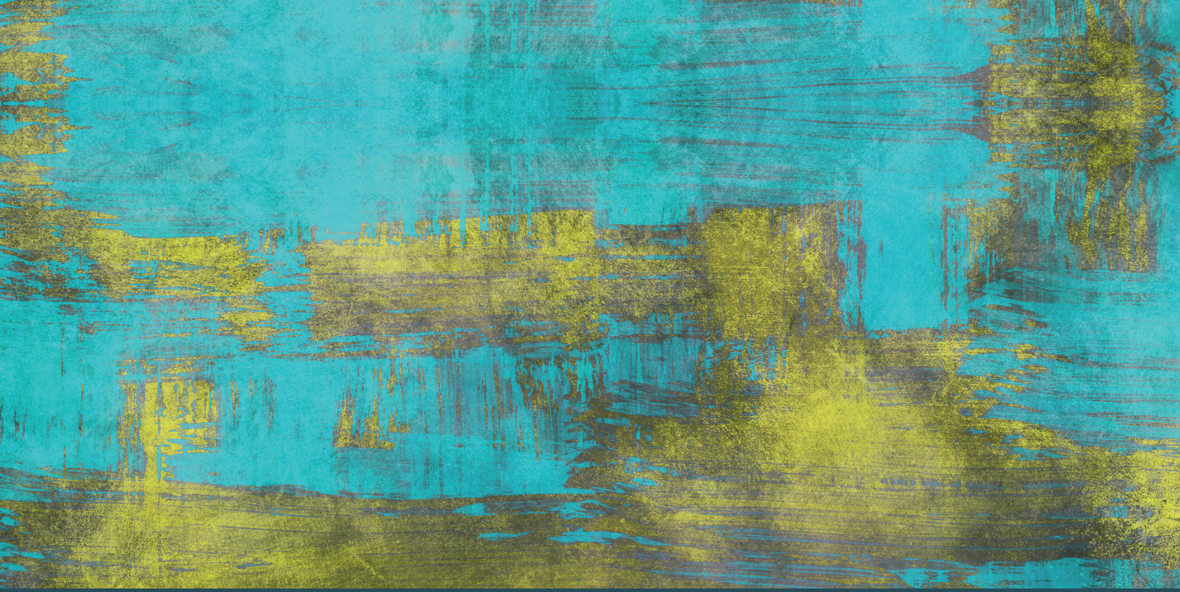

COASTAL LANDSCAPES OF THE MESOLITHIC

HUMAN ENGAGEMENT WITH THE COAST FROM THE ATLANTIC TO THE BALTIC SEA

Edited by
Almut Schülke

ROUTLEDGE

Coastal Landscapes of the Mesolithic

Coastal Landscapes of the Mesolithic: Human Engagement with the Coast from the Atlantic to the Baltic Sea explores the character and significance of coastal landscapes in the Mesolithic – on different scales and with various theoretical perspectives and methodological approaches.

Mesolithic people were strongly connected to the sea, with coastal areas vital for subsistence and communication across the water. This anthology includes case studies from Scandinavia, western Europe and the Baltic area, presented by key international researchers. Topics addressed include large-scale analyses of the archaeological and geological development of coastal areas, the exploration of coastal environments with interdisciplinary methods, the discussion of the character of coastal settlements and their possible networks, social and economic practices along the coast, as well as perceptions and cosmological aspects of coastal areas. Together, these topics and approaches contribute in an innovative way to the understanding of the complexity of topographically changing coastal areas as both border zones between land and sea and as connecting landscapes.

Providing novel insights into the study of the Mesolithic as well as coastal areas and landscapes in general, the book is an important resource for researchers of the Mesolithic and coastal archaeology.

Almut Schülke is Associate Professor of Nordic Archaeology (Mesolithic and Neolithic periods) at the Museum of Cultural History, University of Oslo, Norway. Her research interests include the study of social space and mobility in coastal and other environments, ritual and depositional practices and burial archaeology.

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Human Engagement with the Coast from the Atlantic to the Baltic Sea

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Preface and acknowledgements

In many parts of Europe, people were strongly connected to the sea in what is termed the Mesolithic period (c. 9500–3800 cal BC), with coastal areas vital for subsistence and communication across the water. Most of the coastal zones in Europe were inundated at the end of or after the Last Glacial period with the result that former coastal sites are submerged today. In some parts of northern Europe, as in the Oslo fjord area in south Norway, Mesolithic sites are preserved on dry land due to constant land upheaval during the Holocene. In this region, the Museum of Cultural History, University of Oslo, has in the last two decades, excavated hundreds of former coastal sites in connection with development-led excavations. These excavations provide a comprehensive body of data on sites with different technological and chronological traits, different sizes, ranges of artefacts and raw materials. The data hold key information on economic and social strategies in the Mesolithic period, on movement, connections, land use and taphonomic aspects both within the coastal areas and in their relation to the inland.

One of these excavation projects, the E18-project Rugtvedt-Dørdal in Bamble, Telemark, focused, as described in its project outline (Schülke 2017),[1] on issues related to the variations and continuities in the human use of the coastal zone in the Stone Age. In connection with this project, which was conducted between 2013 and 2016, a research group 'Steinalderens kystlandskap' (engl: *Stone Age Coastal landscapes*) was established, initiated by the author. The aim was to provide a broader academic platform to facilitate scholarly exchange between the project and national and international researchers. Six seminars with external and international scholars were organized by the group, together with a final, international workshop.

This anthology is based on contributions to the international workshop held at the Museum of Cultural History, University of Oslo, 16–19 November 2016, under the title 'The Coastal Landscapes of the Mesolithic', with 50 national and international participants and 20 presentations. The main aim of the workshop was to discuss the topic in light of current international research between the Atlantic and the Baltic. Based on presentations with variations in terms of archaeological, geological and topographic situations, we aimed to address diverse methodological strategies and to share interpretative approaches across geographic areas.

In line with this, this anthology presents current archaeological and interdisciplinary approaches to the study of Mesolithic coastal landscapes with the aim to examine the significance of coastal areas in this period, with case studies from western Europe, Scandinavia and the Baltic presented by a number of international key researchers as well as young researchers. The complexity of concepts such as 'coast' and 'coastal landscapes' is explored on different scales and using a variety of theoretical perspectives and methodological approaches. The research strategies applied in the contributions range from large-scale analyses of the archaeological, geological and climatic development of coastal areas to the exploration of various coastal environments using interdisciplinary methods. Further, the character of coastal settlements, their networks, the social and economic practices in coastal areas and the perception of the coast are explored.

Geographically, the anthology spans wide, from Ireland in the west, across western France, Scandinavia to Latvia in the east, encompassing very different types of seas from the Atlantic Ocean to the Baltic Sea. Chronologically, the term 'Mesolithic' encompasses in this case different cultural and periodical developments in the time span 9500–3800 cal BC. An introductory chapter (Chapter 1) outlines diversities, challenges and perspectives on human–coast relations between the Atlantic and the Baltic and serves to set the chapters in a general context. The other chapters in the book are organized according to different general topics: Part I deals with 'The significance of coastal areas' (Chapters 2–5), Part II with 'Coastal sites, mobility and networks' (Chapters 6–9), Part III focuses on 'The resources of the sea and beyond' (Chapters 10–13) and Part IV explores 'The coastal zone: time depth, historicity and ritual practice' (Chapters 14–16).

The 2016 Oslo workshop 'The Coastal Landscapes of the Mesolithic' was only possible due to the incentive funding allocated by the Museum of Cultural History, University of Oslo. I would like to express my profound thanks for this most valuable financial support. Warm thanks go to all colleagues who participated in the research group's activities for fruitful and stimulating discussions, especially Steinar Solheim, Guro Fossum, John Asbjørn Havstein, Lucia Koxvold and Anja Mansrud, and for their essential help with organizing the final workshop. Thanks also to all of the speakers at the workshop for their most interesting talks and discussions, and to engaged moderators. I am also indebted to senior editor Matt Gibbons and his team for their support in preparing the volume. Thanks to Isak Roalkvam for his work with the copy and edit in an early stage. Finally, I owe all of the authors who have contributed to writing this volume, as well as the peer-reviewers, my sincere thanks for your interest, cooperation and constructive engagement from one end to the other. All the chapters in this volume are peer-reviewed.

Oslo, 5th July 2019
Almut Schülke

Note

1 A. Schülke (2017). Prosjektplan og faglige problemstillinger for E18 Rugtvedt-Dørdal. Mennesker og kystsonen i steinalderen – variasjon og kontinuitet. In: S. Solheim (ed.), *E18 Rugtvedt-Dørdal, Arkeologiske undersøkelser av lokaliteter fra steinalder og jernalder i Bamble kommune, Telemark fylke.* Pp. 27–28. Kristiansand/Oslo: Portal forlag og Kulturhistorisk museum, Arkeologisk Seksjon. This is the published version of the unpublished project plan from 2013.

Abbreviations

BP	radiocarbon years before the present
cal BP	calibrated years before the present
cal BC	calibrated historic years BC
MCH, UIO	Museum of Cultural History, University of Oslo

1 Coastal landscapes of the Mesolithic

Diversities, challenges and perspectives on human–coast relations between the Atlantic and the Baltic Sea

Almut Schülke

Introduction

The coast, as an interface between land and sea, has attracted people since time immemorial. From the shore, the view is wide and the horizon large. The coastline is always in motion, shaped by winds, tides and seasons. Since prehistoric times, coastal areas all over the world have been vital for transport and communication; for the supply of basic food resources such as fish, molluscs, sea birds and marine mammals; for materials such as bones, shells, lithic resources and driftwood; for attracting settlement; and not least, for having a cosmological meaning (Yesner et al. 1980; Erlandson 2001; Erlandson & Fitzpatrick 2006; Fitzpatrick et al. 2015).

From an archaeological perspective, topics such as the relevance, use and exploitation of coastal areas for and by human groups have been discussed since the beginning of the discipline in the 19th century. Archaeological finds from different coastal zones, with different biotopes and ecozones, are central for our understanding of how people were organized throughout the Mesolithic period (c. 9500–3800 cal BC), in social and economic terms, and how they adapted to these environments (Fischer 1995a; Bailey & Milner 2003; Wickham-Jones 2014; Bjerck 2016; Dupont & Marchand 2016a). Exploring Mesolithic 'coastal landscapes' is thus a common and border-crossing topic, not least for the areas at the northern and western edges of the European continent, which are the focus of this book. Today, these coastal zones are delimited by but also connected through the northeastern parts of the Atlantic Ocean and its marginal seas, including the Irish Sea, the North Sea, the Norwegian Sea, the Skagerrak, the Kattegat and the Baltic Sea (Figure 1.1).

Though connected, these seas are different in character, across space and time, with differing environments and temporalities, due to their different geological, geographical, oceanographic and climatic conditions and developments. Different types of land meet different kinds of seas with varying resources. These shorelines, as a junction between fast and fluid, wet and dry, warm and cold, salty and brackish and so forth, have many different facets and were prioritized and utilized differently at different times. The varying character of coastal

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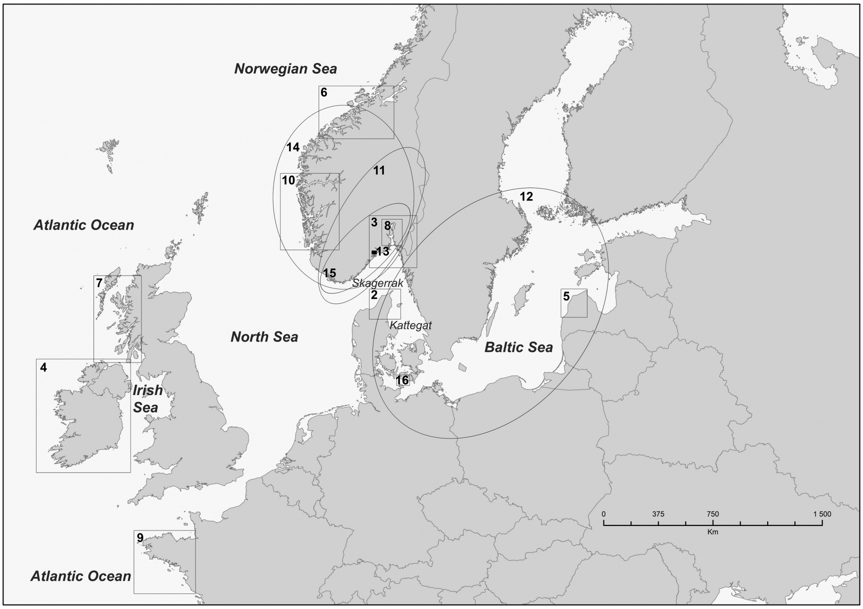

Figure 1.1 The coastal areas between the Atlantic Ocean and the Baltic Sea. The areas dealt with in this book are marked with their chapter number: 2: Jutland (Denmark); 3, 8, 11, 13, 15: southeastern Norway and the Oslo fjord region (Norway); 4: Ireland; 5: Latvia; 6: central Norway; 7: western Scotland; 9: western France; 10: western Norway; 12: the Baltic Sea area (Denmark, northeastern Germany, Poland, Lithuania, Estonia, eastern Sweden); 14: southern Norway; 16: Lolland (Denmark). Illustration: A. Schülke.

zones across geographic regions, their formation and human use through time have had an impact on research traditions and methods, which responded differently to the prehistoric remains preserved in the different areas. As we will see, they create interesting tensions between research landscapes in the different regions.

