional signs of spring, such as thorn leaves and cuckoo calls. Golinski (2007: 91) argues that “this lore is integrated with the rhythms of rural life, the festivals and other communal activities that punctuate the cycle of the year.” It is a form of weather forecasting that is intimately linked with the agricultural calendar and life outdoors. References to weather proverbs, such as “3rd month came in spring like, or according to ye old adage 'like a lamb'. 'The flowers begin to spring, the skies to brighten, & the birds to sing”, are also an example of this type of 'weather wising' (Strauss 2003). By incorporating these observations into the more programmatic accounts of the weather, the diarists are attempting to reconcile the two competing bodies of knowledge: traditional and scientific.

In their diligent recording, the diarists also provided a means by which claims can be tested. It is not uncommon to encounter a weather proverb followed directly by an evaluation of its predictive veracity. For example, in 1800, Robinson wrote this entry: “1st month came in with a morning red! Which is often looked on as a sign of wind, snow or rain! Fine calm day; but next morning a storm of snow from SE.” While today, in the Western world, more faith in might be placed in meteorological science over weather proverbs, the diarists were equally sceptical of both types of knowledge. Elihu Robinson's trials and tribulations with his barometers are a case in point. Barometers during the eighteenth century were the principal instrument within “polite science”, and they clearly fascinated Robinson. He had at least two, noting the purchase of a new 'diagonal' type in the autumn of 1799. This followed a string of entries that showed intense dissatisfaction with the old barometer's readings: “the barometer & weather much at variance it being often about fair or settled fair, yet flood after flood”; “moist & growing & very wet about ye middle: though ye barometer between fair & settled weather”; “between settled weather and great drought: that it appears the air may be very dense or heavy & yet bring rain. Hence we have no instrument to prognosticate rain or fair”. Here, Robinson's frustration is palpable.

In 1790, an entry explains precisely why good forecasting was so desirable: “I was particularly cheated out of getting 2 or more cart loads of oats by dependence on ye barometer which stood about 12° or 13° on ye 10th being a very fine day: and very stormy before ye next morning! Beware for ye future!" In an agricultural economy that relied so heavily on good and well-timed weather for harvesting, the advantages for a farmer who was able to accurately prognosticate the weather are clear. According to Golinski (2007: 136), "the tendency to place excessive faith in the predictions of the instruments was regularly castigated, but also tacitly encouraged by the way it was marketed." The device's intransigent behaviour meant it could be likened to the long-established means of weather prediction, such as astrology. Thus although the barometer was developed as a means to transcend discredited superstitious practices, the tradespeople that sold them relied on tacit references to those traditions in order to cement the instrument's popularity (Golinski 2007). In this respect, the diarists are situated at the very threshold of modern meteorological understanding. It was a position in which every failed forecast, whether by weather proverb or barometric reading, represented superstitions that were increasingly derided by polite society as relics of barbarism and ignorance, and yet also a scientific understanding that was only incompletely formed and still wedded to a less rational past (Golinski 2007: 171).

Perceptions of Weather

We have seen how the process of recording the weather was one deeply tied to prevailing public sentiment regarding what was expected of polite society, but it also was emblematic of a wider confluence of ideas concerning knowledge and morality. Through their comments, the diarists show that their personal perceptions of weather were bound up with their cultural and religious identity, and their understanding of how the world works. Donald Brooks Kelley (1982) describes eighteenth-century Quaker attitudes towards the environment in terms of stewardship of God's bounty. This, Kelley (1982: 80) argues, distinguished the Quakers in America from the "Puritans with their aggressive inclinations to 're-form' the American environment". It is, however, possible to draw parallels between the Quaker outlook and the peculiarly British tendency to view the moderate British weather as "an example of God's providential benevolence to their country" (Golinski 2003: 21). Providence was certainly a key theme of Robinson's exhortations regarding the weather and seasons towards the beginning of his diary. He made a number of comments regarding its power to offer a moderate climate: "after such a wet & cold summer and ye harvest so back it was remarkable favour of kind providence, that ye 9th & 10th month were very dry & pleasant". Even under challenging circumstances in 1795, Robinson's faith was unshaken, arguing that "some times seeming evils in the dispensations of providence are productive of substantial good!" This reflects the emphasis Robinson places on patience and the act of submission. Bad weather was trial that was met with a mantra that "to reason right is to submit, & do our best." Like Rutty earlier, Robinson saw no value in 'crying out against the weather', claiming as he did, "to murmer against ye weather can avail nothing & cannot be right".

During the torrid year of 1800, it is possibly to detect a slight change in attitude as Robinson becomes increasingly depressed concerning the state of world affairs, particularly the wars raging across Europe. He writes: "I have sometimes thought it was not very unlikely, that in ye wisdom & justice of providence, this nation might be humble by some punishment as well as ye nations around us: and as other have suffered by ye Sword of Pestilence! It seems our lot to suffer by famine!" Providence, no longer the benign and passive moderator, is now implicated as an active enforcer of social justice. It is not so much that Robinson has taken on a more evangelical ideology, where God is seen to actively intervene in earthly affairs, but that divine providence is now an arbiter of human morality as well as the physical environment. In this respect, the weather itself takes on an ethical dimension, one that harks back to superstitions of divine retribution and the Biblical flood (Golinski 2007: 45). Robinson's sense of the weather, and how it is expressed and understood in his religious world-view, was directly connected to his experience of world events and social awareness. Just as price movements on the grain markets were likely the product of both physical events and metaphysical concerns, poor social and economic conditions heightened Robinson's sensitivity to bad weather and *vice versa*.

The interconnectedness of human action and the weather betrays an almost ecological outlook (Ingold 2000: 19; Kelley 1982). This is visible in other areas of Robinson's thinking. For example, in concordance with the eighteenth-century Hippocratic tradition, which related physical well-being to characteristics of the air, Robinson noted that "such frequent & sudden changes [in weather] seem to be ye cause of a very common disorder like a severe cold". These ideas were outdated even at the time, with John Rutty arguing that "trying to correlate the weather of the British Isles with the progress of diseases was as hopeless as fixing a sundial on a weathercock" (Golinski 2007: 146), but it shows the extent to which weather was intimately woven into Robinson's understanding of the world. Similarly, after experiencing an earthquake on 11th August 1786, Robinson makes special note of the weather at the time, immediately followed by a comment implying that the quake was a warning from God: "May such a gentle warning have its due effect, by turning our minds to consider our latter end". In doing this, Robinson simultaneously acknowledges a branch of scientific research that posited weather as fundamentally related to subterranean movements (Golinski 2007: 22), as well as drawing on religious superstition. As a warning, the earthquake (and by Robinson's association, the weather) is a perturbation of the natural environment that is once again attributed with a religious and moral imperative, that affects and is affected by the general condition of society.

When taken together, the diarists' perceptions of weather, and the very process of recording it, reflected "an image of the society they inhabited: a substantially literate culture still imbued with oral practices; a partially urbanised society still rooted in the traditions of rural life; a culture that embraced science and technology while still exhibiting vestiges of magical thinking" (Golinski 2007: 76). It was a time of rapid changes, with prevailing attitudes to weather in a state of flux. There is a contrast, for example, between the diarists' records of weather – contained amongst discussions of social, religious and agricultural life – and John Dalton's (1793) regimented instrumental weather records. As Golinski (2007: 215) concludes, prevailingly "the regular climate was viewed as benevolent, a force that integrated human beings with their environment, that answered to their needs, and could even be modified by the progress of civilisation." We have seen in Robinson's diary, that at times of great stress and anxiety, this view was challenged with those that harked back to the less rational past. Crucially, however, there was a greater challenge that developed from the disciplined dedication of weather diarists.

In *Reading the Skies*, Vladimir Janković (2000: 5) describes the development of meterological reportage as constituting "an aspect of English geographical thinking during a period concerned with the creation and sustenance of national, regional, and parochial identities with respect to the moral topography of the land." Thinking about weather was directly associated with thinking about place, and conflicts between local and regional identities were played out through knowledge of the natural world (Janković 2000: 122–4). As instruments and recording methods became more standardised, this relationship became more abstracted. Elihu Robinson's ecological perspective, almost certainly shared by Isaac Fletcher, involved a recognition of the intractability of human society and its natural environment (Kelley 1982). The new meteorology of the laboratory displaced this perspective as its proponents conducted experiments and meditated on causality. These new meteorologists advocated "a 'removal' of meteorological practice from places of life to places on the map" (Janković 2000: 159). This thinking engendered a gradual separation that eventually resulted in the disconnection between people, land and climate, that forms a central theme of this thesis.

Conclusion

Although the past two decades have seen moves towards interpretative and socially embedded perspectives in archaeology (Barrett 1994; Hodder 1991; Tilley 1994), their application in the context of environmental data has been fairly rare (Bender et al. 2007; Evans 2003). Moreover, studies have tended to focus on the more distant past, imaginatively utilising ethnographic analogy to create people-centred interpretations (Thomas 2004: 238–41). By working in the historical period, and by examining personal diaries, it is possible to develop inhabited perspectives that in part derive from the private thoughts of those being studied. The two diaries examined in this chapter provide an insight into the eighteenth-century experience of, and attitudes to, weather. Using methods developed in historical climatology, it was possible to convert qualitative statements into quantifiable weather data. This process was not without its problems. But although the records cannot provide an unambiguous overview of weather conditions through time, we can be confident that at times when there are a profusion of entries, the method provides a fairly accurate and quasi-objective portrayal of the weather experienced by the diarists.

Despite providing illustrative anecdotes, it is difficult to interpret bad weather, as observed by Fletcher in his diary, in the context of the long-term trends and yearly summaries that make an overview of the weather record comprehensible. In an effort to address this problem, a systematic qualitative analysis was performed on Elihu Robinson's diary. This showed that by looking at how the frequency of different types of statement changed over time, it is possible to determine the periods of most concern. However, although there is a tendency within Robinson's diary for entries regarding high prices, social distress and unrest, and to a lesser extent, bad weather to cluster together, it is not clear precisely how these events are related. It could be that Robinson wrote about bad weather and poor harvest prospects more when wider issues were causing him anxiety. So although all of the years identified as being most traumatic for the population either directly followed, or were years in which there were concerns about the quality of the harvest, it is not certain that bad weather was the primary cause. Interestingly, in both diaries, the most serious incursions of bad weather seem not to have occurred during the most extreme years or seasons identified from the weather records. The exception is the years of 1799 and 1800 in Robinson's diary. During these extremely bad years, there appears to have been a perfect storm of bad weather, poor harvests and war.

Beyond the identification of good and bad years, the diaries provide an opportunity for looking at the diarists opinions and perceptions. These show how there were strong links between the diarists perceptions of the weather, their Quaker faith, and their sense of morality and social justice. Moreover, they demonstrate the difficulties in understanding the weather at time when scientific knowledge was becoming popularised, beginning to supplant more traditional, sometimes religious, conceptions of the natural world. In summary, the diaries can be used to reconstruct the weather, past experiences of weather, and attitudes to and perceptions of the natural environment. Crucially, it is possible to look beyond the text and view the context in which the diarists created and maintained their perspectives on the weather. The question is how this narrative compares with those for landscape and environment, and what that then means for how we think about weather, climate and landscape in the past.

The Experiential Narrative

The experiential narrative shows that coping with different weather conditions was an integral part of daily life, and that this was difficult when living on the edge of the Cumbrian fells. Extreme and unusual weather often impacted on farm work, and without central heating, homes were liable to get very cold indeed. It is also clear that milder, everyday weather was constantly in mind. Travel, whether by foot, horse or ship, was often affected, and attendance at the local Quaker meetings was heavily dependent on the weather. At the markets, food prices were probably only loosely related to bad harvests, but when there were high prices this caused significant distress amongst the poorer members of society. Although one might expect bad weather to cause bad harvests that then result in high prices and social tensions, this chain of events cannot be determined in the diaries. Indeed, there are examples where tensions in society made people more sensitive to the weather: in 1801, there was near panic over the weather causing a bad harvest, but concerns proved unfounded.