The notion 'landscape' is complex, and can have many meanings and connotations (Bender 1993; Thomas 2001; David et al. 2014). It can denote a specific geographic area with specific topographic, climatic, environmental and cultural characteristics in the sense of a surface. Or it can be understood more in the sense of a 'container', in which cultural and natural characteristics merge with, for example, human actions, reactions and memories. But it can also be applied to denote a relationship between a contemplator and a subject – in the sense of a (world-)view or a concept of understanding surroundings, comprising humans and non-humans (Thomas 2001; Schülke 2016). Either way, the term 'landscape' denotes a 'section', either as a spatial section and thus a delimited area, or as a culturally/individually defined understanding of a certain surrounding. In the latter sense, 'landscape' applies both to past and present situations and understandings. It encompasses the relationship of people to the coast in the Mesolithic period as well as in our, archaeological, contemporary approaches to it. Thus, the main title of this volume *Coastal Landscapes of the Mesolithic* serves to address not only the manifold coastal areas that were used by Mesolithic people, but also the different understandings of coastal surroundings in the past, as well as the variety of archaeological approaches to the topic.

For archaeologists, the traces and remains that Mesolithic humans left at coastal sites are the main gateway for exploring how prehistoric people might have used, perceived and interacted with coastal areas or 'landscapes' in this period. The study of artefacts and ecofacts, with multidisciplinary methods, can give answers to questions such as those addressed in the invitation to the 2016 workshop 'The Coastal Landscapes of the Mesolithic' in Oslo (Schülke et al. 2016; see Preface and Acknowledgements this volume): What kind of activities can be traced at the sites? Why was the coast attractive? How did people interact within, and towards, changing coastal landscapes? And, can we discern a change in the relevance of coastal areas through time?

Using this background, this anthology aims at putting the manifold relevance and meanings of 'the coast' on the agenda – socially, cosmologically, economically and, in terms of communication, moving beyond conceptions of coastal areas as mere providers of resources. It integrates different theoretical perspectives concerning social, economic and ritual practice, as well as a range of interdisciplinary methods, such as archaeoosteology, archaeobotany, isotope studies, geology and GIS modelling of coastal areas – to name but a few. The case studies encompass Ireland, the Inner Hebrides (Scotland), western France, northern Jutland and the island of Lolland (both Denmark), the central, western and southeastern coastal areas of Norway, northern Germany and the Baltic area with the Latvian coast (Figure 1.1). They provide insights into the chronological and cultural differences of the Mesolithic period between the Atlantic and the Baltic; into differing research traditions, questions and discourses; and into areas with different physical traits regarding topography, vegetation, climate and landscape history – not least addressing the complex and often blurred notion of 'the coast'. Due to the large area covered, the length of the timeframe and the complexity of social and cultural units termed 'Mesolithic', the book will not provide a full cultural historic overview of the use of the coast, from the Atlantic Ocean to the Baltic Sea, between c. 9500 and 3800 cal BC. Furthermore, it will only touch indirectly on the threat of destruction that maritime and coastal cultural heritage is exposed to, caused by environmental and anthropogenic factors (Bailey & Flemming 2008; Hutchings 2017). Instead, this compilation of studies on and from different regions presents similarities and differences in the use of the coastal zone, and discusses its ambivalent role for Mesolithic people as a connector and as a border, applying a range of perspectives and methodologies to analyze different types of archaeological materials. While different regional and archaeological situations might demand different methodological strategies, interpretative approaches can be discussed, compared and shared across geographic areas.

This anthology will hopefully encourage future cooperation in research, through a better understanding of the diversity of the shared topic of interest.[1] This chapter will give a short introduction to the topic of coastal landscapes in northern and northwestern Europe, and provide an overview of some of the main problems discussed in the book. Finally, it will address some of the interpretative challenges, as well as future perspectives, on the study of Mesolithic coastal landscapes.

Varieties of coast and sea: different formation processes, topographies, temporalities and resources

The coastal areas of northern and western Europe, as we know them today, were formed by environmental processes connected to the gradual deglaciation after the last Ice Age (the Weichselian) from c. 13 000 cal BP onwards (Påsse & Andersson 2005; Bailey & Spikings 2008; Bjerck 2008). Melting water and isostatic rebound together with climatic changes lead to different developments of land–sea relations in different regions, with changing coastlines due to regressions, to land upheaval or to transgressions (Bailey & Flemming 2008; Wickham-Jones 2018). The reconstruction of sea-level changes is a multidisciplinary and time-intensive field of research, based on geological and archaeobotanical studies (Christensen 1995; Bailey & Flemming 2008; Wickham-Jones 2018), as is the spatial reconstruction of changing ancient coastlines (Sturt et al. 2013; Chapter 4 [Warren & Westley]; Chapter 5 [Bērziņš]). There are considerable regional and local differences in sea-level changes (compare for example Chapter 3 [Solheim]; Chapter 4 [Warren & Westley]; Chapter 14 [Nyland]; Chapter 15 [Schülke]). Each coastal area has its own nature due to the respective formation processes, which also affected the coastal resources available, the possibilities for human use of the coastal strip and, not least, the archaeological material that is preserved – all these aspects being interconnected.

Large parts of the Mesolithic coastal areas of northwestern Europe are submerged today and are therefore difficult to access and document (Bailey & Flemming 2008; Harff et al. 2016; Wickham-Jones 2018). The biggest area is Doggerland, the North Sea continent, which, at around 12 000–11 000 cal BP, connected what today is Britain, northwestern Germany, the Netherlands, Belgium and parts of northern France – separated from Norway by the *Norwegian trench* (Bjerck 1995; Coles 1998; Gaffney et al. 2007). Within c. 3000 years, between 11 000 and 8000 cal BP, this flat region was inundated, changing all of the coastal areas in the North Sea region by flooding the land bridge between them (Sturt et al. 2013), and transgressing former coastal and inland sites (Amkreutz et al. 2018). Other coastal areas also underwent complicated processes of change. The regions around today's Baltic Sea were affected in different ways by the development of the Late Glacial Baltic Ice Lake into today's sea (Björck 1995; Påsse & Andersson 2005). While the Mesolithic coastal zones in the southwestern Baltic were gradually submerged by the Littorina fluctuations in the 7th and 6th millennium cal BC (Christensen 1995; Larsson 1999; Lübke et al. 2011), areas in the eastern Baltic underwent complicated developments of regressions and transgressions (Chapter 5 [Bērziņš]).

The Atlantic and its marginal seas, which border northern and western Europe (see Figure 1.1), have different characteristics, varying depths and currents and different grades of salinity, which have changed through time (Chapter 5 [Bērziņš]). Tidal rhythms provide a structuring temporality, which also can be seen for the past (Uehara et al. 2006), as do, on a larger scale, the seasons. The coastline is always in motion. While less noticeable in the Baltic Sea, tides condition the daily routines of the inhabitants of the Atlantic and North Sea coasts to varying degrees (Pollard 1996; Chapter 9 [Marchand]; Chapter 10 [Bergsvik & Ritchie]). In some areas, such as western France, the coast is regularly transformed into a large intermediate zone between land and sea, exposing the sea floor, uncovering or washing up food resources and affecting conditions for seafaring.

These seas demanded caution and respect in different ways (Bjerck & Zangrando 2016). They offered different types of resources – molluscs, shellfish and fish – which again affected the food chain and thus the occurrence of other animals such as sea birds and marine mammals. Thus, they required specific techniques and equipment not only for seafaring (Bjerck 1995; Andersen 2011; Bjerck 2016), fishing (Pedersen 1995; Klooβ 2015; Boethius 2018; Chapter 10 [Bergsvik & Ritchie]; Chapter 11 [Mjærum & Mansrud]) and hunting sea mammals (Chapter 12 [Glykou]), but also for staying or settling close to the shoreline, for example in harsh environments in postglacial times (Persson et al. (eds.) 2017). Some coastal areas, such as Bohuslän in western Sweden at the Palaeolithic/Mesolithic transition, developed very productive environments due to the impact of deglaciation on tidal situations, which attracted hunters and fishers (Schmitt et al. 2006).

Short catastrophic events such as storms and floods affect coastal areas. Around 7300 cal BP, the Storegga tsunami, caused by a tremendous slide off of sediments from the margins of the retreating ice shield into the North Sea, inundated shores and coastal sites and settlements in western Norway, also affecting Scotland and the Faroe Islands (Bjerck 2008). Slower environmental changes, such as the Littorina transition, flooded large coastal strips in the Baltic Sea (Christensen 1995; Larsson 2003; Påsse & Andersson 2005).

The coastal areas dealt with in this book (Figure 1.1) have various forms and topographic qualities, with long sandy beaches with or without sandy cliffs (Jutland, Lolland, Latvian coast), rocky cliff shores, offshore islands or skerry coasts (Ireland, Scotland, western France, western Norway, southeastern Norway/Oslo fjord) or fjord landscapes (western Norway). They condition the accessibility of the coast from the sea, including landing places and look-out possibilities (Bjerck 1989; Fischer 1993). The significance of coastal areas, their respective hinterland and its general accessibility – on foot or by boat – also their resources and vegetation, have to be considered (Chapter 9 [Marchand];

Chapter 11 [Mjærum & Mansrud]; Chapter 13 [Wieckowska-Lüth & Kierleis]; Chapter 15 [Schülke]). The relatively flat moraine regions in the southern and eastern Baltic region, with sandy soils, moderate height differences, watercourses and lakes, precondition human movement, use and experience in a different way than rocky plateaus or cliffs (Ireland, Inner Hebrides, Western France) or composite rocky shores close to mountain chains (Norway). Coastal zones also provide different types of mineral resources (Chapter 14 [Nyland]; Chapter 4 [Warren & Westley]).

Significant climatic differences between the areas, and over time, as well as climatic crises such as the 8200 cal BP event, need to be taken into account (Breivik 2014; Apel et al. 2018; Chapter 6 [Breivik]; Chapter 8 [Fossum]). Winter temperatures especially differ between the regions. While the Atlantic coasts seldom see minus temperatures, (parts of) the sea could freeze in areas of the Oslo fjord and the Baltic Sea, attracting species such as seal, and facilitating transport on ice, ice-fishing and seal hunting (Chapter 12 [Glykou]).

Exploring different Mesolithic coastal zones: taphonomic biases as challenges and triggers for research

The interest in the Stone Age people's use of the coast started in the middle of the 19th century, with the identification and first excavations of shell middens – large human-made shell refuse heaps known from several coastal areas of Atlantic Europe (Milner et al. 2007). In northern Europe, they came into focus with investigations of some of the numerous 'kitchen middens' (*køkkenmøddinger*) on Danish ground, starting in 1848 with the establishment of an interdisciplinary research group (*The First Kitchen Midden Commission*). In the 1890s, a second study group, including botanists, geologists, zoologists and archaeologists, excavated several shell middens in Jutland, among them the site of Ertebølle, which became eponymous for the Late Mesolithic Ertebølle culture (5400–3900 cal BC) (Madsen et al. 1900; Andersen 2000). In parallel, in the second half of the 19th century, the first anthropological studies of maritime hunter-gatherers were conducted (Bailey & Milner 2003; Dupont & Marchand 2016b).

The Danish case can serve as an example to illustrate the often complicated nature of studying people's relation to the sea in the Mesolithic period, and thus coast–inland relations (Astrup 2018; Chapter 2 [Astrup]). The area of Denmark has a specific geological situation, placed on the 'tiltline' of the postglacial isostatic land uplift and land sinking. This results in Mesolithic shorelines only being preserved above ground in the northern and northeastern parts of the country, while they otherwise are, together with potential Mesolithic coastal sites, submerged due to the sea-level rises of the Littorina transitions (7th–6th millennium cal BC) (Christensen 1995; Andersen 2007). The archaeological focus shifted from coast to inland after richly preserved Mesolithic wetland sites were discovered inland in the 1930s (Mathiassen 1938, 1942). When prehistoric flooding events were understood more closely in the 1970s, coastal sites came into renewed focus (Krogh 1973; Christensen 1995; Fischer 1995b). Renewed interdisciplinary excavations of shell middens were conducted (Andersen 2000, 2007), while at the same time archaeologists started systematic surveys of submerged Mesolithic coasts. Groundbreaking underwater archaeological methods led to finds of extremely well-preserved organic material, among them wooden constructions such as fishing weirs (Fischer 1995b; Pedersen 1995). The proceedings of the conference 'Man and the Sea in the Mesolithic' held in Kalundborg in 1993, exemplarily sums up the – international – state of the art on the research of coastal settlement above and below present sea level at the end of the 20th century and put many still up-to-date research questions on the research agenda (Fischer 1995a, 1995c). The challenge of studying coast–inland relations on the basis of submerged sites has been addressed in several recent studies (Johansen 2006; Sørensen 2017; Astrup 2018.)

The Danish example illustrates how coastal areas in Europe and all over the world have changed significantly through time, due to local isostatic development and global eustatic sea-level rise, with specific histories of land loss and land gain in different areas (Bailey & Spikings 2008). Archaeologists are confronted with questions on the representativeness of the archaeological material in the coastal zone, for example in regions with 'missing' or uninvestigated sites that are submerged or overlaid today, and difficult to access (Larsson 2003; Bailey & Flemming 2008; Chapter 2 [Astrup]; Chapter 4 [Warren & Westley]; Chapter 9 [Marchand]). Our understanding of the significance and use of coastal areas in the Mesolithic period is therefore closely connected to what is archaeologically visible. This differs from region to region. In Denmark, for example, due to partly submerged coastal zones, the inland, with many well-preserved settlement sites, is seen as an integral part of Mesolithic people's lives (Sørensen 2017; Astrup 2018; Chapter 2 [Astrup]). In Norway, where postglacial land uplift has preserved thousands of Mesolithic coastal sites on dry land, the coast is seen as most central for Mesolithic people's living, while the character of inland use and exploitation is discussed (Bjerck 2008; Solheim & Persson 2018; see also Chapter 10 [Bergsvik & Ritchie]; Chapter 11 [Mjærum & Mansrud]; Chapter 3 [Solheim]; Chapter 8 [Fossum]; Chapter 15 [Schülke]).

Thus, preservation conditions influence the conception of Mesolithic coastal landscapes, besides other source-critical factors such as survey methods. Submerged archaeological sites being difficult to access, when excavated often provide finds that are excellently preserved, and permit insights into the use and procession of organic material. In northern and western Europe, many underwater archaeological investigations have been conducted along the Baltic Sea shores of northern Germany, Sweden and Denmark, the English Channel and the North Sea as well as western Britain (Fischer 1995b; Christensen 1995; Larsson 1999; Bell 2007; Bailey & Fleming 2008; Lübke 2009; Benjamin et al. 2011; Momber et al. 2016; Wickham-Jones 2018). Sites preserved on dry land, as in southeastern Norway and western Sweden, are easily accessible, but often have poor preservation conditions for organic material due to acid soils

(Nordqvist 1995; Bjerck 2008; see Chapter 3 [Solheim]; Chapter 8 [Fossum]; Chapter 11 [Mjærum & Mansrud]). Other coastal areas provide more favourable preservation conditions – such as the sandy soils bordering the southeastern part of the Baltic Sea (Larsson 2003; Brinch Petersen 2015), some coastal wetlands (Boethius 2018; Chapter 16 [Sørensen]), caves in western Norway or on Gotland (Bergsvik & Storvik 2012; Apel & Storå 2017; Chapter 10 [Bergsvik & Ritchie]) or shell midden sites in many parts of northwestern Europe (Mellars 1987; Milner et al. 2007; Andersen 2007; Chapter 9 [Marchand]). From these, a broad spectrum of organic finds is known, such as human and animal bones, antlers, wood or macrofossils, evidence of house floor structures and wattlework used for the building of fishing weirs.

Social organization, mobility and networks

The significance of coastal zones and the degree to which they were frequented and exploited by Mesolithic people are unequivocally connected to the social organization of these groups. A main factor in this is the extent of their mobility, both on land and at sea, in terms of frequency and distances. Were the places at the seashore frequented randomly, seasonally or were they settled permanently?

The role of the boat as a means of short- or long-distance transport, or even as a home, is a central issue, especially with regard to the colonization of Preboreal coastal landscapes with offshore locations by highly mobile groups, although no such remains are preserved (Bjerck 1995, 2016; Glørstad 2013; Schmitt 2015). Using a boat, long journeys could have been conducted within shorter time periods – provided that people knew the most convenient routes and could take advantage of favourable weather conditions (Fuglestvedt 2009; Schmitt 2015). The boat was also an essential means of transportation when moving within a network of established sites (Andersen 2011; Bjerck 2016) to reach islands (Woodman 2003; Conneller et al. 2016; Chapter 7 [Mithen et al.]; Chapter 9 [Marchand]) or to follow animal prey, such as seals (Bjerck 1994; 2016; Chapter 12 [Glykou]) or elk (Fuglestvedt 2009). There are locations which show that people took dangerous seafaring voyages to visit offshore island sites, which from a mere economic perspective were not necessary to visit (Chapter 7 [Mithen et al.]). Lately, the question of survival in rough Late Glacial climates has been in special focus (Persson et al. 2017).

Ethnographic studies are essential for exploring Mesolithic societies (Lee & DeVore 1968; Renouf 1984; Knutsson 1995; Lane 2014). Important archaeological models, such as L. Binford's (1980) model on residential movement versus logistical mobility systems in hunter-gatherer societies, which is still influential, are based on ethnoarchaeological studies. Binford (1980) identifies two main types of hunter-gatherer societies: foragers and collectors. While foragers move in entire groups from place to place within a specific area in search of resources, the more sedentary collectors set out in task groups to procure food and other resources within a specific territory. In this and related studies

(Kelly 2003), adaptive strategies govern the idea of how space is organized, as well as the types of mobility of groups that are logistically developed in different ways (David et al. 2014). Breivik (Chapter 6) investigates these different types of group organization for Early Mesolithic societies in the coastal areas of central Norway. Based on the archaeological and ethnographic evidence, T.D. Price and J.A. Brown (1985) argued that particular hunter-gatherer societies became more complex through time, characterized by features such as sedentism, social inequality, specialization and warfare. According to Price (1985), such complex societies evolved over time in Mesolithic southern Scandinavia, documented, for example, in large Late Mesolithic settlements that also exhibit intensification of subsistence procurement. The idea of coastal societies that were more or less sedentary mainly developed due to the rich Mesolithic evidence from Denmark (Rowley-Conwy 1983; Price 1985). The ideas of Late Mesolithic task group mobility in the coastal zone in western Norway (Bergsvik 2001) or of long-term attachment to coastal areas in the Oslo fjord area (Glørstad 2010) are closely related to the assumption that these groups were more place bound. For other areas, such as on the Hebrides or in western France, the existence of more sedentary societies is more critically discussed (Mithen 2000; Dupont & Marchand 2016b; see also Warren 2005).

On a global level, the comparison of anthropological, archaeological and historical situations exhibits a perspective on a variety of modes of living by and with the sea (Erlandson & Fitzpatrick 2006; King & Robinson 2019). Terms used to classify these societies, for example *fisher–gatherer–hunters* or *hunter–fisher–gatherers*, are problematic as they generalize the groups that frequent the coast (Bailey & Milner 2003). Comparative studies function to illustrate the diversity of relations between people and the sea, to extend ways of seeing differences between regions (Bjerck et al. 2016), in light of diachronic changes of these relations.

From a mere archaeological perspective, mobility patterns and networks can be explored by studying sites from a technological perspective, by identifying practice and spatial movement through *chaîne-opératoire* studies and the distribution of, for example, lithic artefacts – on and between sites (Conneller 2005; Mansrud & Eymundsson 2016). Comparative studies of typological or technological traits can illuminate long-distance networks, contacts and mobility (Pailler et al. 2007; Berg-Hansen 2017; Damlien et al. 2018), including coast–inland networks (Bang-Andersen 1996; Manninen 2009; Chapter 9 [Marchand]). The study of different types of diet through isotope analysis on human bones can map preferences of maritime or terrestrial food (Schulting & Richards 2001; Fischer et al. 2007; Eriksson et al. 2008; but Bailey & Milner 2003). Isotope analysis can – compared with artefact data – contribute to explore the regional mobility patterns of the Mesolithic people (Kjällkvist & Price 2019), while DNA analysis on human bones can give insights into human interaction on a larger scale (Günther et al. 2018). Isotope studies on animal bones, for example marine mammals such as seals, can give insights into mobility and hunting strategies (Glykou et al. 2018; Chapter 12 [Glykou]).

Coastal sites – people's remains: material, place and context

Exploring the relevance and meaning of coastal areas for Mesolithic people starts with the study of archaeological sites as humanly marked places in the coastal zone. Due to the find material, which is part of a broader context, it reaches beyond the site and always also includes the surroundings in the sense of environmental and social context. The relation between archaeological material and sites can illuminate the extent and the purposes of use of locations in the coastal zone, and their meaning and function as a place or a living area for a larger or smaller social unit. The archaeological material can be studied on different levels, from small to large scale, and vice versa, from different theoretical and methodological standpoints.

Diversity of materials and sites

Mesolithic coastal sites can have quite different material expressions, both within and across regions and time, representing different types and lengths of visits – from short-term stays to more permanent occupations (Chapter 6 [Breivik]; Chapter 7 [Mithen et al.]; Chapter 10 [Bergsvik & Ritchie]). People's stays at and engagements with these locations are represented by the remains of structures, the types and numbers of artefacts produced, various raw materials, and are deposited in different stages of their operational chain. They are, as well as ecofacts, affected by specific taphonomic processes. Intra-site distribution patterns and the organization and deposition of mostly lithic artefacts and refuse can be studied to identify the size, activity areas and organization of sites (Nærøy 2000; Viken 2018), not least in relation to structures such as fireplaces (Mansrud & Eymundsson 2016) or dwellings (Grøn 2003; Fretheim 2017). A special topic is shell heaps as intentional accumulations, known from several parts of Atlantic Europe, interpreted as middens, sometimes with monumental traits (Andersen 2000; Bailey & Milner 2003; Milner et al. 2007). Sites and their surroundings can be considered as places of different tasks, which are perceived according to certain situations, in the sense of T. Ingold's (1993) taskscapes (Conneller, 2006) – as places where human experiences overlap and enmesh (Driscoll 2017; Chapter 14 [Nyland]).

Human skeletal remains are known from many Mesolithic coastal sites, often located on an island, as regular burials, and also as loose human bones, with especially good preservation conditions in shell heaps (Meiklejohn & Denston 1987; Larsson 2003; Brinch Petersen 2015; Chapter 9 [Marchand]).

Economic aspects

Faunal remains, macrofossils, pollen, charcoal and shells contribute to the reconstruction of coastal environments (Mellars 1987), as well as to the study of procurement and storage strategies (Chapter 9 [Marchand]). Among them is the processing of marine faunal resources, such as fish and seal (Lübke et al. 2011;

Boethius 2018; Chapter 10 [Bergsvik & Ritchie]; Chapter 11 [Mjærum & Mansrud]; Chapter 12 [Glykou]). Finds of fish bones and fishing gear substantiate that fishing was carried out from the sites, and illuminate different technologies that were used (Enghoff 1994; Hartz & Kraus 2009; Klooβ 2015; Chapter 10 [Bergsvik & Ritchie]; Chapter 11 [Mjærum & Mansrud]). There are, however, taphonomic questions involved. On the coastal sites of western France for example, the relatively few finds of fishbones do not attest to intensive fishing, and it has to be asked whether this situation is due to excavation methods, taphonomic biases or prehistoric cultural choices (Chapter 9 [Marchand]). Bones of terrestrial animals are represented on many coastal sites, and testify to the hunting of both bigger and smaller terrestrial game, and thus represent an interweaving of inland aspects with coastal sites (Glørstad 2010; Lübke et al. 2011; Chapter 3 [Solheim]; Chapter7 [Mithen et al.]; Chapter 11 [Mjærum & Mansrud]).