During the late eighteenth century, the very process of recording the weather was part of a moralistic programme of self-discipline and scientific inquiry. This linked the two diarists into a gentlemanly scientific community, which fostered many of the leading scientists of the day. In the programmatic entries of Isaac Fletcher, the dry daily account reflected a mode of working that aimed to downplay personal expression in favour of rigid objective data. Yet despite these allusions to the scientific method, entries from both diarists betray tensions between the rational enlightenment outlook and more traditional received wisdom. This can be seen in references to weather proverbs and frustrations with the predictive capabilities of the barometer. Each form of knowledge was tested and each rejected. The diarists were situated at the threshold of modern meteorological understanding, but it was a time at which people struggled to make sense of competing forms of knowledge. This conflict went to the heart of people's perceptions of the weather and the natural world.

The diarists' Quaker faith emphasised the providential nature of the weather – its perturbations met with patience and submission. Yet in times of great stress and anxiety, this passive moderator could take on the role of divine arbiter, actively altering the weather in retributive response to society's indiscretions. In this way, Elihu Robinson's perception of the weather was very much dependent on his personal experience, and moral and spiritual outlook on life. Arguably, the weather was so interconnected with the moral standing of society, the physical well-being of individuals, local and regional identities, the harvest and the seasons, and subterranean movements of the earth, that Robinson's thinking could be termed 'ecological'. At this point, however, at the end of the eighteenth century, this understanding of the world was under threat. New, more accurate and better understood, meteorological instruments were being developed, and recording methods were becoming increasingly standardised. As the modern study of meteorology came into being, the relationship of people to the weather became more abstracted. So although the experiential narrative shows weather as an integral and in some ways reflexive part of Cumbrian life in the eighteenth century, it was also the time at which the gradual separation of people, land and climate slowly gathered pace.

Chapter 12: Comparing Narratives II – Adding the Experiential Perspective

Introduction

Chapter seven, when comparing environmental and landscape narratives, encountered a number of difficulties relating to scale. On one hand, there were historical narratives that hinged on poorly resolved long-term environmental and social processes, which could only be loosely compared to one another. On the other, more highly resolved economic and instrumental weather data enabled closer comparison. Not only was there a disconnect in relating the different scales of analysis to one another, but even with high resolution documentary evidence, it was impossible to fully disentangle the extent to which weather affected social processes. In part, this was because even the rich historical dataset was replete with ambiguities and uncertainties, where equifinality was a prominent issue. The more detailed data did, however, provide the means to support or refute a number of hypotheses. The results from the economic data suggested that summer warmth or drought might have been a more limiting factor on crop cultivation than cool and wet conditions. This was particularly interesting considering the emphasis given to the latter in Parry's work. Much of the analysis was fairly functional in character, focussing on rational market economics and physical cultivation limits. Parry's method was used to make a model that made sense when tested against economic data, but there remain a sizeable number of problems linked to the assumptions inherent in its application in Mosser. Using the two historic diaries examined in the previous chapter, it is possible to add another layer to the analysis. The experiential perspective could go some way to addressing these deficiencies. How do the farmers' day-to-day experiences of weather factor into their decision-making processes, and to what extent is weather a factor in social and landscape transformation during the late eighteenth century?

Comparing Records of Weather

One core problem when attempting to relate social change to environmental change was the amount of uncertainty involved in using regional instrumental proxies to provide an indication of the climate of a small area on the north-west edge of the Lake District.

Any interpretation citing the weather as an important driver of change is immediately called into question when it is not certain that the weather is being accurately portrayed. Fortunately, the numerous entries recording weather in the diaries allow us to test the veracity of the regional instrumental series in the Mosser area. Such a comparison would, however, need to be approached with a number of caveats in mind. In the previous chapter, it was observed that the method of translating daily or weekly entries into monthly and seasonal averages imperfectly masks the fact that much of the weather went unrecorded. There were clear cases where only one or two days of weather were being extrapolated to reflect a whole month's weather. In this respect, the series that were produced do not always accurately reflect the weather experienced by the diarists. A further problem lies in the fact that the diaries do not provide an instrumental record. Thus although it is possible to compare trends, from cooler to warmer and drier to wetter, we cannot infer specific temperatures or rates of precipitation from the diaries. Fletcher and Robinson do take instrumental readings from time to time, but there is no way to test their accuracy – indeed, there are many problems associated with calibrating early instrumental readings (Jones 2001). Despite these caveats, the diary records can be used to provide a reasonable indication of whether the instrumental series have any validity in this area, particularly during times when weather was well recorded.

Isaac Fletcher

Newton Rigg Temperatures

	Year	Spring	Summer	Autumn	Winter
Year	X	X	X		
Spring		X			
Summer					
Autumn					
Winter					X

Newton Rigg Precipitation

	Year	Spring	Summer	Autumn	Winter
Year					
Spring					
Summer					
Autumn					
Winter					

Elihu Robinson

Newton Rigg Temperatures

	Year	Spring	Summer	Autumn	Winter
Year					
Spring		x			
Summer			x		
Autumn					
Winter	-X	-X	-X	-X	

Newton Rigg Precipitation

	Year	Spring	Summer	Autumn	Winter
Year	X				
Spring	X	X			
Summer					

Table 7: Correlation matrices showing the relationships between diary-derived and instrumental weather records. X = statistically significant correlation, x = practically significant correlation, - = negative correlation.

Statistical tests were conducted to assess the relationship between the diary-derived weather records and synthesised instrumental series (Table 7). Even accounting for the low number of cases (23 maximum), there is a remarkably low degree of correlation between annualised datasets. The tests found medium to large, positive correlations between Isaac Fletcher's yearly (*rho* = .465, *n* = 18, *p* = .052), spring (*rho* = .533, *n* = 23, *p* = .011) and winter (*rho* = .509, *n* = 23, *p* = .016) temperatures compared with the corresponding figures from the NRT. Yearly averaged temperatures from Isaac Fletcher's diary also correlate positively with NRT averages of spring (*rho* = .493, *n* = 18, *p* = .038) and summer (*rho* = .498, *n* = 18, *p* = .035) temperatures. There is no correlation between the precipitation figures from Fletcher's diary and the NRP.

In terms of Elihu Robinson's diary, there are no statistically significant correlations between temperatures in spring (*rho* = .383, *n* = 21, *p* = .086) and summer (*rho* = .396, *n* = 22, *p* = .091), but they might be of practical significance. Surprisingly, there are a group of strong negative correlations between winter temperatures from the diary and yearly (*rho* = -.680, *n* = 21, *p* = .001), spring (*rho* = -548, *n* = 21, *p* = .010), summer (*rho* = -.627, *n* = 21, *p* = .002) and autumn (*rho* = -.645, *n* = 21, *p* = .002) temperatures from the NRT. In warmer years, Robinson's record shows colder winters and *vice versa*. It seems unlikely, however, that warmer years genuinely occurred in tandem with colder winters. The results probably stem from a systematic or methodological bias: it is possible that Robinson became desensitised to higher temperatures during particularly warm years, thereby causing him to exaggerate the difference when winter came; alternatively, a similar effect could have occurred when translating the weather observations onto the ordinal scale. Yearly (*rho* = .627, *n* = 17, *p* = .026) and spring (*rho* = .510, *n* = 21, *p* = .018) values from Elihu Robinson's precipitation record correlate positively with the corresponding periods in the NRP. There were further positive correlations between spring (*rho* = .704, *n* = 20, *p* = .001) and autumn (*rho* = .449, *n* = 21, *p* = .041) precipitation in the diary and the yearly averaged NRP.

The records from both diaries were combined together by averaging competing values in the three overlapping years. The spring (*rho* = .492, *n* = 42, *p* = .001) and winter (*rho* = .431, *n* = 43, *p* = .004) diary records show statistically significant correlations with the NRT. There is no repetition of the correlations between diary winter temperatures and the various averages from the NRT. Of the precipitation records, only the yearly (*rho* = .518, *n* = 29, *p* = .004) record shows a statistically significant relationship. The relationship between spring temperatures (*rho* = .318, *n* = 32, *p* = .076) is perhaps of practical significance, however.

On the whole, temperature trends from Isaac Fletcher's diary appear more closely related to the NRT than Elihu Robinson's. The NRP is better reflected in precipitation values from Robinson's diary, although this is not surprising considering the NRP record only starts in 1766, thereby preventing comparison along the whole span of Isaac Fletcher's diary. There is, however, an overall lack of statistical correlation, suggesting that the synthesised instrumental series can only provide an extremely limited picture of weather in Mosser and Eaglesfield. That being said, there are a few further points to note. Although statistical correlation is not high, graphs displaying variation over time do at times show a clear visual correlation. For example, the summer temperatures derived from Isaac Fletcher's diary form no statistically significant correlation (*rho* = .212, *n* = 22, *p* = .344) with summer averages from the NRT. There is, nevertheless, a clear relationship between the two: the cold summer of 1767 is visible on both records, and from 1773 to 1779 the two follow each other's trends extremely closely (Figure 72). The records are least closely aligned when diary entries for the season drop below 30, when roughly less than one third of the season's days were recorded. With this in mind, and perhaps due to the low number paired cases, statistical correlation might not be the best method of testing for relationships.

Even accounting for the visual correlation not reflected in the statistical analyses, there is great disparity between datasets. The reasons for this are likely many and complicated, and it is not possible to pinpoint a sole or primary cause. Ostensibly, there is a tendency towards increased correlation during periods in the diaries when weather is well recorded. This suggests that the main source of discrepancy lies in an imperfect handling of a lack of data in the diaries. In this context, it is not particularly surprising that statistical correlations are revealed tend only to be fairly weak. It is important to note, however, that despite these problems, there are times when covariance between datasets is very good. At some times, at least, the regional instrumental series *are* broadly representing weather trends recorded in the diaries. These relationships are flawed and they are qualified, but they are there.

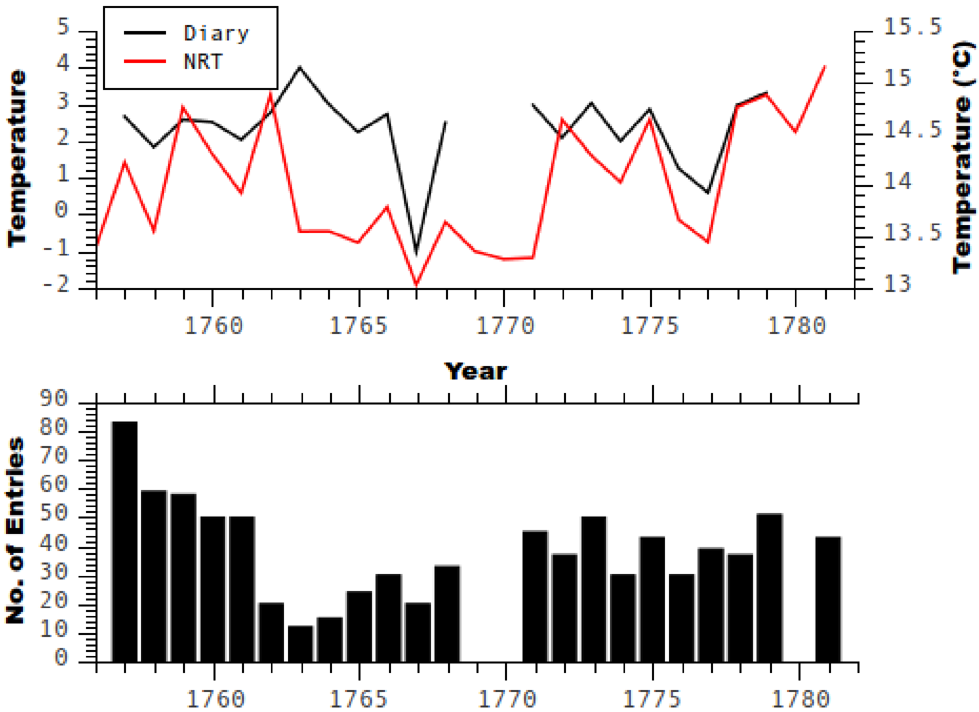

Figure 72: Summer temperatures from Isaac Fletcher's diary compared with NRT summer temperatures (top). The frequency of Isaac Fletcher's diary entries concerning weather during summer (bottom). The two temperature records correlate most closely during periods when Fletcher's weather record is most complete.