The analysis of killing age on animal bones, compared with the seasonal behaviour of modern animals (Dupont 2016; Chapter 9 [Marchand]; Chapter 12 [Glykou]) and seasonal indicators of collecting activities such as for shellfish or hazelnuts (Chapter 9 [Marchand]; Chapter 7 [Mithen et al.]) might indicate activities related to specific seasons; however, identifying season-related activities on archaeological assemblages has taphonomic, methodological and interpretative pitfalls (Milner 2002). The vegetation of the coastal hinterland and possible human manipulation can be explored through archaeobotanical analyses (Wieckowska-Lüth et al. 2018; Chapter 13 [Wieckowska-Lüth & Kierleis]).

Site placement

Discussing site placement, the spatial closeness of shore-based sites to the sea, is primarily explained by easy and low-cost access to food resources (Rowley-Conwy 1983, 1984) as well as easy access by boat. Places with good conditions for fishing were important social arenas for Mesolithic people, interpreted as locations at which social diversity evolved (Bergsvik 2001; Chapter 10 [Bergsvik & Ritchie]; Chapter 11 [Mjærum & Mansrud]). Stationary fishing structures, facilities for processing fish as well as the aspect of storage attest to the importance of fixed/marked locations for these coastal societies (Pedersen 1995; Dupont & Marchand 2016b; Boethius 2018). Also, certain locations and/or situations would have brought people together, transforming locations into social aggregation sites, for example in connection with the stranding of whales, and multidisciplinary studies can help to address these issues (Evans et al. 2016).

Based on archaeological experiences with the topographic placement of coastal sites, site-placement models for Mesolithic coastal sites were developed in different areas (Bjerck 1989:fig. 45; Fischer 1993, 1995b). Fischer's (1993, 1995b) concept-sketch of a typical bigger Late Mesolithic coastal site from Denmark covers a stretch of at least 100 m in flat areas along the coast. In comparison, even the larger Late Mesolithic coastal sites from Norway have smaller dimensions – located in a compartmentalized coastal topography with terraces of different sizes between rocky outcrops (Glørstad 2010). Are these differences due to adaptations of the same principles to different types of landscape or to different cultural choices, or do they just reflect different ways in which archaeologists delimit coastal sites? Shores and their adjacent hinterland areas with differing topographic traits are accessible in different ways. This is, for example, the case for areas with 'open' surfaces with few obstacles, such as the southern and southeastern Baltic region, with more compartmentalized areas, such as western Sweden and Norway.

Cosmological dimensions

That the sea and the coastal zone also had symbolic significance is reflected in raw materials collected at the beach, such as shells used as ornaments in burial contexts (Dupont et al. 2014). However, the ideological and cosmological dimensions of coastal locations have mainly been discussed for site types which are considered to belong to the ritual sphere, such as Norwegian Stone Age rock art (Helskog 1999; Lødøen 2003, Gjerde 2016), coast-based burial sites (Larsson 2003; Sørensen 2016) and ritual deposits (Bergsvik 2009; Chapter 16 [Sørensen]). Some researchers have suggested that depositions in the coastal zone, often at river outlets, could be explained with ethnographically attested beliefs that consider coastal areas as liminal zones (Pollard 1996; Sørensen 2016). Understanding coastal settlement sites, in analogy with ethnographically studied hunter-gatherer life-worlds, as part of past life-worlds, opens up for discussing the cosmological dimension for diverse spheres of life. Mesolithic settlements placed at the shore have been related to a conceptional tripartition of the real and the supernatural world as known from recent hunter-gatherer societies (Helskog 1999; Larsson 2003), and interpreted, for example, as safe places in between a lower (water) and an upper (sky) world (Bergsvik 2009). Also, coastal places are addressed as liminal places at the edge of the world, as places of transformation between life and death (Pollard 1996), and bone fishhook manufacture on coastal locations is seen as a process to handle the dangers and unpredictability of a marine way of life (Mansrud 2017). Coastal sites are also discussed as important anchor points in the consciousness of individuals and groups (Glørstad 2010; Mansrud & Eymundsson 2016; Chapter 15 [Schülke]).

Aspects of time and chronology

To date activities at Mesolithic coastal sites, though a central concern of archaeology, is – converted into human lifetime – still a rather general affair. Material traits are persistent, often across millennia, while radiocarbon dates cover ranges of time. The latter are not always available. Thus, discerning 'contemporary' activity on locations is dependent on the chronological resolution that the archaeological material allows (Chapter 6 [Breivik]; Chapter 4 [Warren & Westley]). Mithen et al. (Chapter 7) choose to work with radiocarbon-dated sites to reconstruct activity events, while Bergsvik and Ritchie (Chapter 10) operate within time-slices of 500-year lengths, and Fossum (Chapter 8), using a well-documented sea-level curve, argues with 200 year precision (bins of 200-year lengths) for the dating of former coastal sites. Solheim (Chapter 3) uses the statistically processed development of the number of radiocarbon dates through time to discuss the development of demography, while Nyland (Chapter 14) and Schülke (Chapter 15) integrate the aspect of people's experience from a more theoretical perspective. Addressing the interpretative challenges and limitations of Mesolithic (coastal) chronology should be a major concern in future studies.

The coast – centre or periphery? Some future perspectives

At the beginning of this millennium, the question was posed whether living by the coast and with the sea was, in prehistoric times, and on a global scale, a marginal phenomenon, compared to living in inland areas (Bailey & Milner 2003). This was due to missing data, especially for the earlier parts of the Mesolithic period. Today, in the light of an immensely increased body of data on coastal sites, both on land and underwater, the question of the importance of coastal environments for Mesolithic people, in terms of communication, resources and cosmology, is much more a question of why situations are so different in the different regions. For the areas between the Atlantic Ocean and the Baltic Sea, the importance of the coast for Mesolithic people is obvious in cases where repeated or long-term use of coastal areas is documented throughout the period. In Norway, for example, this can be, to a large extent, related to the abundance of marine resources, which enables easy and year-round food provision (Chapter 3 [Solheim]). The role of the coastal environment, however, is not so obvious in other regions – either due to visibility, due to archaeological preferences or due to a factual underrepresentation of coastal sites – or a combination of all. In areas with a distinct inland Mesolithic tradition, where Mesolithic shorelines in addition are difficult to reconstruct, the significance of the coast has been rather underestimated, as in Ireland (Chapter 4 [Warren & Westley]). Or, there has been comparatively little focus on the coast, as in Latvia (Chapter 5 [Bērziņš]). While the inland evidence has been connected to the coastal Mesolithic, for example in Denmark and western France (Chapter 2 [Astrup], Chapter 9 [Marchand]), there are other areas for which inland finds are seldom connected to the archaeological evidence in the coastal zone, as with the southern Baltic coast of Germany; probably due to a divide between the different methods involved in the investigation of sites, with underwater archaeology in the coastal zone and surface surveys in the inland areas.

In regions with good preservation conditions of coastal sites, the significance of the coastal environment seems to shift over time. People moved and explored the peripheral coastal areas in the north, which were placed at the periphery of the Pleistocene world (Bjerck 1995; Fuglestvedt 2009; Breivik 2014; Berg-Hansen 2017) – which through time became centres of people's social world (Chapter 10 [Bergsvik & Ritchie]; Chapter 11 [Mjærum & Mansrud]). The perception of centre and periphery shifts through movement. In some contexts, the coast must surely have been more in focus than in others, for example regarding seasonal activities, such as seal hunting (Chapter 12 [Glykou]), and the use of different landscape zones for different purposes, for example the transportation of fish to the inland areas (Chapter 11 [Mjærum & Mansrud]). Also, coastal sites can be places for targeted returns, but they could also be given up for social reasons (Chapter 15 [Schülke]), in some cases centred around import places such as rock procurement sites (Chapter 14 [Nyland]), or ritual places (Chapter 16 [Sørensen]). Fully submerged areas, as for example Doggerland, or the coastal areas of the southeastern Baltic Sea, changed from being centres to being submerged and invisible.

This situation, with evidence from the Mesolithic coastal areas of northern and western Europe being taphonomically biased in different ways, provides a chance from a theoretical and methodological point of view. Comparing the – partly missing – evidence of different regions can trigger new perspectives and approaches to the study of coastal landscapes. A compilation of case studies as in this anthology indicates the potential which may lie in future developments of these topics. They open up for future perspectives:

- To broaden our understanding of the relevance of coastal zones by comparing different areas – archaeologically, topographically and oceanographically, also with regard to different research traditions and to the terminologies used to describe sites or topographical characteristics.
- To understand coastal sites in their respective contexts, and also to see the possibilities that might lie in addressing limiting, source-critical factors, for example regarding taphonomic processes in the respective areas.
- To think of the relevance of the coast in relation to the respective inland areas and the possibilities that it might offer – connected for example to questions of movement and seasonal use.
- To integrate questions of cosmology and the ritual sphere, as seen in, for example, rock art and death rituals, more purposefully into the study of coastal sites and environment, as well as questions of social and political organization.
- To actively face more of the challenges of chronology, and the question of how to translate very general chronological frames into the lived lives of people.
- To improve understanding of the diversity of coastal environments and of the human response to them.
- Finally, to work with an understanding of the bigger picture of the Mesolithic use of coastal areas in general, with a historic dimension, related to topics such as the character of the use and meaning of coastal

environments, continuities and discontinuities, social contact, mobility and territoriality in a long-term perspective.

The structure of this book

The anthology is divided into four parts. Part I: The significance of coastal areas, introduces the variety and contrasts of Mesolithic coastal landscapes between the Atlantic and the Baltic Sea, with regard to geographic differences, preservation conditions, cultural historic development, state of research and archaeological interpretation. The four case studies discuss general trends from northern Jutland, Denmark (Chapter 2 [Astrup]), southeastern Norway (Chapter 3 [Solheim]), Ireland (Chapter 4 [Warren and Westley]) and Latvia (Chapter 5 [Bērziņš]). Part II: Coastal sites, mobility and networks, is devoted to examples of coastal sites in different regions and different periods of the Mesolithic, their qualities, their relation to climatic factors and their interpretation regarding their belonging to wider networks, not least discussing aspects of mobility. The cases include diachronic trends among Early Mesolithic site types in central Norway (Chapter 6 [Breivik]); Mesolithic sites and coastal exploitation in western Scotland (Chapter 7 [Mithen, Wicks and Berg-Hansen]); Late Mesolithic coastal settlement in times of climate change from one part of the Oslo fjord area (Chapter 8 [Fossum]); and Mesolithic networks of Atlantic France (Chapter 9 [Marchand]). Part III: The resources of the sea and beyond, encompasses chapters on the development of Mesolithic fishing techniques and landscapes on the coasts of western Norway (Chapter 10 [Bergsvik and Ritchie]); the question of fishing management in different geographic zones of southeastern Norway (Chapter 11 [Mjærum and Mansrud]); and seal-hunting techniques and landscape use in the Baltic Sea (Chapter 12 [Glykou]). Furthermore, the development of coastal vegetation for a case study from southeastern Norway, on the basis of lake sediment coring, is discussed from an archaeobotanical perspective (Chapter 13 [Wieckowska-Lüth and Kierleis]). The final part, Part IV: The coastal zone: time depth, historicity and ritual practice explores human experiences in and of coastal areas. It contains a discussion of the long-term use of stone quarries in southern Norway (Chapter 14 [Nyland]); a study of different types of use and reuse of coastal areas in southeastern Norway in a long-term perspective (Chapter 15 [Schülke]); and presents a ritual deposition area at the shore of the island of Lolland, Denmark, that was continuously used from the Late Mesolithic to the Early Neolithic periods (Chapter 16 [Sørensen]).

The chapters of this book tend to cover several topics, and could have been assigned to more than one of its four parts. Thus, the chapter division offers one route of many possible journeys through the current coastal landscapes of the Mesolithic period, between the Atlantic and the Baltic Sea.