Reviewing the Economic Data

Earlier, economic data for Mosser and Eaglesfield was compared against the instrumental weather series in an effort to ascertain how weather affected the local agricultural economy. Although the results showed very few statistical correlations, some interesting points were raised. As discussed above, it was suggested that excessively warm weather was a greater threat to crop cultivation than cool summers. Despite tending to reduce the overall quantity of the harvest, hot years seem to have resulted in lower wheat prices. The quantities of different crops taken for the tithe in Eaglesfield changed from year to year. Looking at these figures, it was inferred that barley was most sensitive to the weather, whereas oats appeared to be the least sensitive of the grain crops. This latter observation was also supported by contemporary observations that attested the predominance of oats as the staple crop. Only very limited evidence was found to support the claim that the changing emphasis from crops to livestock in Mosser was driven by changing climatic conditions. Using the diary-derived weather records, these relationships can now be re-examined. Does having a local perspective on the weather shed new light on its relationship to the local economy?

Looking first at the figures for the great tithe, in terms of both its value and the total number of shocks taken in payment, there is a moderate negative correlation between the value of the tithe and year temperatures (rho = -.429, n = 26, p = .029) (Table 8). Perhaps of practical significance, there are further correlations between the value of the tithe and spring (rho = -.340, n = 29, p = .071) and summer (rho = -.321, n = 30, p = .084) diary temperatures. There are no correlations between the weather variables and the number of shocks taken, and precipitation appears unrelated to either the value or quantity of produce taken. In chapter seven, when relating the great tithe data to the synthesised instrumental series, the relationship between the number of shocks taken and the weather added an extra element to the interpretation. At this stage, however, with no relationship found between the diaries' weather and the number of shocks tithed, there are two likely scenarios: warm weather could increase the quantity of the harvest, lowering prices at market; or hot weather could cause low growth during the summer, resulting in less grain and a lower tithe value.

Results from examining the price data might be able to help. Prices for each of the three types of grain are negatively correlated with summer temperatures (oats: rho = -.481, n = 27, p = .011; barley: rho = -.380, n = 28, p = .046; wheat: rho = -.440, n = 30, p = .015). As summer temperatures increased, prices decreased. The prices of wheat (rho = -.500, n = 23, p = .015) and oats (rho = -.676, n = 22, p = .001) also correlate negatively with autumn precipitation. These results can be used to narrow down the options for interpreting the tithe value. If prices tend to fall during warmer summers, it is unlikely that low tithe values were caused by low yields. Instead, the increase in tithe value as a result of cold summers can be attributed to increased prices. Following a simple supply and demand model, the implication is that warm summers and wet autumns resulted in bumper harvests. From these results, a more nuanced understanding of bad years emerges. For farmers, weather conditions that were sub-optimal for their crops were more profitable than bumper harvests. For those purchasing food at the markets, cold summers and dry autumns were perhaps most feared, when low yields brought increased prices. If farmers really did prefer sub-optimal weather conditions then this is not conveyed in the diaries, where complaints about the adverse effects of bad weather are frequent. It is possible that some of the annual prices reflect the markets before the harvest was taken that year, thereby complicating the simple supply and demand model. A one year lag was introduced to the weather data to compensate, but no significant correlations were found.

Great Tithe

Diary Temperatures

	Year	Spring	Summer	Autumn	Winter
Value	-X	x	x		
No. Shocks					
Oats Price			-X		
Barley Price			-X		
Wheat Price			-X		

Newton Rigg Temperatures

	Year	Spring	Summer	Autumn	Winter
Value		-X	-X		
No. Shocks	-X	-X			
Oats Price		-x			
Barley Price		-X			
Wheat Price		-x			

Great Tithe

Diary Precipitation

	Year	Spring	Summer	Autumn	Winter
Value					
No. Shocks					
Oats Price				-X	
Barley Price					
Wheat Price				-X	

Newton Rigg Precipitation

	Year	Spring	Summer	Autumn	Winter
Value					
No. Shocks					
Oats Price					
Barley Price					
Wheat Price					

Table 8: Correlation matrices showing the relationships between weather records and data concerning Elihu Robinson's payment of the Great Tithe. X = statistically significant correlation, x = practically significant correlation, - = negative correlation.

Further analysis attempted to look at how weather altered the balance of crops produced. Earlier results suggested that barley was the crop most sensitive to weather conditions. Comparison with the diary-derived weather records found no statistically significant correlations, but one result came close. This was a moderate positive correlation (*rho* = .432, *n* = 21, *p* = .050) between the percentage proportion of barley shocks taken for the tithe and yearly temperatures. It suggests that as yearly temperatures increase, so does the amount of barley produced in relation to the other crops. It was, therefore, surprising that there were no correlations reflecting the necessary concomitant falls in the proportion of wheat and oats produced. As before, a one year lag was introduced in an attempt to see whether the previous year's weather affected the quantities of crops sown, but no correlations were found. Earlier analysis suggested that barley preferred warm, dry conditions. Although the preference for warm conditions is confirmed by the results here, we can no longer be sure that wetness was an important factor in ensuring a good barley harvest. Barley is, nevertheless, confirmed as the crop most obviously sensitive to the weather.

Finally, tests were undertaken to see if the diary record of weather would show a relationship between the declining reliance on crops in Mosser during 1747-1775 and changing climatic conditions. There are no statistically significant correlations, but a moderate negative relationship (rho = -.435, n = 16, p = .092) between summer precipitation and the proportion of crops comes close. Previously, the period in focus was reduced down to 1766-1775, when it was shown that increasing yearly temperatures were related to the increased prevalence of crop products within the small tithe. This result was not replicated using the diary-derived weather record, but the relationship between summer precipitation and the proportion of crops was shown to be accentuated (rho = -.841, n = 6, p = .036). However, this result should be viewed with caution, as only six pairs of cases were compared.

Comparing Results

With so many potential inconsistencies and sources of error, and so many instances where more than one explanation could account for a particular result, it is possible to make too much of these statistics. There are good reasons to expect that neither the synthesised instrumental series nor the diary-derived weather records provide an unambiguous reflection of past weather in Cumbria. Each is flawed in its own way, and there is no way to establish which is more accurate. Although some of the correlation results were similar, the conclusions reached were not always the same (Tables 7 and 8). However, if contradictory results are ignored and complementary results emphasised, the following interpretation takes shape: summer weather had the greatest impact on the harvest. Surprisingly, at Elihu Robinson's farm, hotter summers tended to produce lower valued harvests, comprising of an increased proportion of barley. Although comparisons with the instrumental records imply that this decline in value was due to smaller harvests, hotter summers have been shown to correlate with lower grain prices. Therefore, falling harvest values may be due to lower prices rather than decreased yields. Wet autumns tended to result in lower wheat and oats prices. In this instance, increased yields in wetter years seems likely, perhaps highlighting the negative impact of drought years. Certainly, during the years of 1800 and 1801, concerns about low rainfall in the growing season contributed to higher grain prices. On Elihu Robinson's farm, the tithe data shows that the worst weather conditions for him as a farmer were hot summers and dry autumns, yet lower prices at the grain markets suggest supply increased with warmer summers.

There could well be a disconnect between what constitutes a poor year for the farmer, when prices are low, and what constitutes a poor year for the non-farming population, when grain prices are high (Jones 1964). The weather record from Elihu Robinson's diary shows that 1790, 1793 and 1795 had the coldest summers, and 1779, 1781, 1793, 1794, 1800 and 1801 the driest. Of these, only 1795, 1800 and 1801 were years of particular distress. In the same period, according to the instrumental series, 1784, 1799 and 1802 had the coldest summers, while 1780 and 1800 were the driest. But because we cannot be certain which weather record is most accurate, it would be wrong to simply pick out the worst years on either scale and argue that they had the worst weather and biggest impact on social life. However, using the weather records in combination with the qualitative analysis of Elihu Robinson's diary, it is possible to suggest that the run of cool and dry summers experienced during the 1790s heightened the sense of anxiety during this decade. The years highlighted here might not have been the worst in terms of social unrest or food scarcity, but they may have helped ensure price levels remained at an inflated level, even if the actual harvests were by no means cataclysmic. Indeed, the evidence suggests that these could have been particularly good years for the farmers.

To summarise, there is a link between weather, the quality of the harvest and prices, but it is not a strict deterministic relationship. We can see from Elihu Robinson's diary that context is important. The turn of the century saw a decade of poor summer weather conditions collide with anxieties of war and blockades, food was scarce and prices increased markedly. Only these factors combined were enough to really visibly threaten society as a whole. Although we still cannot ascertain precisely the extent to which weather accentuated the social problems of the 1790s, the results here suggest a greater role than initially surmised.

Effects in the Landscape

There remains a problem in transferring between the effects of bad weather and the processes identified as part of the landscape narrative. In Mosser, the small tithe data suggested a clear transition from crop production to livestock farming, and this was a process also discussed by other historians (Dilley 1991; Searle 1983). Although farmers might have preferred sub-optimal weather conditions for arable farming, too great a decline in the weather may have provided an impetus to focus more on livestock, and the evidence for a link between the weather and harvest values supports this idea. However, during the period 1747-1775 the tests show no relationship between either of the weather records and the decline of crops in small tithe takings. A negative relationship between wet summers and the proportion of crop products taken for the small tithe may be of practical significance. It suggests that in wet summers, crops were less likely to comprise the small tithe payments. However, assuming the transition to livestock is a genuine phenomenon, then by these measures, weather can only be deemed to play a small role, if any, in the farming decisions that were taken. A similar conclusion is reached when considering whether the division and enclosure of fields in Mosser during the late 1750s and early 1770s was related to the weather. There is a reasonable hypothesis that is not contradicted by evidence from the diaries, but supporting evidence is also limited.

There is a trend developing here. It is much easier to statistically prove links between physical parameters, such as weather and crop yields, than it is to explain those links in terms of human decision making. Furthermore, where a variable is a function of both physical and cognitive factors, as it is in the case of price data, it is very difficult to define the relative influence of each. In terms of interpreting human response to weather, much depends on farmers' attitudes to risk. This concept was discussed earlier in relation to Parry's model. Are people more concerned about the increased incidence of particularly bad years, for example, or do they notice an overall, progressive decline in seasonal weather conditions? Again, both might be important depending on the situation, and the increasing anxiety shown by Elihu Robinson as the 1790s progressed probably supports this. Even taking these points into account, correlations can be counter-intuitive. The fact that wheat and oat prices tend to fall after wet autumns is a strange result, and not easily explained. As mentioned above, it is particularly surprising given how concerned both diarists were with rain during the harvest. Although it is possible to simply discard results that do not meet expectations, to dismiss them out of hand is to ignore potentially valuable information. Overall, although the process is flawed, the diaries have been very useful in providing an overview of the lived experience of the weather, but using the resultant record in a solely functionalist, statistical examination of the economic data can only tell us so much.

Attitudes to Weather and Landscape

In the previous chapter, a qualitative analysis of Elihu Robinson's diary showed that it is possible to use different diary entries to build up a picture of how Robinson perceived the world around him. This reveals a tendency for entries concerning high prices, social distress and bad weather to cluster together. Yet it was unclear from the analysis how these various factors related to one another. As observed above, correlating trends can only tell us so much, especially in situations involving human activity. Instead, both diaries document an experience of weather that, although obviously related to economic activity, was not at all conceived of in terms of trends and processes. Coping with the weather was an integral part of daily life. Whether working in the fields, selling produce at the market, or travelling to the Quaker meeting house, weather was constantly in mind. Entries show how the diarists respected the providential nature of the weather, but that understanding was threatened during times of stress, anxiety and particularly bad weather. At these times, conceptions of the weather took on a moral and ethical dimension, reflecting the diarists' concerns about the state of society. This is a richness of interpretation that goes far beyond correlating economic and weather trends. It ties the experience and understanding of weather to Robinson and Fletcher's sense of identity, their moral and spiritual outlook, and their day-to-day relationship with the environment. The question is, is it possible to reconcile this rich experiential characterisation of the past with the economic data and the social processes that operate well beyond the level of the individual?

Ecological Perspective

Donald Brooks Kelley (1982: 88) claims that Anthony Benezet, a Quaker living in America throughout the middle of the eighteenth century, fashioned a “moral ecology” with which to make sense of the world. The confluence of ideas at the heart of Elihu Robinson's understanding of the world can be described in a similar way. This ecological outlook developed out of contemporary science, the eighteenth-century Hippocratic tradition, traditional rural received wisdom, and religious and spiritual life as a Quaker. For Benezet, “men could never be in harmony with God or nature if the rich hoarded wealth to the manifest disadvantage of the poor” (Kelley 1982: 84). This entailed the condemnation of waste or disrespect of life, while conserving wealth for the common use of humanity (Kelley 1982: 87). This kind of thinking is visible in Elihu Robinson's writings, where he chastises the excesses of the wealthy and actively pursues policies to help the poor. Kelley (1982: 86) writes that Benezet's solutions to ecological abuse centred on individual self-restraint and reformation, but was moderated by appeals to “'Authority' in hierarchical fashion for 'justice,' 'virtue,' and 'compassion.'” Robinson makes similar appeals, with his exhortations to 'patience', 'Providence' and 'submission'. With the acceptance of divine authority constituted in this way, Benezet “envisioned man as simply a steward of God's natural bounty as a largesse to be sheltered and conserved”. This view contrasted strongly with the Puritan inclination to associate the unaltered natural world with “pagan darkness and profanity” (Kelley 1982: 80; Schama 1995: 201).

For Elihu Robinson and, we can reasonably assume, for Isaac Fletcher, the ecological perspective united people – both rich and poor – the land and the weather in a symbiotic relationship, with divine providence ensuring balance was maintained. In doing this, Providence could transform from a passive moderator to an active enforcer, with weather used as stick and carrot to control societies and nations that transgressed God's moral and spiritual code. Bad weather was thus the hand of Providence manifest: “to murmer against [it] can avail nothing & cannot be right” (ER July 1790). Although there was this desire to submit to the vagaries of the providential environment, by keeping weather diaries the two Quakers were doing anything but. As items of material culture in their own right, the diaries are the physical evidence of a moralistic programme of self-discipline and scientific inquiry. The process of recording the weather linked the diarists to gentlemanly scientific community, but also betrayed a friction between the rational enlightenment outlook and traditional, received wisdom. This friction was central to the diarists' ecological world view. Too rational and the weather's role as active arbiter of moral justice is questioned, too superstitious and nature becomes less benevolent and more malevolent. Fletcher and Robinson lived in the very midst of change. By writing diaries about farming, social, religious and business life, they were committing their ecological world-view to paper. Everything is related, so everything is written down together, side-by-side. The weather is an integral part of this, but as fledgling steps of modern meteorological recording, the diaries also represent a trajectory of thought that ultimately breaks down the ecological perspective.

Bad weather events "were a reminder that the weather remained stubbornly unpredictable and sometimes dangerous, notwithstanding the efforts of enlightened investigators to subdue it by scientific reason" (Golinski 2007: 43). Those efforts were made through the keeping of structured weather records, not dissimilar to those kept by our diarists. The act of documentation, of providing structure and writing things down, has been characterised in diverse situations as a process by which order or civilisation is brought into focus, while chaos or barbarianism pushed to the margins. This is true whether talking about the maps produced by pioneering colonisers (Harley 1988, 1992; Johnson 1995: 90–6; Oliver 2007) or Dutch landscape art (Cosgrove 1984; Ingold 2011: Ch.10; Thomas 1993). As well as fulfilling a role in affirming identities of place (Janković 2000), the process of recording the weather was an attempt to order the chaotic, poorly understood world of meteorology. This betrays an ideology more in common with the aggressive reforming tendencies of Puritanism than the complex juxtaposition of world-views that characterised the Quaker's ecological perspective (Kelley 1982). More to the point, it is a process in which environmental, landscape and experiential narratives are united.

Uniting Narratives

In the earlier chapter setting out the environmental narrative, investigations focussed on two areas of study. Although there was an examination of natural changes in the past, equally important was the human relationship with the environment. Early research into Cumbrian environmental history often failed to distinguish between the two, but more recently, as scientific techniques have developed, environmental archaeology is able to observe past human activity through complex environmental indicators. Whereas early studies determined that “the most important factor controlling vegetation history is shown to be man” (Pennington 1970: 77), Paul Coombes' later research at Mockerkin Tarn found few signs of the human activity thought to impact upon the area since the Roman era. There are, nevertheless, signs that the local environment changed markedly during the eighteenth century. Changes to lake ecology were seen in both Loweswater and Mockerkin Tarn at this time. Although the causes of these changes were not investigated within the respective papers, findings from the landscape narrative offer possibilities. Experimental mining and lead prospecting, the establishment of the lime kiln at Pardshaw and Winchester's (1994: xix) speculation that Fletcher was a local innovator in terms of liming fields all contribute to an impression of a landscape increasingly exploited. A similar theme arose from the landscape narrative. The various episodes of piecemeal enclosure, the attempt to buy Mosser Common and the final parliamentary enclosure of Mosser Fell are described by Dilley (1991) as an “enclosure revolution” that saw the rate of enclosure in Cumbria increase five-fold from 1700-1900 compared with 1500-1700. Although the agricultural revolution in Cumbria was notably more fragmented and sedate compared to the changes that occurred further south, this was a time in which technology and farming practices were changing. And with enclosure, so too were attitudes to land, common rights and customary tenancy.

Both narratives, environmental and landscape, speak of change; change that involved new and more intensive ways of exploiting the resources of the landscape. Here, there was a friction as old ideas clashed with new. On the farms, contemporary commentators looked on aghast as the locals stuck steadfast to their traditional, outdated crop rotations. Yet at the same time, people like Isaac Fletcher were experimenting with lime. Across the landscape, debate raged as to the relative merits of enclosure – increased control had to be balanced against the extinguishing of common rights and traditions. There is no simple formula to establishing how people saw such changes: Dilley (1991: 464–515) has argued that the impetus to enclose could come from tenant or landholder, depending on the specific circumstance of the time and locality. Outside of Mosser, the conflict between old and new played out in the transition from customary tenancies to leasehold as the dominant form of land occupation, a process that saw the traditional class structure eroded by a pervasive market economy and inheritance practices (Searle 1983, 1986). In one sense, these clashes, the friction between old and new, mirrored the incongruities manifested in the diarists' attitudes to weather. And here too, the ecological perspective was under threat: “Benezet assumed the social dimension of ecology in the conservation of 'a certain degree of wealth for the common use of mankind'” (Kelley 1982: 87). This was an ideology of conservation, stewardship and mutual profit. However, the changes in Mosser and beyond during the late eighteenth and early nineteenth centuries heralded an altogether different kind of ideology, one that centred on individual ownership, commercial enterprise and environmental control.

In this respect, the parliamentary enclosure of Mosser in the 1860s was the culmination of a long process in which land was brought under control. The enclosure map is physical evidence of this – the untamed yet well used common wastes brought under a proprietary gaze through the imposition of lines on a page. In the same way, committing weather observations to ink was part of a process by which the weather was tamed – the mystery and danger of unpredictable bad weather brought under control by the unswerving discipline of systematic observation. Weather was no longer about the experience and knowledge of a place, but phenomena schematically ordered as though they were being mapped (Janković 2000: 159). The ecological perspective was eroded as the study of modern meteorology, agricultural innovation and the notion of land as commodity all served to separate people, landscape and weather. It is true that “enclosure was one element, along with improved transport and the development of more distant markets, which gradually made rural society more prosperous without altering it drastically” (Whyte 2003: 92). However, indistinct in this conclusion is a recognition that these upheavals were part of a wider narrative of ideological change. Attitudes to land and weather were being transformed. These transformations mirrored one another, while at the same time forming a disconnection that is still prevalent our conceptions today.

Re-evaluating Parry's Model: The Problem of Risk

Information from the experiential narrative enables us to better assess the validity of Parry's model in Mosser. The model's efficacy is dependent on there being a positive relationship between growing season temperatures and the success of the harvest. Although Parry was able to confirm this at high altitudes, there was some doubt over whether such concerns would be applicable at altitudes well below the absolute limit of cereal cultivation. Although the economic data is at times confusing and contradictory, it does indeed seem to show that warm weather results in larger harvests. This is particular true of barley, which appears to be sensitive to summer temperatures. Another important factor in the practical application of the model is whether it is constructed using an accurate temperature series. Here the Mosser model encounters difficulties. When comparing instrumental and diary-derived weather records, the NRT matched trends in the diaries to some extent, but this relationship was very weak. Considering all the potential sources of error, it was not possible to state with confidence how accurate a portrayal the NRT provides for weather in Mosser. Although there are certainly hints that temperature trends were broadly similar across the records, even a relatively small increase in annual variability could greatly affect the positioning of risk thresholds.

A number of suggestions were made for improving the model. Primarily, these involved reworking the model to include weather variables other than temperature. However, following findings arising from the statistical analysis of economic data, one of the most intriguing suggestions was an inversion of the model. This would involve defining drought-affected years, then recalculating the model based upon excessive warmth rather than lack of warmth. While this idea seems good in principle, the results warn of associating drought too closely with increased temperatures. Furthermore, there appear to be quite complex relationships between temperature and precipitation in different parts of the year and yields of the three different types of cereal crop. Remodelling for drought would, therefore, require thresholds to be defined for when the lack of rain outweighs the effect of warm weather. Even if these thresholds were successfully negotiated, the diaries also highlight a disconnect between what might be deemed a bad year for farmers, and a bad year for consumers. So although hot summers probably resulted in increased grain supplies at market, suiting the non-farming population, this also meant reduced returns for farmers because of low prices. The whole idea of what might necessitate a response is brought into question.

These issues are also prevalent in the model as it currently stands. While it has been shown that warmth during the growing season almost certainly had a strong effect on harvest yields and grain prices, the complex interplay between market and farmer made it difficult to define the kinds of bad years that would result in widespread landscape change. This is endemic of a deeper problem inherent in Parry's original conception of the model, where Parry graphically portrays climatic risks through the positioning of the 'marginal zone'. This zone covers the area between a 1-in-50 and 1-in-10 chance of GDD not reaching the predefined 'bad' harvest level. However, the selection of the 1-in-50 and 1-in-10 limits was arbitrary. Parry and Carter (1985: 103) argued that "ideally the choice of frequencies would be based empirically upon behavioural surveys." In the Lammermuirs, the upper limit to the marginal zone (1-in-10 chance of harvest failure) was deemed directly equivalent to the physical limit to crop cultivation. The lower limit (1-in-50 chance of harvest failure) was defined as the limit to commercial cropping, although its significance, Parry (1978: 82) admitted, would be dependent on the particular "economic or social incentives to cultivation operating at any one time." At lower altitudes, such as around Mosser, where the marginal zone was modelled on the assumed limit to commercial (rather than subsistence) cultivation, these "social or economic incentives" are all the more relevant. In short, the risk thresholds are mathematical guesses that represent simply the potential outcome of a very complicated set of interrelated affecting factors. This, perhaps against Parry and Carter's wishes, has the effect of reducing the conceptualisation of risk and risk perception to fairly uncomplicated assessment of costs versus benefits, where set responses (such as settlement abandonment or changes in farming practices) are elicited when fixed physical thresholds are crossed.

This is perceived to be unproblematic because, in Parry's (1978: 94) words, people "confronted by uncertain conditions, make rational decisions and choose strategies that maximise the certainty and quantity of return in relation to time and effort." Of course, people do engage in this sort of thinking all the time, but it is crucial to recognise that perceptions of costs and benefits can change, and that they are not always based on a wholly rational appraisal of the situation. This is something the proponents of substantivist economics have long recognised, but is not well accommodated in Parry's method (Charles and Halstead 2001; Mauss 1954; Sahlins 1974). In Mosser, Fletcher's adherence to long and inefficient crop rotations, during a time when agricultural reformers all over the country were espousing new methods, was based both on the Lake District's remoteness and the strength of local tradition. When identifying responses to climatic changes through alterations to agricultural regimes or settlement location, it is important to take into account the vagaries of particular historical situations. Similarly important, then, are attitudes to weather. They are not fixed. Not only were Fletcher and Robinson's attitudes to weather a function of the friction between old and new during the early modern period, they were open to reassessment. The way in which Robinson's characterisation of providence, for example, changed from passive moderator to active enforcer, is a case in point. Whether the weather was viewed as a benign provider or malevolent arbiter of morality could be critical when considering how people dealt with the 'riskiness' of changing climate or, as they would perceive it, increased incidences of bad weather. Why, for example, change farming practices if you have faith that better weather will arrive next year? Conversely, if you believe that bad weather is a punishment from God, and you perceive moral indiscretions to continue unabated in the face of his wrath, then perhaps a response to protect yourself might be warranted.