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Note

1 An example of such cross-regional approaches is the recent establishment of the International Research Network (IRN) ‘Coast–inland dynamics in prehistoric hunter-gatherer societies (PrehCOAST)’ supported by the CNRS, France, organized by Grégor Marchand (CNRS), Pablo Arias (University of Catabria), Valdis Bērziņš (University of Latvia) and Almut Schülke (MCH, UiO), which has its roots in two international workshops (Dupont & Marchand 2016a and the 2016 Oslo workshop ‘The Coastal Landscapes of the Mesolithic’ in 2016).

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Part I

The significance of coastal areas

2 The role of coastal exploitation in the Maglemose culture of southern Scandinavia – marginal or dominant?

Peter Moe Astrup

Introduction

The extent of dry land during the Boreal period (8000–7000 cal BC) has long been demonstrated by finds of terrestrial and lacustrine peat deposits under the sea in southern Scandinavia. The lack of coastal sites from the Maglemose culture (c. 9500–6400 cal BC) has therefore been explained by the postglacial sea-level rise which is assumed to have flooded the region and any sites that existed there (Sarauw 1903; Clark 1936; Fischer 2001). The extent to which coastal settlements are absent from the record, whether they were important and whether they were similar to the bog/wetland sites that have formed archaeologists' perception of the Early Mesolithic of southern Scandinavia for over a century, remains uncertain.

Several studies have been conducted to clarify the significance of the coast during the Maglemose culture. Most importantly, attempts have been made to study the stable isotope values of the available bone material (Fischer et al. 2007) and to identify coastal sites under water using the so-called fishing-site model (Fischer 1993, 1995, 1997, 2001; Astrup 2018). Despite these efforts, there is only sparse evidence to suggest that coastal exploitation took place in the Preboreal and Boreal periods. It is not until the transition to the Kongemose culture (c. 6400–5400 cal BC) that there is substantial direct evidence for a marine-based subsistence economy in the form of faunal remains and coastal sites. It has, in other words, proved difficult to identify new evidence from Maglemose sites, which is useful for evaluating the significance of marine resources in southern Scandinavia.

Given the oft-stated high bioproductivity and biodiversity of coastal areas, some researchers find it hard to believe that these resources were ignored in prehistory (e.g. Erlandson 2001). A desire to trace marine exploitation as far back in time as possible has unfortunately prevented researchers from paying the necessary attention to evidence that might indicate a later adaptation of marine-based economies and/or technologies. Application of a linear developmental mindset should be avoided, and caution should be exercised when comparing societies that existed at different times and in different environments. Archaeological remains around the world may indicate that marine

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resources were exploited prior to the Early Mesolithic (e.g. Erlandson 2001). This does not, however, prove that people made use of the same resources during the Maglemose period. Therefore, the evidence from southern Scandinavia is discussed here from a Danish perspective and with a focus on the archaeological record from Denmark.

Background and aims

The study of Mesolithic coastal settlements has a long tradition in Denmark, dating back to the first half of the 19th century (Madsen et al. 1900). Even so, only a few Maglemose and Early Kongemose sites are considered to have occupied coast-near positions. These include Pilhaken c. 7000 cal BC (Fischer 1995); Fløjstrup Skov c. 6950 cal BC (Dencker & Jensen 2000); Musholm Bugt c. 6400 cal BC (Fischer & Malm 1997); Kalø Vig I c. 6400 cal BC (Fischer 1994; Fischer & Hansen 2005); Blak II c. 6300 cal BC (Sørensen 1996, 2017); Tågerup c. 6300 cal BC (Karsten & Knarrström 2001) and a site in Aarhus Bay c. 6400 cal BC (Astrup 2018). Despite the small number of recorded coastal sites, it has been suggested that the coast played a greater economic role in the Maglemose culture than is indicated by the available evidence (e.g. Fischer 2001; Astrup 2018). The Early Mesolithic continues, however, to be seen as diametrically opposed to the Late Mesolithic Ertebølle period with regard to the significance of marine resources. The few traces of Early Mesolithic coastal settlements in Denmark contrast sharply with the situation in parts of Norway and Sweden, where coastal sites of this period are represented on land, rather than submerged beneath the sea. In these regions, the coast was occupied by mobile, marine-oriented hunter-gatherers between 9500 and 9000 cal BC (Bjerck 2009; Breivik 2014).

It remains unclear why there are so few records of sites in Denmark dating back to 9500–8500 cal BC compared to Sweden and Norway, where there are many known coastal sites. Was marine exploitation in Denmark of minor importance, relative to Sweden and Norway, for environmental and/or cultural reasons, or have traces of coastal sites here remained unidentified due to the Holocene sea-level rise, unlike the situation in Norway and Sweden where Early Mesolithic coastlines were uplifted? Because of the scarcity of evidence in Denmark it is unknown whether the most permanent/sedentary habitations existed along the coast during the Maglemose culture. If this were the case, when and why did these settlements appear and in what ways, if at all, did they differ from inland habitations? These are some of the questions that have remained unresolved since the definition of the Maglemose culture more than 115 years ago (Sarauw 1903; Astrup 2015, 2018).

A refined understanding of the subsistence economy is crucial to resolving the above questions, given that our current understanding of social organization (i.e. degree of mobility and cultural complexity – as defined by Price 1985) largely depends on evidence for the presence of technologies for marine exploitation, such as stationary fishing structures. If it can be demonstrated that people relied heavily on marine resources, our view of their social organization might also have to be redefined. The observed differences between the Early Mesolithic societies of Denmark and those of Sweden and Norway may appear over-exaggerated if new research is able to show that coastally positioned sites were also widespread and dominant across most of southern Scandinavia.

While archaeologists have long recognized that glacial rebound raised Early Mesolithic coastlines in Sweden and Norway, the opposite, i.e. submergence, has always been assumed in Denmark (Fischer 2001; Jensen 2001). However, a recently completed PhD project (Astrup 2015, 2018) has demonstrated that the former coastlines of Vendsyssel dating from the latter part of the Maglemose culture, 7000–6500 cal BC, are situated above present-day sea level; this phenomenon is not evident anywhere else in Denmark. These uplifted shorelines are important because any correlations between Maglemose sites and palaeo-coastlines are more likely to be identifiable above present sea level, where archaeological material has been recovered for centuries, as a result of the collection of stray finds and excavations. In contrast, investigations have only recently been undertaken in submerged areas. The aim of this chapter is therefore to demonstrate whether the known Maglemose sites in Vendsyssel had a coastal position, simply by mapping them in relation to the reconstructed coastlines of this region (Figure 2.1; Astrup 2018).

Reconstructing the elevated coastlines of northern Denmark

In order to determine the position of the coastline as it was c. 6750 cal BC, data from a selection of geological publications were compiled. These included studies by A. Jessen (1899, 1920, 1936), K.S. Petersen (1984), K.L. Knudsen and K. Nordberg (1987), P. Hauerbach (1992), N. Richardt (1996) and the publication of the Ertebølle settlement at Yderhede (Christensen & Nielsen 2008). It has been argued in these studies that the highest sea level in northern Vendsyssel occurred around 14 000 cal BC, with beach ridge systems from this time being identified 60 m a.s.l. (Mertz 1924; Richardt 1996; Astrup 2018). A coastal cliff between Hirtshals and Frederikshavn is visible in the landscape today and is thought to have been formed by the Zirphaea Sea slightly later around 10,500–10,000 cal BC, when the local sea level was 16–22 m above its present level (Christensen & Nielsen 2008). A peat layer at Yderhede, dated to 9812–9411 cal BC (AAR-2460), indicates a regression from c. 60 m (c. 14,000 cal BC) to less than 11 m during the Late Glacial period (all dates have been calibrated using OxCal V4.1 and are listed at 68% confidence limits). Another peat layer from the Early Holocene was recorded in a geological section near Tværsted Å, where it is overlain by marine deposits (Krog 1984). Two shells from a marine layer in this section, 6 m above sea level, have been ^{14}C dated to 7471–7143 cal BC (K-1472) and 7002–6505 cal BC (K-1054). A peat deposit directly underneath the marine layer, at an elevation of 5.5–5.7 m, has been ^{14}C dated to 7940–7581 cal BC (K-1475), 7962–7589 cal BC (K-1476),

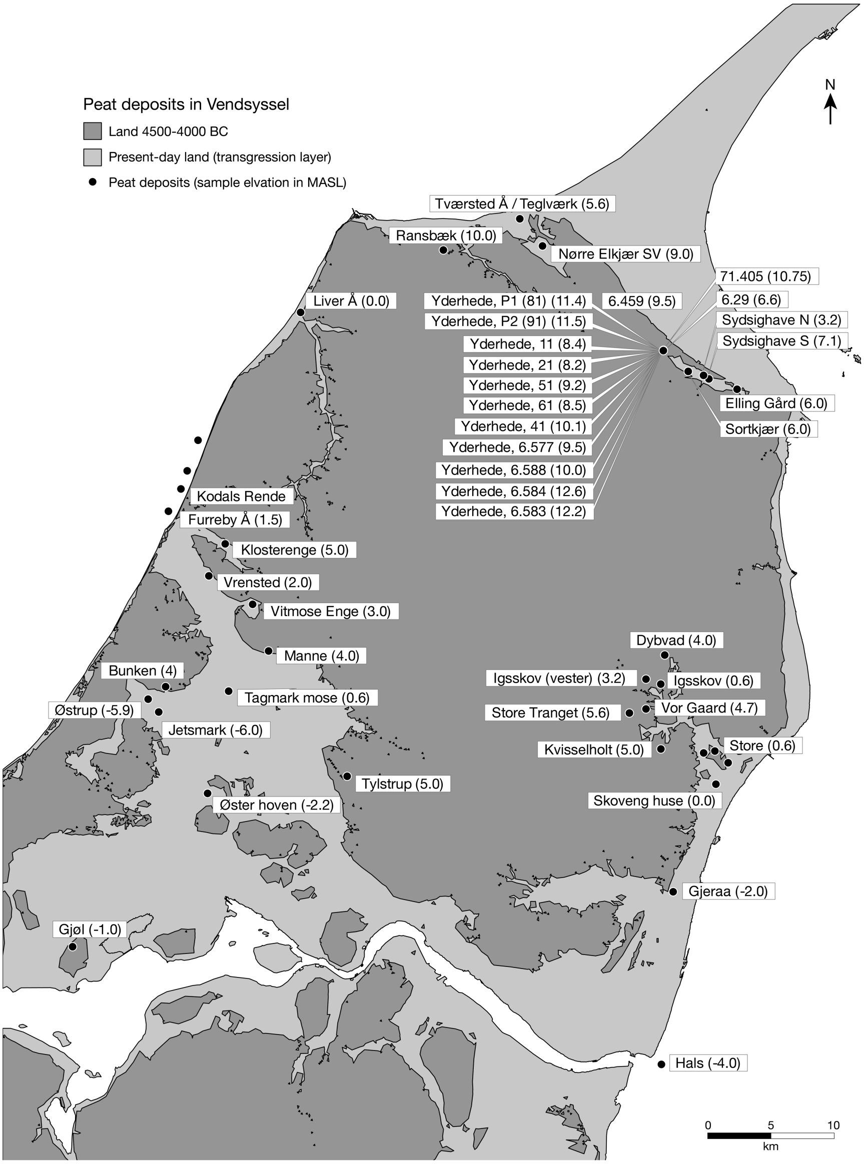

Figure 2.1 Peat deposits in Vendsyssel in or below deposits of the Littorina Sea. Numbers in brackets refer to the lowest elevation where peat has been recorded at each location. Illustration: P.M. Astrup.

7601–7311 cal BC (K-1477) and 7611–7316 cal BC (K-1478). Three radiocarbon-dated samples from a marine refuse layer at the Ertebølle settlement of Yderhede (AAR-2462–64) also permitted the sea level to be reconstructed rather precisely to around 13 m above present-day level in c. 5200 cal BC (Nielsen & Christensen 1999; Christensen & Nielsen 2008).