By reducing these issues into a simple expression of risk, the model masks a great deal of historical complexity. Consider, for example, the events of 1800 and 1801. Whilst this was only a short-term event at the culmination of only a decade or so of poor weather and trying political and economic circumstances, it shows how responses to environmental stresses are engendered by very complex sets of historically and individually constituted attitudes. Submission and patience were transformed into active resistance as Robinson and other's faith in the benevolence of divine providence was brought into question. Responses were many and diverse. They included selling produce below market value, government advice to grow increased quantities of potatoes and turnips, as well as increases in the amount of cultivated land. There was almost certainly no unified mentality driving these reactions. Variously, greed, empathy and need could all equally have played a role. In this context, conceptualising risk becomes increasingly difficult, as purely rational reactions to set physical stimuli are recast as socially embedded responses to the complex interplay between various triggers, trends and traditions. Of course, arguably, the purpose of a model is precisely to express this complexity very simply. Parry and Carter (1985: 109) explicitly state that the model is designed to be "a prediction that can be tested against historical records and then, if necessary, reformulated."

Indeed, despite its many flaws the model does ably express two proven scientific premises: temperature affects the growth of cereals, and temperature changes significantly with altitude. At the physical limits to cultivation, changes in temperature have been shown to have geographically wide-ranging effects (Parry 1975). In Mosser, evidence from the small tithe sufferings corroborates this picture The concept of the marginal zone is flawed, but Parry's upper and lower limits still have some significance, provided the model has access to valid temperature data. The 1-in-10 threshold reflects a compromise between the impact of particularly bad years and overall changes in average temperatures. At the 1-in-50 threshold, the link with average temperatures is much weaker. Neither threshold should be considered an absolute limit, but if changes in the farming regime appear to closely match the movements over time of the 1-in-10 threshold, then it can be reasonably assumed that those changes might to some extent be related to changing temperature trends. Similarly, if changes in the farming regime appear to closely match the movements of the 1-in-50 threshold, then those change might be the reactions to the extremes of a few extremely bad years. Overall, however, as a mediator between social and physical interpretations, there remains a question whether the model can ever find a satisfactory middle ground between a lack of detail and too much detail. On one level, the sheer number of physical factors that might affect crop cultivation preclude a detailed plotting of farming risks. On an another, the model is ill-equipped to handle social problems, such as changing attitudes to the weather and 'irrational' economic activity, which might determine the triggers for response, and the extent and types of response.

Discussion

Although the weather information can be extracted and compared against other environmental and economic data, this only shows limited covariance. There are good reasons to suggest that neither the instrumental series nor the diary-derived weather records provide an accurate reflection of past weather. Similarly, potential sources of error and uncertainties, as well as a lack of agreement between various sources of data, mean that the economic data remains difficult to interpret. When the results are combined, it is possible to make some broad statements as to the effects of weather on the farming economy, but examined on their own these are of limited value. One interesting element of the results is the suggestion that the worst weather conditions for Elihu Robinson were hot summers and dry autumns, despite the positive impact of the warm summer on crop yields. This shows that poor years for farmers need not necessarily equate to poor years for the non-farming population (cf Jones 1964). Furthermore, when these results were examined in the context of the qualitative analysis of Elihu Robinson's diary, it was found that is was not possible to simply highlight the worst weather years and assume that these had the greatest social impacts.

Rather than focussing on the absolutes of economic data and statistical correlation, a truer interpretation of climate-society relationship needs to be more reserved and subtle. The 1790s, for example, were not catastrophic, but the poor weather contributed to a heightened sense of anxiety. Grain prices were elevated and worries about weather and social unrest increased. Elihu Robinson's diary shows a link between weather, the quality of the harvest and prices, but it is not a strict deterministic relationship. Historical context is vital. At the end of the decade, the few years surrounding 1800 brought truly terrible conditions for much of the country. Poor summer weather conditions combined with anxieties of war and blockades, food was scarce and prices rose astronomically. It is hard to define the precise extent to which weather accentuated these problems, but it no doubt played a role. The functionalist, statistical examination can only tell us so much. While correlations between physical parameters are explained relatively easily, as soon as people become involved, attempts at explanation become a lot more complicated. Often it is impossible to get to the heart of human decision making simply through the identification of correlative relationships. With this in mind, interpretations that rely on straight-forward correlations between climatic and social processes are always likely to be flawed or incomplete.

Elihu Robinson's attitudes to weather can be understood as part of an ecological world-view, in which religious beliefs, morality, identity and relationships with the land are all combined. This perspective was historically constituted, in that it developed out of Robinson's scientific understanding, the eighteenth-century Hippocratic tradition, agricultural wisdom, and religious and spiritual life as a Quaker. Moreover, it is a perspective dependent on friction between the rational enlightenment outlook and traditional, received wisdom. Robinson references a more superstitious past, whilst simultaneously engaging in the gentlemanly scientific enterprise of recording the weather – an enterprise intended to demystify and order the chaotic, poorly understood world of meteorology. These frictions between the old world and the new can be seen played out across each narrative. Each draws a picture of marked change during the eighteenth century. The landscape was transformed as enclosure gathered pace and urban centres' populations exploded. Whereas the ecological perspective combined an ideology of conservation, stewardship and mutual profit, in eighteenth-century Cumbria, ideas of individual ownership, commercial enterprise and environmental control were taking hold. In this respect, each narrative describes the gradual erosion of particular historical perspectives, as the study of modern meteorology, agricultural innovation and the notion of land as commodity all served to separate people, landscape and weather. This is an interpretation of human-environment relations in which weather and attitudes to weather are central, but its not one that is well described through simplistic characterisations of climatic causes and socio-economic effects.

When Parry's method is re-evaluated in this light, flaws concerning the conceptualisation of risk come to the fore. The diaries show how people's attitudes to the natural world were constituted entirely within their particular historical setting, yet the model is reliant on fixed attitudes to weather and farming-related risks. In this respect, the concept of the marginal zone is inherently flawed despite its partially successful application in Mosser. The focus on GDD and warmth means that the model can always be accused of being too simplistic, but the analysis shows that increasing the level of detail engenders a growing set of problems. Although Parry understood these limitations, arguing that the model should be used as a 'retrodiction' against which the historical reality can be tested, an experiential perspective shows that it fails to adequately bridge the gap between climatic change and social responses to that change. Despite attempting to avoid the pitfalls of determinism, the model's processual, correlative, and economically rational underpinnings mean that it is ill-equipped to reveal the socially embedded, historically constituted nature of human-climate relationships.

Conclusion

The Mosser landscape was changing throughout the eighteenth century, with fields undergoing a steady rate of division and enclosure. It is not certain whether the short runs of good or bad weather impacted upon this process. The over-riding factors were probably economic, but weather could have played a role in guiding the timing of changes. Situated on the edge of the Lakeland fells, Parry's method indicates that much of the Mosser landscape was marginal for cereal cultivation. Tithe data supports this interpretation, but it is not clear whether climate changes were responsible for the progressive alteration of the crop/livestock balance – urbanisation and the market economy may have played a much greater role. On the farms, seasonal weather undoubtedly made a difference to harvests and the well-being of livestock. With lives spent predominantly outdoors, the farmers and their labourers were acutely attuned to the weather, and prevailing conditions could have influenced the siting of stone walls and of the sheep heafs. The eighteenth-century diarists were fascinated by the weather, recording it in detail and often commenting on extreme or unusual weather events and the timing of the seasons. Of most interest is how the diarists' perceptions of and attitudes towards the weather were linked to the same overarching processes that culminated in the enclosure of the landscape. It is in the context of the birth of modernity that people's responses to climate change and bad weather were constituted.

The diaries, with their very intimate perspective on eighteenth-century life, show how weather was integral to day-to-day activity, people's moral and spiritual outlooks, and senses of identity. When this perspective is compared against the other narratives, the paucity of interpretations that centre solely on economy and land use is revealed. The human-environment relationship goes beyond economic factors. Although the emphasis on individual experience has been articulated well in other areas of archaeology, few, if any, have thought about the human experience of climate change lies in their relationships and perceptions of the weather. Of course economic concerns play a role in this. There are physical limits to what can or cannot be grown, and to what humans can and cannot endure. But the experiential perspective gained from the diaries show that there is so much more to people's interactions with weather. Crucially, only by thinking about the past from this perspective can all the narratives for Mosser be satisfactorily reconciled.

Chapter 13: Discussion

Introduction

Chapters two and three charted how research into climate-society relationships developed over the last century. They showed how this involved the rejection of determinism and catastrophism, with scholars preferring to instead describe interactions in terms of heterarchies and non-linear dynamics (e.g. Crumley 1994; van der Leeuw and McGlade 1997). This sometimes involved complex mathematical modelling and concepts from ecology, such as resilience theory. As dating techniques improved, the scalar focus has narrowed, and there has been the gradual integration of social theory into systemic and processual descriptions of change. Recently, this culminated in Robert Van de Noort (2011) outlining a programme for 'climate change archaeology', stating that different theoretical approaches are now united in studies of past people and climates. Underlying these developments were difficulties in reconciling cultural and natural conceptions of humanity: do people behave like animals in relation to their environments? Chapter three followed this debate through anthropological research into human-environment relations. This showed how interactions with the natural world could be socially mediated, and how historians, archaeologists and ecologists adopted these ideas for their investigations of the past. However, the chapter concluded by arguing that existing approaches had failed to reconcile the different scales and methods of working integral to archaeological research. Moreover, it observed that weather, as the means by which climate was experienced, remained absent from archaeological interpretation.

The case study was developed as a way of testing a new theoretical approach to studying climate-society relationships, which attempts to characterise interactions through experiential perspectives. This was inspired, in part, by Tim Ingold's (2007a, 2011) concept of weather-worlds, where landscape and weather are intertwined as the medium through which people live their lives. The aim was to move away from abstractions of long-term change, and focuses on people's immediate experiences of daily weather. It was thought that, because landscapes can be viewed as the material manifestation of these daily interactions, these experiences could be characterised through studies of the landscape. Then, using concepts like resilience theory and social memory, the analysis might move across scales, contextualising short-term experiences within narratives of long-term change. Previous chapters analysed whether different methods and sources of data could be integrated within a single narrative of change, but this chapter assesses whether the overall theoretical approach, to focus on weather, has been successful. It asks to what extent it is now possible to move on from the debates that have dominated climate-society discourse from the late 1970s onwards. Can the recognition that people are affected by the environment around them be reconciled within a non-deterministic interpretive framework? In discussing these questions, I will evaluate the approach taken in the case study, as well as provide suggestions as to how archaeological research might proceed in the future.

The Utility of Parry's Model

Throughout the case study, I have looked at the efficacy of Martin Parry's Lammermuirs model for describing the relationship between climate and society within Mosser. There are good reasons for focussing on this particular model, despite the moves other researchers have made towards complex, agent-based modelling (van der Leeuw and McGlade 1997; Wilkinson et al. 2007). In the Lammermuirs, the model was shown ostensibly to be very successful in 'retrodicting' changes in settlement patterns as a result of climatic change. This has meant the study has become very well known amongst scholars researching settlement in upland Britain (cf. Tipping 2002; Evans 2003; Coombes and Barber 2005). There are also practical advantages to the method: the use of instrumental data means that, for the period from 1659 up to the present day, the model is not reliant on palaeoenvironmental proxies, which can be poorly resolved and consequently unreliable (Baillie 1991). Furthermore, the method attempts to transcend simplistic or deterministic conceptions of social and environmental factors by placing an interpretive emphasis on people's perceptions of, and attitudes to, risk.