Based on lacustrine deposits recovered 4.5 m below sea level in the harbour at Sæby (Mörner 1969), and the data shown in Figure 2.2, it appears that the local sea level most likely reached a minimum around 9500–8500 cal BC during the Preboreal. There must then have been a stable sea level for a short time until it began to rise again. More of the submerged peat deposits must, however, be dated before firmer conclusions can be drawn about the level from which the transgression began, although it did continue until it reached a level of c. +13 m around 5200 cal BC (Astrup 2018). Consequently, if the available ^{14}C dates from Tværsted Å are reliable, coastlines and potential coastal sites from the latter part of the Maglemose culture should be expected at elevations ranging from 0 to 7 m above present sea level in northern Vendsyssel. If the coastal cliff of the Zirphaea Sea was formed 16–22 m above present sea level around 10,500–10,000 cal BC, as suggested by A.B. Nielsen

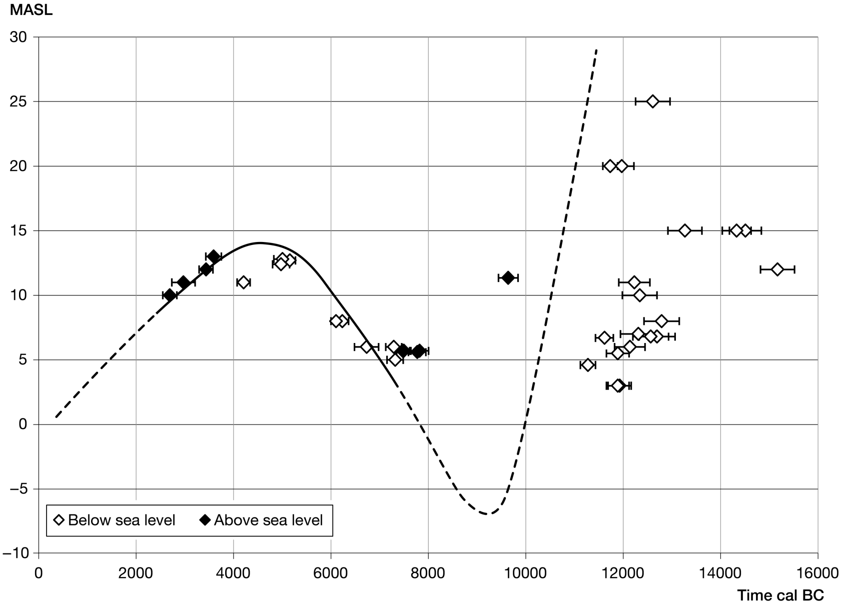

Figure 2.2 Sea-level curve from northern Vendsyssel: samples deposited below sea level are shown in white color. Samples deposited above sea level are shown in black. Poorly established parts of the sea-level curve are marked with a broken line. The ^{14}C dates are presented with 68% confidence limits. Additional information about the individual samples can be found in Astrup (2018). *Source*: After Astrup (2015, 2018).

and C. Christensen (1999), then coastal sites from the Late Glacial and Early Holocene may similarly be situated on land. It is therefore possible to search for correlations between Maglemose sites and the contemporaneous coastlines when these are mapped together.

Vendsyssel is the region in Denmark that has been subjected to the greatest uplift (Mertz 1924; Petersen 1984; Astrup 2018). The effect of a eustatic sea-level rise was therefore in some periods balanced by an almost identical rate of isostatic uplift, which in turn reduced the actual coastline displacement. Potential coastal sites/areas in Vendsyssel may consequently have been inhabitable for a much longer time compared to any other areas in Denmark. Extended periods of occupation may have allowed more and/or larger coastal sites to develop in the same areas near the coast than was the case anywhere else in the country. This should make it easier – at least in principle – to investigate whether people, over longer periods, continued to position their settlements near the coast.

Although Vendsyssel, as a region, is well-suited to the present study, it also has some restrictions that require further clarification. A description of the coastline models used in this study is presented in Astrup (2018). Most importantly, the north-west coast of Vendsyssel is influenced by sediment transport that has been ongoing since the last Ice Age. For example, a comparison of a map from 1787 with one from the late 1800s (Jessen 1920) suggests that at least 100–150 m of land has disappeared from the west coast at Lønstrup and Maarup. However, it is difficult to determine how much land has been lost since the Mesolithic. Due to this constant movement of sediments along the exposed parts of the northern and western coasts of Vendsyssel, the modern bathymetry of these two regions is a poor analogy for the former topography, which cannot be reconstructed by simulating a reduction in sea level. The east coast, on the other hand, is better suited to coastline modelling using elevation models.

Maglemose sites in Vendsyssel

In the following, the archaeological evidence from Vendsyssel is compiled and mapped to examine how Maglemose sites were positioned relative to the coast (see also Astrup 2015; Astrup 2018). The archaeological record for Vendsyssel dating back to 9500–6400 cal BC is consistent with that documented elsewhere in southern Scandinavia. However, compared to the well-studied peat bogs of eastern Denmark, Scania and northern Germany, the number of records is limited and only a few sites have been excavated and published in any detail. Of particular importance is a large fragment of a pine arrow found during peat cutting in a raised bog near Flippenborg, which has been radiocarbon dated to 7382–6970 cal BC (8180 ± 140 lab. no. K-1323), i.e. the latter part of the Maglemose culture (Andersen 1978a). Finely denticulated barbed bone points have also been recorded from a number of local bogs such as Svennum Mose, Tidemandsholm and Horne Terp (Andersen 1978b; Figure 2.3). Of the few

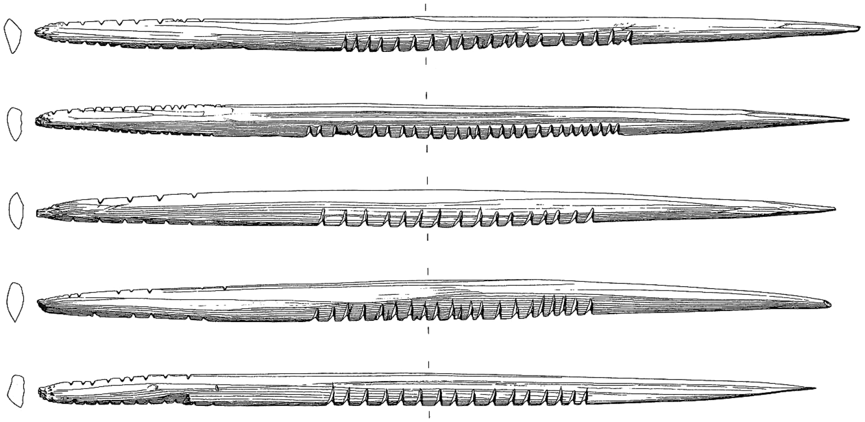

Figure 2.3 Five finely denticulated barbed points from Horne Terp. The length of these barbed points varies between 29.6 and 31.5 cm. Their width varies between 1.2 and 1.5 cm. *Source*: From Andersen (1978b). Printed with permission.

sites that have been excavated in Vendsyssel, Ulvkær stands out: Within an area of 114 m^2, more than 67,746 pieces of flint, including 369 microliths, were recorded (unpublished data from Vendsyssel Historiske Museum). Ulvkær is by far the most substantial Maglemose site in Vendsyssel and the number of finds clearly reflects the fact that it has been excavated – unlike most other sites, which are represented by surface collections of artefacts.

Mapping the Maglemose sites

To achieve as complete a distribution map of the Maglemose sites as possible, all site reports held at Vendsyssel Historiske Museum were reviewed. Thus, an attempt was made to ensure that all object identifications were consistent and that all sites and single finds from Vendsyssel of Maglemose date were included in the present study.

Most of the sites shown in Figure 2.4 are represented by surface collections of artefacts from ploughed fields. The amateur archaeologist U. Mortensen, in particular, was responsible for many of these finds in eastern Vendsyssel. Some of her records comprise numerous artefacts, whereas in other cases only a few objects were found, but her site documentation always includes drawings and detailed information about the number of finds. This does not, however, change the inevitable fact that the volume of finds recorded at each of the sites, and the density of sites within a region, depend on the number of surveys conducted.

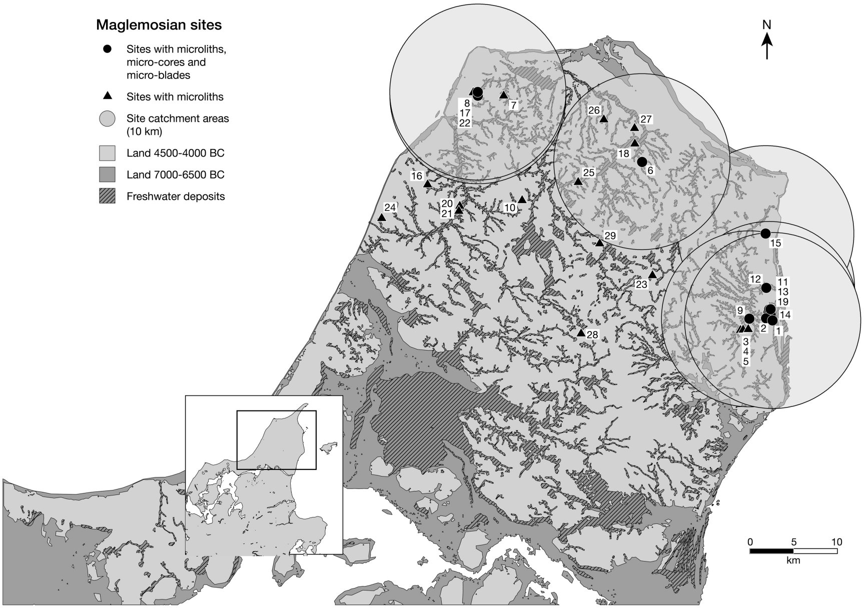

Figure 2.4 Maglemose site positions in Vendsyssel. The sites are defined as find locations that have produced microliths and are mapped in relation to the reconstructed coastline from the latter part of the Maglemose culture (7000–6500 cal BC). A circle with a radius of 10 km has been drawn around the sites of assemblages which contain microliths, micro-blades and micro-cores. These are loosely considered as habitation sites. The numbers refer to Table 6.1 in Astrup (2018), which contains information about the objects recorded at the individual sites. Note that the position of the coastline in western Vendsyssel is strongly influenced by erosion and therefore originally likely to have been situated further to the west during the Maglemose culture. *Source*: After Astrup (2015, 2018).

For a secure dating of the sites, a find complex should contain at least one microlith or other diagnostic artefact relating to the Maglemose culture. Other types of objects found together with the microliths are also important because they may help us to determine whether a specific settlement is chronologically ‘clean’ or whether it represents several different occupations. The quantification of finds from each locality can therefore provide information on the size of the settlement as well as permitting other researchers to evaluate the representativeness of the various sites that were mapped (quantifications of objects from all localities are listed in Astrup 2018, Table 6.1). The numbers of objects listed in the archaeological site reports have, however, not been cross-checked against the finds in the museum archives.

The archaeological material may represent either habitation sites where people intended to live, and therefore stayed for some time, or places used for other purposes, such as hunting, gathering or fishing stations (e.g. Binford 1980). However, given that arrowheads may only represent a single hunting episode, they must be accompanied by other artefact types or flint debris, which indicate that flint-knapping activities were performed, for the site to represent a habitation. An attempt has therefore been made to distinguish loosely between potential occupation sites and hunting stations/camps, simply by recording whether microliths, micro-blades and micro-cores appear together.

Different environments have varying potential with regard to fishing, sealing, terrestrial hunting and gathering. By studying the catchment areas within a given region, it can be seen whether a specific settlement was located in a way that made it profitable to exploit a specific resource. A model that has often been used for this purpose is site-catchment analysis (e.g. Higgs & Vita-Finzi 1972; Bailey 1983; Surface-Evans 2012). It seems likely that settlements were not located randomly across the landscape but positioned to maximize efficiency and minimize effort in gathering resources. If the area immediately around a site reflects the resources people exploited, then the site's catchment area can be used to place it in an environmental and economic context (Jochim 1976; Hassan 1979). This assumes that people were aware of cost–benefit ratios and could access the resources present.

All sites would have been positioned to satisfy a range of requirements. To refine evaluations of the motives involved in this decision, a map is presented showing sites, freshwater deposits and former coastlines (Figure 2.4). The Maglemose sites are plotted in relation to the reconstructed coastline from the latter part of the Maglemose culture. A circle with a radius of 10 km has been drawn on the map around assemblages encompassing microliths, micro-blades and micro-cores, i.e. sites that are loosely considered as habitation sites. This makes it possible to examine whether the richest sites (in terms of number of finds) occur in specific types of environments. Studies of the site-catchment areas were undertaken in the simplest way to determine whether settlements were positioned such that marine exploitation was profitable.

Results

It is evident from Figure 2.4 that most of the assemblages containing microliths, micro-blades and micro-cores were associated with sites located in former coastal areas. The coastal zone must therefore have occupied a substantial proportion of the individual site-catchment areas suggesting that the coastal region was of some importance. Otherwise, the settlements could have been positioned further inland where the coastal zone would not have comprised such a major portion of the catchment area. The location of the settlements where freshwater streams met the marine coast meant that a great variety of resources were available within a short distance of the same position. It may therefore be no coincidence that most of the substantial Maglemose sites in Vendsyssel are located relatively close to the former coastline, since this is most likely a consequence of coastal areas being the perfect locations for the exploitation of both terrestrial and marine resources (see Astrup 2018 for a more exhaustive discussion).

As can be seen from Figure 2.4, the smallest sites tend to occur away from the coastline, close to river and lake environments. It is possible that these sites were utilized during shorter stays for hunting or fishing activities. However, due to the way in which the archaeological material has been recovered, it is difficult to determine whether the richest localities (in terms of the number of objects) reflect longer habitation phases or repeated occupations. It is therefore difficult to give any assessments of sedentism on a qualified empirical basis. The most substantial sites in Vendsyssel were, however, located within walking distance of the contemporaneous coast. This implies that a coastal site position was important to the people in this region, for either economic, demographic or social reasons.

Transgressed sites on land are known to exist in many different places in Scandinavia", including western Sweden and southern Norway (Andersson et al. 1988). In the area around Gothenburg alone, more than 60 transgressed sites were investigated between 1968 and 1988 (Andersson et al. 1988). As shown in Figure 2.2, the highest postglacial sea level in Vendsyssel, 13 m above that of today, occurred around 5200 cal BC. Any coastal sites older than 5200 cal BC are therefore likely to have been covered by a thick layer of postglacial sediments. This may explain why there are no records of Maglemose sites on the distribution map where postglacial deposits are present.

Due to these transgression layers, it has not been possible to determine whether sites were located directly on the shoreline during the Maglemose culture. Nevertheless, changes in the Mesolithic settlement pattern are indicated by the following observations: There are numerous traces of Maglemose activities 1–3 km away from the contemporaneous coastline, while settlements in the Late Mesolithic were positioned closer to the coast. Future investigations will hopefully clarify whether Boreal sites are buried beneath the transgression layers. The drill database 'Jupiter' maintained by GEUS and Jessen's (1899, 1920, 1936) descriptions of cores with peat (see Figure 2.1) may be useful in identifying the most promising areas.

Discussion

The above analysis suggests that the largest sites were located near river outlets and the coast was within reachable distance. Some inland bogs may well turn out to contain as yet unidentified settlements. This does not, however, change the fact that most of Vendsyssel today is covered by cultivated fields, which have been just as accessible to archaeological surveys in the interior as in former coastal areas. The distribution of known Maglemose sites evident along the east coast is primarily due to surface finds collected by the amateur archaeologist Mortensen, and the distances she could cover by bicycle from the town of Sæby. Most of the finds that she recorded were found in close proximity to the contemporaneous coast. Although the activities of amateur and professional archaeologists may have been unevenly distributed across Vendsyssel, there does not seem to be any obvious explanation for why inland settlements (except those in bogs) should have been more difficult to identify than coastally oriented sites. The area has been subject to archaeological research for many years and there is no reason to presume that a greater number of sites have been missed in the interior than in the coastal regions. It seems more likely that the site distribution is representative, thereby reflecting the occurrence and availability of exploitable resources, transport routes or other culturally determined factors, whose importance remains unclear.

The relationship between coastal and inland sites in Vendsyssel remains unknown and site distributions must be perceived as representing a mixture of sites positioned in various environments that were probably inhabited for different reasons. Some people may have remained on the coast all year round, while others were more mobile, making use of both the coast and the inland areas. A third possibility is that some groups concentrated on coastal resources and were responsible for the coastal sites while others relied entirely on the inland areas (Noe-Nygaard 1988).

L. Larsson (1980:19; Figure 2.5) has presented a model of the possible settlement organization in Scania during the later Kongemose period, in which he suggests that three different regions were occupied throughout the year, with occupation of the coastal region in the summer. In the autumn, groups were split into smaller units that moved inland to freshwater basins or the

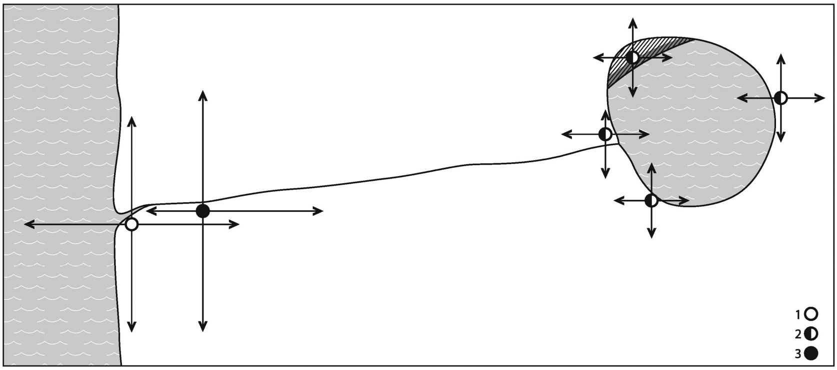

Figure 2.5 Model of the organization of settlements in northern Jutland according to Larsson (1980:19). Redrawn by the author, with permission. Key: (1) large coastal camps occupied primarily in the spring and early summer, (2) small camps in the interior used mainly in the autumn and (3) camps of unknown size used primarily during parts of the winter.

upper reaches of rivers. In the winter, settlements were located further down the river, with the coast at an accessible distance. Most researchers agree that Maglemose inland sites represent summer and autumn habitations used for fishing, hunting and gathering, with dwellings located at the water's edge (Clark 1975; Rowley-Conwy 1993; Schilling 1999; Fischer 2003). If extensive winter occupations had been located on lakeshores, it seems reasonable to expect that more evidence would have been found (Rowley-Conwy 1993). The sites along riverbanks in Vendsyssel could therefore potentially have been inhabited during the coldest part of winter, when a more sheltered location along the river was preferable but with the coast still within easy reach (Larsson 1980; Rowley-Conwy 1993). If this was so, the sites in Vendsyssel may represent some of the winter habitations that have been difficult to find elsewhere because they are now submerged. While this remains a possibility, the coastal positions in Vendsyssel may also give an incorrect picture of the role of marine resources, if only a minor part of the resources consumed at these sites derived from the coast. Additionally, due to the lack of faunal remains from these sites, it is not possible to determine whether they were in fact inhabited during the winter months.

The settlement pattern evident in Vendsyssel was, of course, influenced by the local ecological conditions and may not apply in other areas. Special environmental conditions could, for example, have made it particularly profitable to exploit the coast in Vendsyssel, i.e. if this was particularly rich in marine resources or the interior was lacking in terrestrial resources. Conversely, the coastal zone may not always have been as productive as many would like to believe. Compared to the Late Mesolithic, very little is known about the productivity of the marine environment and the types of fish, whales and molluscs that Boreal people could have encountered in the coastal zone. The coast would certainly have been very different from the skerries of Norway and Sweden that are thought to have constituted a productive environment in the Early Mesolithic (Breivik 2014; Schmitt et al. 2009). However, even if the coastal zone did not provide the same biological productivity and diversity in the Boreal period as it did in the Atlantic time, it may still have provided enough resources to make coastal exploitation profitable.

It is clear that marine resources would have had little value if people were unable to exploit these in a beneficial way. Based on the available evidence, it seems difficult to imagine that the simplest types of fishing gear, such as fish hooks and fishing spears, recorded in Boreal (Maglemose) inland contexts were not used in the littoral zone as well (Astrup 2018). There is also good reason to believe that seals were recognized as an important resource, given that they need to come out of the water to rest and breed and could therefore be approached by hunters. It has correctly been argued by H.B. Bjerck (2009) that it would have taken time to develop advanced techniques to hunt sea mammals far from land. But it seems unreasonable to argue that people were unable to take advantage of resources in the littoral zone, such as seals that could be approached along the beaches. It is more plausible to argue that the lack of evidence for marine exploitation reflects the fact that either coastal sites are missing from the current record or the lack is a result of cultural traditions which restricted the use of marine resources. The latter explanation seems, however, unlikely against the background of the evidence from Vendsyssel presented here (Astrup 2018).

Recent studies of contemporaneous sites from the Baltic region, such as Sunnansund, show that coastal sites were also used in winter (and perhaps all year round; Kjällquist et al. 2016), as has been suggested to be the case for the coastal Maglemose sites in Vendsyssel. Some of these Early Mesolithic sites have evidence of simple hunting of grey seal, while the presence of sea mammals that are more difficult to catch has not been demonstrated. This may suggest either that not all coastal resources were exploited or that sea mammals were scarce due to the low salinity in the Baltic Basin. The Baltic sites also indicate that freshwater fishing occupied a dominant position in the subsistence economy and that fishing appears to have surpassed seal hunting in importance (e.g. Kjällquist et al. 2016; Boethius 2017; Boethius et al. 2017). This probably reflects the fact that people were adapted to the local conditions.

The actual number of sites in Vendsyssel is limited, and they potentially span a period of several centuries or even millennia. Due to the relative paucity of Maglemose sites in Vendsyssel, compared to the extensive evidence for inland occupation in other regions of southern Scandinavia, it would therefore be spurious to argue for a complete revision of the current perception of Maglemose settlement systems. Given that very few Boreal settlements have been discovered on the Danish seabed, we should probably not expect the number of known submerged coastal sites to increase significantly in the near future, although new sites will inevitably be discovered.

It is obvious to ask whether the positioning of Maglemose settlements in Vendsyssel followed the same principles as in other parts of southern Scandinavia. Marine waters first breached the Baltic straits between 7000 and 6500 cal BC (Christensen et al. 1997) and we should therefore not expect to find coastal sites in this area dating back to the earliest part of the Maglemose culture. In view of this, it seems unlikely that marine resources would have constituted a significant calorific element for Maglemose people in northern Germany and southern Denmark prior to the intrusion of seawater through the Great Belt. The southwestern Kattegat, however, may well turn out to have a central role in the search for traces of the earliest marine interactions. Systematic investigations should be initiated with the aim of examining how much is potentially missing from the current archaeological record. One way of doing this would be to make model-based predictions of likely locations for coastal settlements and subsequently investigate these, now submerged, areas in detail and extrapolate the results on a larger scale (Astrup 2018). This should involve new classifications of marine-related activities, applying parameters such as intensity and frequency of exploitation.

Conclusion and perspectives

An attempt has been made to map Maglemose sites in Vendsyssel to investigate how these sites were positioned relative to contemporaneous coastlines. The results show that most settlements were located close to the former coastline such that the coastal zone would have comprised a considerable proportion of the site catchment area. This suggests, in turn, that the coastal zone was of some importance. Otherwise, settlements would have been better positioned further inland where the coast would not have constituted such a major portion of their catchment areas. Mindful of the fact that past settlement positions were not determined solely by economic motives, it is suggested, nonetheless, that the ability to exploit a combination of terrestrial and marine resources probably provided the best subsistence base and that this was the most important reason for Maglemose settlements being located in close proximity to the coast.

A complete absence of faunal remains from Vendsyssel makes it impossible to determine the actual calorific value/consumption of resources, in the form of marine fish, sea mammals, molluscs, coastal birds, plants and terrestrial animals, at these settlements. As a consequence, it is questionable whether coastal settlements in the Maglemose period could yield sufficient resources to permit permanent occupation and whether such settlements were as densely populated as those attributed to their later variants in the Kongemose and Ertebølle periods. What is needed to enable firmer conclusions to be drawn are well-preserved deposits at coastal settlements containing a representative selection of faunal remains which permit determination of the proportion of marine resources relative to terrestrial resources in the subsistence economy. The most obvious places to look for material of this kind is probably on the coastal settlements that now lie submerged beneath the sea. Ongoing investigations in the Bay of Aarhus in western Denmark aim to identify such sites in order to clarify whether these were occupied seasonally or all year round and whether the faunal composition on coastal sites differs from that at Boreal inland settlements and the typical coastal settlements of the later Ertebølle culture.