Parry and Carter (1985: 109) understood that there was no simple causal relationship between climatic risk and the cultivation limit, and a reading of Parry's (1978) *Climatic Change, Agriculture and Settlement* shows that he understood the pitfalls of simplistic deterministic thinking. At one point, Parry (1978: 135) goes as far as to say that “archaeologists, in particular, have been too eager to adopt an environmental explanation for settlement changes without a clear understanding of the processes involved”. Yet Richard Tipping (2002: 11) describes Parry's Lammermuirs work as constituting “one of the keystones of the deterministic paradigm”. This is because the model relies on the fact that crop yields are physically dependent on changes in the climate. Parry (1978: 95) felt that under “conditions of extreme marginality”, environmental constraints on yields were likely to over-ride the social, technological and political framework that he knew would in part guide people's reactions to adversity – for Parry, warmth was the definitive factor in the positioning of cultivation limits in marginal areas. The result of downplaying these factors is, in Tipping's (2002: 14) words, a method that “places too great an emphasis on what was a subsidiary and insignificant component on upland farms, and undervalues the support structures that link upland with lowland economies. Most importantly, it assumes that the individuals making decisions on these upland farms always acted with economic rationality in mind.” Human adaptability is thus reduced to a simple measure of costs versus benefits. Theoretically speaking, this runs counter to the arguments of substantivist economics and, following an examination of the diaries, it was shown that farming decisions in Mosser and Eaglesfield were not always made in this way.

One caveat to this critique is that Parry would argue that Mosser does not fit his definition of marginality: there is no farming near the absolute limits of cereal cultivation and Fletcher's diary describes not only a subsistence regime, but an active market economy with which the farm was engaged. In this respect, it is surprising that the model for Mosser does appear to 'retrodict' a situation that is at least partially supported by other evidence. This is perhaps testament to the model's ability to express how small changes in physical factors can have geographically wide-ranging effects. That being said, it is clear from the diaries that a description of marginality that privileges only the physical constraints of harvesting one type of crop is too simplistic. We have seen how the very notion of marginality was dependent on a range of factors that fed into the many vagaries and inconsistencies of human choice. Yet despite this, a conclusion that uses modelling as its basis would ultimately rest on the temporal and spatial correlation of landscape and climatic changes.

Correlation and Causation: Modelling the Past

We saw earlier that correlative approaches were vociferously criticised in the late 1970s and early 1980s by scholars who argued that "explanation' on the basis of correlation is simply rationalisation" (Anderson 1981: 339) and, therefore, 'facile' (McGhee 1981: 163). In archaeology, responses to these criticisms have been fashioned in two ways. The first is in an implicit recognition of the paucity of archaeological datasets. Ingram et al. (1981: 11) observed that "only detailed local climate information will suffice for rigorous analysis of climate-society links", so archaeologists and palaeoenvironmental scientists have sought data at ever higher chronological resolutions. Simultaneously, the long-term perspective of archaeology has been recognised and encouraged, particularly in the realm of climate change studies (Van de Noort 2011; Rowland 2010). This is supported theoretically by an interest in time perspectivism, in which it is recognised that "increasing the distance between observer and what is observed … places particulars in a wider perspective that can introduce new understandings and perception of new relationships" (Bailey 2008: 15). In part, this is an idea developed out of the Annales approach of Braudel and others, who argued that different processes come into view at different scales of analysis. On one hand, understanding is thought to emerge out of ever greater accumulation of ever more highly resolved data (Barrett 2001). On the other, that detail is sacrificed as archaeologists widen their perspective to focus on the *longue durée* of deep time.

The second means of responding to the critique of facile and simplistic causality has been to develop ever more sophisticated models of causality. As De Vries (1980: 606) states, we "cannot hope to achieve significant results (or fairly test the impact of climate) in the absence of a detailed causal model". Of course, during the 1980s, the development of post-processual approaches to archaeology came in response to a vigorous critique of the systems approach that underlay most exercises in modelling. In *Reading the Past*, Ian Hodder (1991) argued that "ecosystemic approaches are inadequate partly because they do not give sufficient weight to non-material forces and to particular historical meanings" (Hodder 1991: 26). This results in a passive view of individuals, who appear only as "predictable automata, driven by covering laws" (Hodder 1991: 27). John Barrett (2001) has complained about a "burgeoning catalogue" of social models and artefacts, which fails to confront human agency and ways in which people make decisions in the face of complex and changing material conditions. Proponents of modelling approaches would argue that they have now transcended these criticisms, and indeed the problem of determinism. The combining of complex modelling and non-linear dynamics with socially aware ecosystems theory is one of the factors that led Robert Van de Noort (2011: 1046–7) to state that “the different theoretical strands in archaeology are not in opposition when it comes to explaining the diverse connections between climate, environment, landscape and people”.

There are several reasons for espousing such a positive view. Most notably, the mathematical characteristics of complex models and non-linear dynamics are thought to provide good analogues for processes formerly described only in social theory. There is an emphasis on initial conditions and the unpredictability of future states, and there is an interplay between deterministic and stochastic processes that seems to mirror archaeological conceptions of structure and agency (van der Leeuw and McGlade 1997). When combined with ecological concepts such as adaptation, resilience, self-organisation and hierarchy, it is argued that the relationship between people and the environment can be explored quantitatively, whilst maintaining a qualitative, people-centred perspective (Crumley 1994a; Kirch 2007; Patterson 1994). The advances in modelling are so great that simulations can now be populated by decision-making 'agents', with each governing its own behaviour “based on its own local rules and in response to its own perceptions, preferences, capabilities, and goals” (Wilkinson et al. 2007). Such models are a step away from the limited, well-defined expressions of causality observed in older models such as Parry's. Moreover, the problems of determinism and economic rationalism are tackled directly. The complex and non-linear nature of the models ensures that change is never simply the function of one prime mover, such as climate. By taking an agent-based approach, by modelling social adaptation and risk buffering strategies, and by introducing a certain degree of randomness into decision-making algorithms, the modelled people of the past are no longer the predictable and ahistorical “automata” of Hodder's (1991) critique.

Despite these two strands of response to the early 1980s critiques, the case study shows a number of problems with each. In terms of resolution, it was shown that even with a daily weather record and written documents containing detailed economic data, it was not possible to discern to what extent climate had an effect on social processes. Parry's simple model, based primarily on sound scientific assessment of the physical characteristics of oats, was shown to intersect with human decision-making at numerous levels. Although complex, agent-based models can, to some extent, account mathematically for the vagaries of human choice, they cannot themselves explain or understand it. Here Hodder's (1991: 34) critique still has relevance: "why is the system or subsystem the way it is?" There is thus a disjunction in the way in which models are used. On one hand, modellers use archaeology as a tool for improving their models. On the other, archaeologists use models as tools for explaining relationships in the past. In each, knowledge will be incomplete; assumptions will need to be made. In modelling, this is problematic because small changes in one part of complex, dynamical systems can effect large changes elsewhere. In archaeological interpretations, there is a danger of circular reasoning as models are used to describe and explain the very same processes that are used to construct the models. It is, therefore, still true that on its own, modelling cannot adequately account for "the great richness, variability and specificity of cultural production" (Hodder 1991: 34).

This was a point epitomised within the case study, where much time was devoted to examining how and whether the various environmental records could be related to landscape processes and farming practices. Although lack of information was a problem in respect to creating monthly averages from diary entries, for the most part the data was high resolution and high quality. Despite this, the physical/economic approach to describing change was unable to even begin to quantify how climate might have affected people in the past. Instead, the richest and most detailed interpretation comes not from any form of systemic modelling, nor from any expression of effects or responses that centre on economy. In discussing how attitudes to weather were developed and transformed both in relation to the weather experienced by the diarists, their own personal world-views, and prevailing scientific and philosophical thought of early modernity, the resultant interpretation united multiple scales and methods of analysis. The case study was therefore able to touch on how the individual experience of weather can be related to wider climatic changes. The sustained period of bad weather and the worsening political and economic situation during the 1790s can perhaps be seen as a microcosm of how rapid and detrimental climate change could have been experienced in the deeper past. The various economic responses – the growing of different crops, the expansion of cultivated land, the gifting of food to those most in need, reducing consumption – can all be modelled to an extent. But the subtle shift in Robinson's attitude as his faith in God's providence is put to the test, and the friction between old ideas and new – emblematic of the birth of modernity – could never be appreciated on a purely systemic level.

Landscape and Weather: Expressing Modernity

One of the aims of this thesis was to consider whether an inhabited perspective on the lived experience of weather could be helpful in studies of climate and history. This follows work in anthropology and, specifically, Ingold's (2011: 135) assertion that we live "not on the fixed surface of the landscape but in the swirling midst of the weather-world." In part, this idea was developed out of the phenomenological philosophy of Maurice Merleau-Ponty, and given the importance of phenomenology in the landscape archaeology of the past two decades, there was reason to think such a perspective might be useful in the context of this research. Of course, in this study, the principal means of exploring the lived experience of past peoples was not through the kinds of phenomenological methodology proposed by Tilley (1994, 2004), but through the diarists' writings. In part, then, this was an exercise in historical research, but one that went beyond simply relying on the text as a written guide to the past. Much of the richest narrative was developed from interpreting Fletcher and Robinson's motivations and attitudes in producing their diaries. By attempting to reach a first-person perspective on the past, the study revealed not only how weather was integral to daily life in eighteenth-century Cumbria, but world-views that were at the very heart of a developing modernity. Moreover, through this perspective can be glimpsed the formation of the intellectual paradigms that have made examining the relationship between climate and human history so difficult.

Using Bruno Latour's (1993) *We Have Never Been Modern*, an influential twentieth-century scientific and philosophical history, it is possible to define the core characteristics of modernity, and trace how these were expressed both in the eighteenth century and in archaeological research. Latour (1993: 10–1) argues that modernity is constituted by two separate practices that must remain separate. The first, *translation*, creates hybrids of nature and culture. The second, *purification*, separates the world into realms of the human and nonhuman. Following this schema, the rise of modernity is accompanied by an unnoticed friction between the separation of social and natural worlds, and the creation of knowledge that transcends the two. It is possible to see these concepts active in Elihu Robinson's life. There is translation as the barometer and thermometer combine the physical and natural worlds, and when environmental knowledge is produced in the culturally constructed, collaborative networks of gentlemanly scientific endeavour (Latour 1993: 24). Meanwhile, in the process of pursuing that very endeavour, of recording the weather, Robinson creates an ontological division between human world of social action and non-human world of mechanical meteorology. There is a purification as weather observations are abstracted and standardised in the regimented form of detached description.

FIRST PARADOX

Nature is not our construction; it is transcendent and surpasses us infinitely.	Society is our free construction; it is immanent to our action.

SECOND PARADOX

Nature is our artificial construction in the laboratory; it is immanent.	Society is not our construction; it is transcendent and surpasses us infinitely.

CONSTITUTION

First guarantee: even though we construct Nature, Nature is as if we did not construct it.	Second guarantee: even though we do not construct Society, Society is as if we did construct it.

Third guarantee: Nature and Society must remain absolutely distinct: the work of purification must remain absolutely distinct from the work of mediation.

Figure 73: Latour's (1993: 32) conception of the modern constitution.

Latour's modern constitution consists of a series of guarantees, the fourth of which he describes as “the crossed-out God” (Figure 73). In the words of Latour (1993: 33): “His transcendence distanced Him infinitely, so that He disturbed neither the free play of nature nor that of society, but the right was nevertheless reserved to appeal to that transcendence in case of conflict between the laws of Nature and those of Society.” Again this is reflected in Robinson's own cosmology. God was crossed out as the world was left to run without his direct intervention. But in times of great stress, as disasters in the social and natural world combined towards the end of the eighteenth century, and as faith in the passivity of providence waned, a more active providence was called upon to mediate between natural and social spheres – God was returned to the world as his laws were reinvented.

In chapter 3, I argued that the processual archaeology of the 1960s and 70s, which modelled the human relationship with the environment as thermodynamic system, was directly influenced by the philosophy of René Descartes and a negative, mechanistic conception of humanity. There was a division between nature and culture, yet people themselves were both part of nature and transcendent of it. In this respect, processual archaeology displayed the very essence of modernist thinking, as described by Latour (1993). In his book, *Archaeology and Modernity*, Julian Thomas (2004: xi) goes a step further, arguing that the practice of archaeology is distinctly modern. In this conception, it is not only the particular brand of processual archaeology that is modernist, it is the whole discipline. Thomas (2004: 53) describes the archaeological method as hinging on an assertion that "new knowledge can be created from the observation of material things." Perversely, however, the methods of archaeology involve removing oneself from the making of ethical or political interpretative judgements, and are thereby "more likely to maintain the established order of thought than to produce novel re-descriptions" (Thomas 2004: 77). Archaeology, then, is grappling with the same modernist principles that Robinson was grappling with over 200 years ago. But this, argues Thomas (2004: x), is problematic for studies of the premodern past, because "our contemporary habits, ways of life, commonplace ideas and daily experiences conspire to make it all but impossible to comprehend lives that were ordered in entirely different ways."

Modernity, it seems, is all pervasive and prevents us from relating to people of the premodern past. Bruno Latour's (1993: 47) argument, however, centres on the idea that "modernity has never begun." The hybrids of modernity are no different from the premodern past. Although the people of modernity try very hard to neatly categorise the human and nonhuman world, doing so can only result in the proliferation of hybrids that are impossible to categorise: "The constitution explained everything, but only by leaving out what was in the middle" (Latour 1993: 47). For Robinson, this engendered a friction between the ideas of the superstitious past and the new ideas of scientific progress – he found neither could satisfactorily explain his experience of climate and society at the end of the eighteenth century. This is unsurprising, because adhering to the modern constitution can only ever result in a state of becoming modern, never will modernity be achieved (Latour 1993; Thomas 2004: 51). Thomas (2004: 51) argues that it is, therefore, a mistake to think of modernity as an "integrated totality" – as people have struggled to attain modernity, it has become something plural. We saw earlier, that the modernity experienced and created by the Quaker diarists was subtly different from those of more Puritan persuasions. In the former, the natural world was to be conserved and protected, in the latter it was to be remodelled and civilised, in both it needed to be ordered and dispassionately categorised in order to be understood. Of course, the other point made was that Robinson's attitudes were historically constituted, and that in his particular brand of modernist thinking were the seeds of its demise – a process by which the modernity of the Western world has come to be homogenised under the mantle of colonialism.

In his call for a 'counter-modern' archaeology, Thomas (2004: 248) argues that accounts of the past gain in richness even when they are "not intended to reach a definitive, non-contradictory point of closure." The role that analogy has in this is tool by which archaeologists ask: "*what if* it was like this" (Thomas 2004: 241)? There are clear parallels here with modelling. Although the simplistic causality of early explanatory models is rejected, the complex non-linear dynamics of newer, more investigatory models is encouraged. By repeating simulations over and over again, by changing variables and adding new components, modellers can ask again and again '*what if...*'. The real world is too complex to be modelled in totality, but complex models could shed light on some of the dynamic relationships between economic and climatic processes (McGlade and van der Leeuw 1997). Above, however, I argued that a complex modelling approach on its own could not begin account for the richness obtained by focussing on the lived experience of weather. Thomas' (2004: 235) criticism of the modern archaeology is that, "contrary to modernist dogma, investigations that have been shorn of aesthetics, rhetoric and poetics are impoverished rather than more secure in their conclusions, for they arrive at patterns of understanding which exclude significant dimensions of human existence."

In the same way that the diarists' mechanical observations of weather were less informative than their musing on its social effects and links to their ethical outlooks, the interpretive analysis that explored these issues was more encompassing than the focus on raw economic and weather data. This has implications for how archaeologists approach climate.

Social Memory

In reviewing contemporary approaches to climate and history, I argued the social memory concept, which has been suggested as a means of reconciling processes operating on human and environmental time-scales (McIntosh et al. 2000b), was ill-suited to archaeological research. This reasoning was supported by a set of case studies that relied either on historical documents or detailed ethnographic oral histories, and Dean's (2000: 111) assertion that archaeologists should avoid overplaying "non-material aspects of archaeological investigation". Moreover, Evans' (2003) application of the concept in an archaeological context was found to be over-reliant on the Mande case study, which was geographically and temporally dislocated from his own studies (McIntosh 2000). Ostensibly, the social memory concept accords well with the conclusions drawn from my own case study. It explicitly recognises that people's perceptions of the environment are central to their responses, and it therefore relates reactions to changing climate with culturally conditioned societal knowledge and experience. Where it differs, however, is in its scalar focus. Social memory operates on the level of society, whereas the inhabited approach of the weather-world centres on the experience of the individual. In order to work at the social level, the proponents of social memory introduce a number of concepts that describe the mediation between individual experience, the transmission of useful knowledge across time and space, and people's ability to harness that knowledge to deal with changes in the climate. Thus we are told of the *symbolic reservoir*, a shared vocabulary of symbols based upon deep "cosmological principles that give a historical trajectory to the social construction of reality" (McIntosh et al. 2000a: 26). It comprises a "fluid repertoire of ideological, symbolic, metaphorical, and mythical notions" (McIntosh et al. 2000a: 26). The *cultural* *schema* derives from the symbolic reservoir, and is described as “the socially agreed-on framework for debate about how the world works, the framework of understanding and communication that allows community decision making and mobilisation” (McIntosh et al. 2000a: 27).

Using cultural schemata and their symbolic reservoirs, societies 'imprint' “climatic surprises, palaeoclimatic cycles of different periodicities, and major modes of climate” (McIntosh et al. 2000a: 27) in their social memory. Such concepts reference the field of cognitive anthropology, in which human perception and action is accounted for “in terms of acquired schemata or programmes that differ from one culture to another” (Ingold 2000: 163). Understanding and action are thus underlain by “a huge database” that provides “all the information necessary to generate appropriate responses under any given environmental circumstances” (Ingold 2000: 164). As I showed earlier, this is an understandable response to the simplistic interpretations of the past, where environmental causes were directly and mechanistically related to social effects, because it begins to account for the knowledgeability of human actors (Ingold 2000: 165). The problem is that this approach remains grounded in Cartesian ontology. The natural body is the input device, conceived separate from the cultural mind, which operates on a societal level. Here again, modernity pervades contemporary analytical thought. There is a separation “between *cultural* memory aids and the mnemonic quality of moving and dwelling within the *natural* world” (Thomas 2004: 195, original emphasis). The human and non-human are separated out, while simultaneously the reaction of society to environmental crises is seen to be a hybridisation, combining both natural and cultural processes.

In drawing upon the ecological psychology of James Gibson, as well as elements of phenomenological philosophy, Ingold's (1992, 2000, 2007a, 2011) appeals for understanding people within the weather-world rest on a different conception of knowledgeability. Social memory contains knowledge that is prepared and structured according to pre-given cultural schemata and socially-agreed symbolic reservoirs. That knowledge is actively searched and sorted in order to find homologies about how to act in particular situations (Ingold 2011: 159; McIntosh et al. 2000a: 25). In contrast, Ingold (2011: 161) argues that knowledge “merges into life in an active process of remembering rather than being set aside as a passive object of memory, *it is not transmitted*." This is a subtle difference, but it is an important one. It foregrounds the importance of lived experience, as opposed to cultural schemata. The aim is not to portray a transcendent individual, completely free from the influence of others, but to recognise that individuals are "agent[s]-in-the-environment" (Barrett 2001; Ingold 2011: 171; Thomas 2004: 148). Information can be passed from person to person, and certain groups of people may reference certain forms of information in similar ways, but information can only be made meaningful when people put it into the context of their own lived experiences. The abstracted level of societal understanding is replaced with the engaged level of the individual and their journey through life: "It is through wayfaring, not transmission, that knowledge is carried on" (Ingold 2011: 162). Knowledge about how to act in certain situations is, therefore, *made* through active engagement in the present, not *transmitted* wholesale from the past through the medium of culturally encoded messages. The logical conclusion is that Durkheim's (1950) assertion is overturned: psychological and social processes are one and the same (Ingold 2000: 171).

The above discussion is not designed as an argument against the idea of culturally constructed environmental knowledge, but to show that there are a number of problems in the ways in which knowledge production and dissemination has been conceptualised. Elihu Robinson's approach to dealing with the crises at the turn of the century was guided by knowledge created during his experience as a Quaker, farmer and gentleman. Social memory was made manifest in relation to Robinson's own actions, not in "stored knowledge" unevenly distributed across society (McIntosh et al. 2000a: 28–9). With this in mind, however, there remains the problem about how to apply these ideas in an archaeological context. This is particularly true where documents cannot give us a detailed insight into people's lives, and where a paucity of data appears to demand a societal, rather than individual, focus.

What if?

In their critique of Chris Tilley (1994, 2004, 2008) and Vicky Cummings' (Cummings et al. 2002; Cummings and Whittle 2004; Fowler and Cummings 2003) phenomenological method for landscape archaeology, Barrett and Ko (2009) develop their own idea of what a phenomenology-influenced archaeology might look like. Coming to similar conclusions about the making and application of knowledge, Barrett and Ko (2009: 290) argue that it is in “dynamic and historical conditions of material existence” that researchers can apply phenomenological concepts. Through these we can begin to explore how particular ways of going about in the world come to be possible within certain historical situations. It is an approach that bears a strong similarity to Thomas' (2004: 241) calls for archaeologists to ask: “*what if* it was like this?”

The results from this thesis suggest that instead of asking '*what if* climate affected human history?', archaeologists should be asking '*what if* the people of the past lived not in landscapes, but weather-worlds?' In this conception, the role of palaeoenvironmental research is not diminished, nor is the need to understand how climate might affect societies' economies. It does, however, recognise that dividing research into spheres of landscape, climate, economy and society, has been counter-productive. In the case study, the split between environment, landscape and diary served primarily to highlight the difficulties working between data derived from different methods and scales of analysis. Although in practice, this is often the only practical means of putting together a comprehensive archaeological investigation, the division causes us to labour heavily on problems of cause and effect that are all but intractable. Complex modelling can only help to an extent, it cannot provide explanations in itself (Coombes 2003: 331).

Climate is integral to landscape, and weather is how that integration is expressed on a daily basis. So although limitations of scale can be accepted in a methodological sense, that should not necessitate a theoretical division that separates out history into arbitrarily defined and independently constituted scales of action (cf Bailey 2008). Deep structuring processes, such as climate change, are only made relevant in the lived experiences of individuals. More than that, by considering the landscape as a weather-world, weather and climate are brought into the same theoretical field that sustains the study of landscape archaeology. Climate is transformed from prime mover (or insignificant background context) into a material condition of past action. An archaeology of the weather-world might, therefore, concern itself with how agencies in the past operated through their relationships with the weather, and how changes in the weather facilitated different strategies and understandings. Ethnographic and phenomenological analogy has a role in guiding these investigations, but to avoid one-size-fits-all caricature, archaeologists must focus on the "historical realities of human agency" (Barrett 2001: 157). As such, climate change, through the experience of weather, can be related to the politics of identity, the understanding of place, and "a concern for the where of all human practice, in any or all of its dimensions" (David and Thomas 2010a: 39).

Conclusion

Over the past 40 years, the climates of the past have been of considerable interest to those who would link human history with that of the natural world. Martin Parry's (1975, 1976b, 1978, 1981, 1985; Parry and Carter 1985) method for integrating climatic and social narratives of landscape change, although dated, remains influential, particularly in the context of upland Britain. Parry recognised that the relationship between climatic cause and social effect would not be simple, but the model relies on formalist economic principles in order to work. The use of the model to explain how spatial changes in settlement correlated with environmental changes was thus flawed – a conclusion supported by my own application of the method in Mosser.

Instead of simply modelling the economic effects of people's interactions with the weather, the approach in Mosser used historical diaries to gain inhabited, first-person perspectives on life in the eighteenth century. This revealed within Elihu Robinson's world-view, the core characteristics of modern thinking, as described by Bruno Latour (1993). There are thus parallels between Robinson's attempts to understand the world and Julian Thomas' (2004) argument that archaeology as a discipline has been constrained by modernist thought. The current problems in relating environmental change to social change stem directly from the early modern period, when people like Fletcher and Robinson struggled to accommodate their religious and superstitious outlook with the developing science of meteorology. Here began the separation of weather and climate from landscape. As a result, Thomas' (2004) calls for a counter-modern archaeology resonate with both Ingold's (2007a, 2011) argument that we should view landscapes as weather-worlds, and the first-person approach to exploring experiences of weather. In a counter-modern archaeology there is a place for complex modelling, where, by exploring events repeatedly from different angles, models can shed light on the relational dynamics between economic and climatic processes. Equally, however, a counter-modern archaeology recognises that such modelling can only form part of historical narratives of change.

Ostensibly, social memory is a concept through which these findings can be applied to studies of the more distant past. But although the idea of social memory injects human perception and knowledgeability into interpretations of human-environment relations, it does so using concepts developed from cognitive anthropology that situate 'response' at a societal level. In this, there is a Cartesian distinction between nature and culture, non-human and human, agent and society – fundamentally modern divisions. Ingold's (2000, 2007b, 2011) ideas about how knowledge is made and referenced use ecological psychology and phenomenological philosophy to remove these distinctions. The result is a greater focus on lived experience. Information is made relevant only in the context of experience, it is not transmitted wholesale as encoded messages from the past or across societies. Guided by Barrett and Ko (2009), I argue that in order to apply these ideas in archaeology, we need to focus our attention on how particular ways of going about in the world were made possible at different times by certain material conditions. In the context of climate change in the past, it is suggested that this might best be achieved by asking 'what if the people of the past lived not in landscapes, but weather-worlds?' From this perspective, studies of weather and climate are reunited with the study of people in the landscape. In this respect, climate change and climate stability, bad weather and good, are all intrinsic to our understanding of how past people went about in the world.

Chapter 14: Conclusion

I am the sky itself as it is drawn together and unified, and as it begins to exist for itself; my consciousness is saturated with this limitless blue

Maurice Merleau-Ponty

Introduction

This study has explored how the relationship between society and climate in the past can be examined as part of a holistic landscape approach. This involved producing three different narratives of change for Mosser, Cumbria, in the late eighteenth century. These employed a variety of different methods and scales of working, and dealt with different types of data. Each approach was evaluated in the context of researching how past people interacted with climate and climate change, before comparisons were made between narratives. The aim was to explore how and whether experiential perspectives, through an appreciation of weather, could help transcend many of the difficulties involved in researching climates of the past.

The Narratives

Environment

The environmental narrative developed for Mosser incorporated two different ways of reconstructing the past environment. The first was a synthesis of of existing palaeoecological studies that contrasted both local and regional perspectives, as well as the changing approaches to palaeoenvironmental data that have been enabled by technical advances. Paul Coombes' (2003) results from nearby Mockerkin Tarn showed clearances during the Bronze Age and Anglo-Saxon period. During the eighteenth century, both pollen data and lake ecology indicators suggest a decline in land-use intensity, whereas a marked change in the lake ecology of Loweswater indicated an increased land-use intensity (Bennion et al. 2000). It is a picture that is vague at best, and certainly lacks the detail and chronological resolution advocated by Tipping (2004: 19) in his attempts to let the palaeoecological data "speak for themselves". The palaeoclimate record is similarly vague, even discounting the problems Coombes had in deriving a record from Mockerkin. Charman et al.'s (2006) regional synthesis appears to show increasing wetness throughout the eighteenth century, but there are difficulties identifying the broader period of the Little Ice Age. Away from Mosser, Coombes (2003: 328) was able to unite land use and climate data, but he found that “the epistemological and statistical tools used in palaeoecology are poorly suited to the task” of understanding causality, where cultural and climatic changes occur synchronously. He did, however, find that lowland communities might have been less able to cope with climate changes than those in the uplands, thereby questioning our definitions of marginality.

The second means of reconstructing the past environment relied on two long-running instrumental weather records: the CET and EWP. Using a series of regression equations, these were bridged to a weather station in Penrith, around 30km east of Mosser. Although these records were developed for areas distant from Mosser, separate studies have found that these respected series correlate well with records across the length and breadth of the country. It was hoped, therefore, that they could provide a reasonable approximation of the weather experienced in Mosser throughout the eighteenth century. Using the records, trends and unusual years can be identified, but the records in themselves provide no means for relating changes in the weather to social history. Martin Parry's environmental model for the Lammermuir Hills is designed to do just that. Although his method and results have been critiqued by Tipping (2002) from a palaeoecological perspective, I wanted to explore how environmental modelling could be applied in Mosser. Although it was quickly discovered that the land around Mosser was too low to be considered marginal for subsistence cereal cultivation, the model was successfully produced using expected limits of commercial cultivation. The upper limit of the marginal zone tended to respect the boundary of the enclosed farmlands, while the lower limit stretched out across much of Mosser. There were, however, a range of problems with the method's application. These centred on three assumptions concerning people's dependency on cereal cultivation, their perception of climatic risks, and the primacy of temperature in determining altitudinal limits to cultivation. Further uncertainties arose concerning the suitability of the temperature data and the validity of the model in non-marginal situations.

Landscape

A social landscape history of Mosser was produced from three principal sources of information: existing secondary literature concerning the social and economic history of Cumbria; hedge, boundary and upland walkover surveys of the study area; and historical maps and documents contained in the Cumbria county archives. For the most part, the history of Mosser corresponds with the rest of Cumbria as a place that was gradually becoming less remote over the course of the eighteenth century. The landscape became more enclosed and common rights were extinguished, but the parliamentary enclosure of Mosser Fell in the mid-nineteenth century was only the culmination of a much longer process. The fact that the inhabitants of Mosser were freeholders divorced them from the tenancy struggles observed in other parts of the county, but it could not distance them from the growing market economy driven by the rapidly expanding urban centres on the north-west coast. Although rapid depopulation has been suggested for other areas of Cumbria at this time, Mosser seems to have experienced remarkably few changes, but some estate fragmentation and consolidation did occur. On the farms, a mixed farming regime dominated, but evidence suggests that the balance between crops and livestock has changed over the years. The late eighteenth century saw a shift away from crops towards livestock, but evidence of ridge and furrow above the head-dyke probably reflects the profitability of cereal farming during the Napoleonic Wars. Climatic impact was hard to discern simply from the landscape history, but there are indications that drystone walls (as opposed to hedges) were sited on ground most exposed to the weather, and that sheep heafs were located outside of Mosser on the eastern slopes of the fell, and thereby less exposed to the prevailing westerlies.

Experience

Two diaries spanning the late eighteenth century enabled the production of a final, more experiential narrative on the relationship between people and climate. There were three ways in which this was done. Firstly, using techniques employed in historical climatology, the diarists' weather observations were translated onto an ordinal numerical scale. This allowed a holistic overview of weather trends, as well as statistical comparisons with other data. Secondly, the diarists' observations on weather impacts were assessed, and Elihu Robinson's diary underwent systematic, qualitative analysis. This helped characterise the diarists' experiences, and revealed how deeply their lives were entwined with the daily weather. It also showed how years with bad weather, poor harvests and high prices tended to cluster together. It is not clear, however, how or whether these events were related – certainly there were occasions when fear of a bad harvest was more instrumental in raising prices than lack of farm produce. The final aspect of this narrative was the attempt to look beyond the description of the diary entries. It explored how the production of the diaries was part of the gentlemanly commitment to scientific progress. The weather and recording of the weather were bound up with the diarists' personal morality and world-views. Their Quaker faith taught them to endure the weather with patience and submission, but their resolve was tested during times of bad weather and social stress. Crucially, the diaries reflect wider tensions between traditional wisdom and Enlightened perspectives on God, science and nature. At the threshold of modern meteorological understanding, the diarists viewed the weather as deeply integrated in social life, but it was a time when the gradual separation of people, land and climate was gathering pace.

Comparing Narratives

Ever since it was discovered that the world's climate has not been static throughout the ages, researchers have been intrigued by the suggestion that climate could be a prime mover in the deep history of human societies. Such questions have become all the more pertinent when palaeoclimatology can identify variability over ever shortening time-scales. Within the different disciplines, as they struggled to incorporate climate into their narratives of the past, a number of different trajectories of thought were embarked upon. In history and historical climatology, dissatisfaction with environmental determinism yielded concerted attempts during the late 1970s and early 80s to transcend determinism and better unite studies of climate and socio-economic history. There were three main elements to their critique: that the paucity of historical datasets inhibits the definition of detailed climate-society links, that difficulties arose because research necessarily crossed disciplinary boundaries, and that causation cannot be assumed from correlations between climate and social history (Rothberg and Rabb 1981; Wigley et al.

1981). These were each found to be relevant in this study, particularly when attempting to reconcile the environmental and landscape narratives. A lack of information and poor chronological resolution prevented correlating trends and events, the numerous potential sources of error within each method underlined the importance of understanding the limitations of other disciplines, and where correlations were found causal mechanisms could not be defined.

There were, however, some aspects of the early critiques that were questioned. For example, although increased resolution and detail were thought to engender better analyses of the climate-society dynamic, it was found that no matter the level of detail, defining relationships is always difficult. Analysis showed that a worsening climate could have been a factor in the piecemeal enclosure of eighteenth-century Mosser or it could have been a wholly socio-economic process, but there is no way of determining the relative likelihood of each scenario. Potential relationships between prices, tithe values and weather records were interrogated using statistical analyses, but for the most part, few clear correlations were found. Rather than helping create unambiguous narratives of climatic impact, they served primarily to refute simplistic, common-sense hypotheses on how climate affected local economies. Although economic data did lend support to some aspects of the environmental model for Mosser, it also raised questions about the importance of crop farming, and about what conditions constituted bad years. Overall, Rabb's (1980) suggestion that we should not seek to bridge across climatic and social chronologies, using ever more complicated models of causation and ever more refined concepts of 'harm', seems to hold true.

Using weather reconstructions from the diaries to make comparisons between the local experience of weather and the regional picture derived from the instrumental records yielded few statistically significant correlations. There are, nevertheless, hints that the regional perspective does give a rough approximation of the weather experienced by the diarists, but a clear set of problems arose from a lack of data within the diaries, despite the apparent advantages afforded by the high chronological resolution. The level of detail was increased and our understanding of particular aspects of the local economy was enhanced, yet correlating economic and weather variables failed to transcend problems outlined in the 1970s and 80s. In contrast, by using the diaries to gain an intimate, inhabited perspective on daily life, it was possible to unite each approach in a single narrative that described how people's relationships with climate were transformed as part of a wider transition into modernity. This interpretation involved going beyond the economics, trends and events of climate history, but treated the diaries as material culture, constituted by the diarists' interactions with weather and climate.

Implications and Future Research

Taken together, the results of this thesis suggest that although complex ecosystems and economic modelling has becoming popular in studies of climate in the past, the focus on the physicality of climate-society relationships downplays the importance of individuals' perceptions and attitudes to the weather. It is only by taking a broad, yet people-centred perspective that problems of correlation, causality and lack of data are able to be set aside. Theoretically, this accords well with attempts to explore the past through phenomenological and inhabited perspectives. It also reflects Tim Ingold's (2007a, 2011) assertions that we should view landscapes as weather-worlds, where people, land and weather are all enmeshed in constant flux. Previously, the concept of social memory was conceived to offer a means by which human agency could be reconciled with the long-term nature of climate changes, and the broad scales and low chronological resolutions inherent to archaeological research (McIntosh 2000). However, these results suggest a more appropriate theorisation of human-climate relationships would focus less on how environmental knowledge is stored and transmitted, and more on how knowledge is made manifest through active engagements with the changing material conditions of the past.

One of the most intriguing findings was the link between contemporary approaches to researching climate and history, and the diarists' experiences over two hundred years ago. It was then, at the beginnings of modernity, that traditional and more holistic understandings of how the world works began to be threatened by increasingly compartmentalised approaches to scientific knowledge. According to Thomas, these problems are as relevant today in archaeology as they were when first expressed, and they serve to limit our understanding of the past. The counter-modern archaeology that Thomas (2004: 248) calls for is one that recognises the poverty of approaches that aim to “reach a definitive, non-contradictory point of closure.” Interpretations of human responses to climate change in the deep past are, therefore, able to accommodate the multiplicity of inhabited and phenomenological perspectives. Indeed this approach is deemed essential for transcending the limitations of modernism, which maintains arbitrary divisions between the human and natural words, and renders incomprehensible the people of the pre-modern world. But there is also a danger of caricature, where phenomenological and ethnographic analogy simply transfers findings from one setting to interpret another. This threat can be reduced by maintaining interpretative emphasis on the historical context and material conditions that people engaged with (Barrett 2001; Thomas 2004). It is an approach that does not lessen the importance of detailed palaeoecological information, nor prevents the application of modelling techniques. It does, however, suggest that future researchers should remember that is through weather that climate changes are expressed, and that weather is a material condition of landscape – one that is embedded in social and cultural formation, and thus as much open to archaeological investigation as any other aspect of the past.

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