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3 Mesolithic coastal landscapes

Demography, settlement patterns and subsistence economy in southeastern Norway

Steinar Solheim

Introduction

The coast is often recognized as not only one of the most important, but also one of the most vulnerable ecotones on earth. Major movement of sediments and nutrients is driven by waves, tides and currents in the water, and this energy creates a habitat that adapts to the specific, diverse and extreme conditions of the coast. For example, the physics of the North Atlantic drives one of the world's most productive marine pelagic food webs, and the large fish stocks of the North Atlantic rim, such as cod, mackerel and herring, are dependent on this food web. The marine ecosystem accounts for a very large part of global primary production and offers good conditions for human settlement. Today, the population of Europe's coastal regions is rapidly increasing (European Environment Agency 2006; Neumann et al. 2015). Coast and marine resources are central to the economy and settlement of large parts of modern Europe (Eurostat 2016). The sea and the coastlines are of central importance, not only today but also in prehistory. Despite this, terrestrial resources have traditionally been considered as the most important economic and symbolic factors in human history, and resources such as big game and agriculture have been held as the prime movers of structural and cultural development in Europe (e.g. Childe 1925; Sahlins 1972). Consequently, marine adaptation and coastal settlement have been considered as marginal phenomena and relatively late features of human history (Bailey & Milner 2003). One possible reason for this is that it is difficult to interpret the changing intensity of exploitation of coastal and hinterland resources in Mesolithic Europe, not least because of the fact that the environments and the available resources at the coast and in the hinterland in regions such as Scandinavia have been constantly shifting due to postglacial changes in climate, the environment and forest cover (Bailey et al. 2017:7). Due to the richness, productivity and availability of resources, we can, however, assume that coastal regions and their surroundings could support higher population sizes and denser human settlement than the continental hinterlands where most of the currently known evidence from the Mesolithic has been recovered (Bailey et al. 2017:2).

Our knowledge about early coastal societies and marine adaptation in different regions of the world is increasing. New finds and data have focused

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research on the importance of marine and aquatic environments. We now know that marine resources were utilized early on and that marine adaptation was crucial for important steps in human prehistory such as the colonization of new continents and the increasing complexity of human societies (Erlandson & Fitzpatrick 2006:6–7; Bjerck & Zangrando 2016:10–13). This has led researchers in recent years to adopt the idea that coastlines and marine resources have played a much more significant role at different stages of human development than what was previously thought in the syntheses of European and global prehistory. In line with this, in this chapter I discuss the coast's importance for the habitation and economy of Early and mid-Holocene foragers, using southeastern Norway as a case study.

A large part of the world's prehistoric coastlines is submerged, and it is estimated that an area equivalent to 40% of the current European land mass has disappeared because of rising sea levels since the Late Glacial Maximum (Bailey 2011:314; Crombé et al. 2011:454). Because of the inundation of previously inhabited land, the archaeological data on early coastal adaptation is heavily biased and fragmented. The geology of the coastal regions is also often stressed as a major issue when it comes to investigating coastal settlement. The archaeological record of coastal areas is especially afflicted by concerns such as preservation, site taphonomy and site visibility, especially in relation to coastal geomorphology, erosion and sea-level changes (Bailey 2004; Erlandson 2008; Dawson 2015). As a consequence, for many parts of the world, we can find no direct evidence of Early or mid-Holocene coastal settlement above today's sea level. In some regions and for some periods, only prehistoric inland settlements are documented on dry land, leading to a bias in archaeological models on demographic and cultural development (Van de Noort 2011). There is good reason to be sceptical about the syntheses of human prehistory based on this data (Fischer 2011:299; van der Plicht et al. 2016:116–117).

Mesolithic sites from raised shorelines in Norway, Sweden and parts of Finland are some of the best exceptions to this pattern around the world (Fischer 2011:301), and in parts of these countries there is great potential for studying the temporal development of coastal settlements found on present-day dry land (Solheim & Persson 2018; Tallavaara & Pesonen 2018). In southeastern Norway, the retreat of the Scandinavian ice sheet caused dramatic changes in the region's landscape. Unlike most parts of Europe, the glacio-isostatic rebound led to constant land uplift in the postglacial period (Sørensen et al. 2014). This implies that the Stone Age coastal areas of southeastern Norway have qualities that compare to only a few other regions of the world for studying long-term continuity and changes in coastal settlement. Here, it is possible to establish a relative site chronology based on the shoreline displacement as well as to date sites independent of radiocarbon dates or typological/technological dating. The distribution of sites at different heights above the current sea level makes it possible to investigate the temporal variation in settlement intensity, and the relationship between settlement and constantly shifting shorelines during the Early- and Mid-Holocene. Furthermore, the site distribution can be compared with the summed probability distribution of radiocarbon dates to study the temporal variation in population in order to investigate if there were stable or fluctuating population sizes. Finally, information retrieved from rather fragmented faunal data and isotopic evidence from human remains can inform us about the subsistence economy and accessibility to and use of different resources.

Data and method

In Norway, there is good evidence for early coastal adaptation. In this chapter, I aim to demonstrate how coastal regions and their resources were of central importance to the people settled in this region during the Mesolithic. More specifically, I focus on the Mesolithic period (c. 10 300–6000 cal BP) in the coastal region of southeastern Norway (Figure 3.1), discussing three

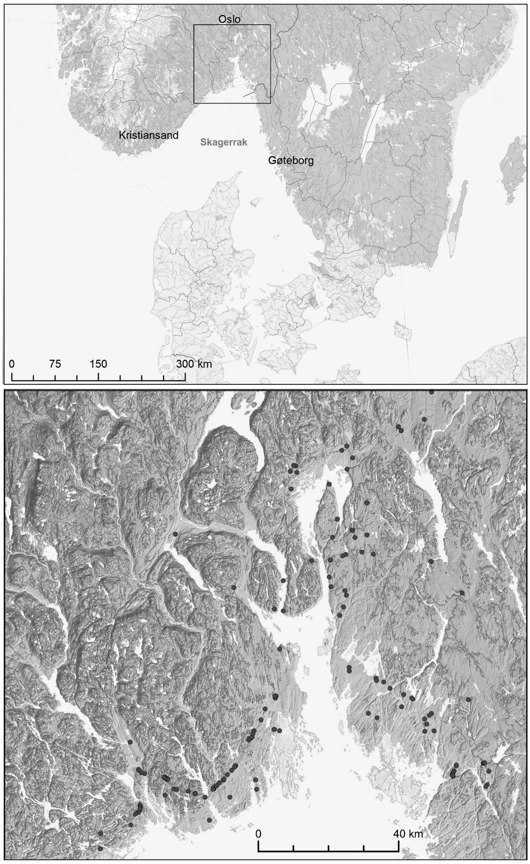

Figure 3.1 Southern Scandinavia. The case study area of southeastern Norway is marked with a rectangle (top). The location of the radiocarbon-dated sites used to create SPDs in Figure 3.3 (see page 49). *Source*: P. Persson, MCH, UiO

interrelated aspects: (1) site location and settlement strategies, (2) temporal variation in population size and (3) subsistence economy and diet.

Defining site location by using radiocarbon dates

The location of sites close to the shoreline can be considered as a valuable indication of marine adaptation, and the geographical context of a site's location can give information on potentially accessible resources. The topography of coastal southeastern Norway is characterized by a large and varied archipelago made up of islands, inlets, bays and fjords. In the Early and mid-Holocene, when the sea level was higher than today, the Oslo fjord was wider and the archipelago was larger (Glørstad 2010:41). The archipelago offered safe conditions for resource extraction in sheltered waters, and it also provided numerous natural harbours connecting land and sea, offering good conditions for people to settle.

The temporal trends in settlement location demonstrate a close relation between Mesolithic sites and changing shorelines. Figure 3.2 plots 102 radiocarbon dates from 29 Mesolithic sites from the western part of the Oslo fjord region in relation to the local shoreline displacement curve. The combination of the sea-level curves and the placing of the radiocarbon calibration plots at the respective site's correct height above sea level demonstrates that there is a close correlation between the radiocarbon-dated Mesolithic sites

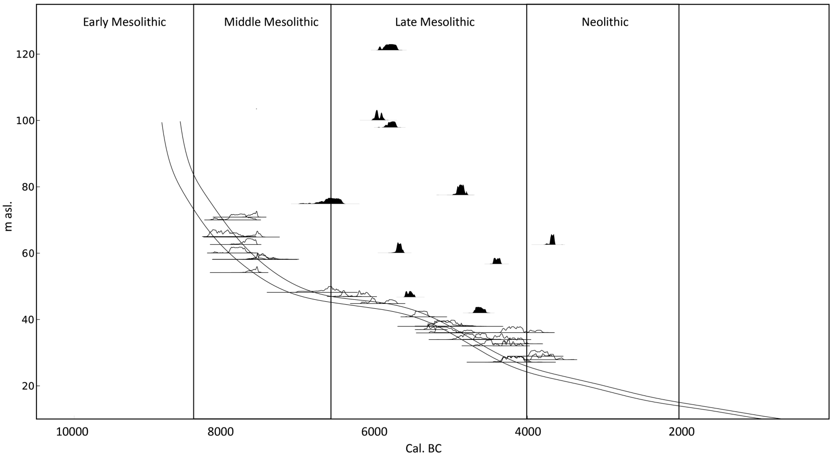

Figure 3.2 Summed radiocarbon dates from Mesolithic sites in Telemark and Vestfold counties in the western part of the Oslo fjord region are plotted at their height above sea level and in accordance with calibrated age BC. The majority of radiocarbon dates has a close relation with the shoreline displacement curve. This indicates that the sites were situated close to the contemporary shoreline. The dates that deviate from this pattern are coloured black. All dates are presented in Table 3.4. *Source*: S. Solheim.

and the shoreline displacement curve. The majority of the available radiocarbon dates (n = 102) indicates a pattern with Mesolithic sites located close to the shoreline. A potential source-critical factor here is that most excavations of Mesolithic sites in southeastern Norway are carried out at the same height as the Mesolithic shorelines. This can potentially bias our understanding of the settlement location. A small number of radiocarbon dates do indeed deviate from the general pattern, and a total of fourteen Late Mesolithic dates (13.5%) are not closely connected with the shoreline curve. The use of these sites obviously doesn't reflect shore-bound activity, which requires further explanation.

The radiocarbon-dated contexts that don't have a close correlation with the shoreline displacement curve are from sites where the main activity phase is interpreted as older than the radiocarbon dates, based on lithic assemblages. A possible explanation might be that the samples date later activity that was not shore bound, or potentially that the dated material derives from disturbances of the dated context and the intrusion of charcoal due to natural processes (Crombé & Robinson 2014; Jaksland 2014:28–33). This is exemplified by sites such as Dørdal, Anvik and Pauler 2. The main activity phases on all three sites are dated to the Early Mesolithic, but they all have radiocarbon dates from the Late Mesolithic. During the Late Mesolithic, the sites were situated away from the coastline at locations with a good overview of the surrounding landscape, e.g. at inlets to fjords and river systems, and might have functioned as activity sites connected to monitoring the landscape or scouting for resources. The three sites have structures with at least two overlapping radiocarbon dates, but no traces in the lithic assemblages can be associated with Late Mesolithic activity. All typological and technological characteristics in the find assemblages demonstrate that the main activity at the sites took place during the Early Mesolithic (Nyland 2012; Eymundsson 2013; Solheim et al. 2017). It is unclear what kind of activity the radiocarbon dates from the three sites actually represents, but it is possibly related to human activity (see Chapter 15 [Schülke]).

Sum probability distribution of radiocarbon dates

The temporal variation in population size can be investigated using radiocarbon dates and summed radiocarbon probability distribution plots (SPD). The method is built on the assumption that radiocarbon dates can be used as a proxy to measure the temporal strength of the archaeological signal and that the archaeological signal correlates with fluctuations in the number of people, meaning more people create a stronger signal (Rick 1987). The potential and limitations of the method have been debated in several papers (Williams 2012; Shennan et al. 2013; Contreras & Meadows 2014; Timpson et al. 2014; Brown 2015; Torfing 2015). Naturally, the radiocarbon data does not measure the actual population size (Torfing 2015), but information about temporal differences in population sizes and relative variation in human activity or intensity in settlement can be inferred from this data (Timpson et al. 2015:200; Freeman et al. 2017).

The data set used in this study consists of 589 radiocarbon dates related to anthropogenic activity from 167 sites in coastal southeastern Norway dated between c. 10 000 and 3000 cal BP (Figure 3.3). The dates are mainly collected from open-air sites with no stratigraphy related to anthropogenic activity, with the exception of a few graves and rock shelters. Neolithic radiocarbon dates are included not only to avoid edge effects but also to be able to comment on development after the Mesolithic period.

To model the radiocarbon data, R programming code provided in the *rcarbon* package was used (Bevan & Crema 2018). The applied methodology was originally introduced by Shennan et al. (2013) in order to avoid a visual

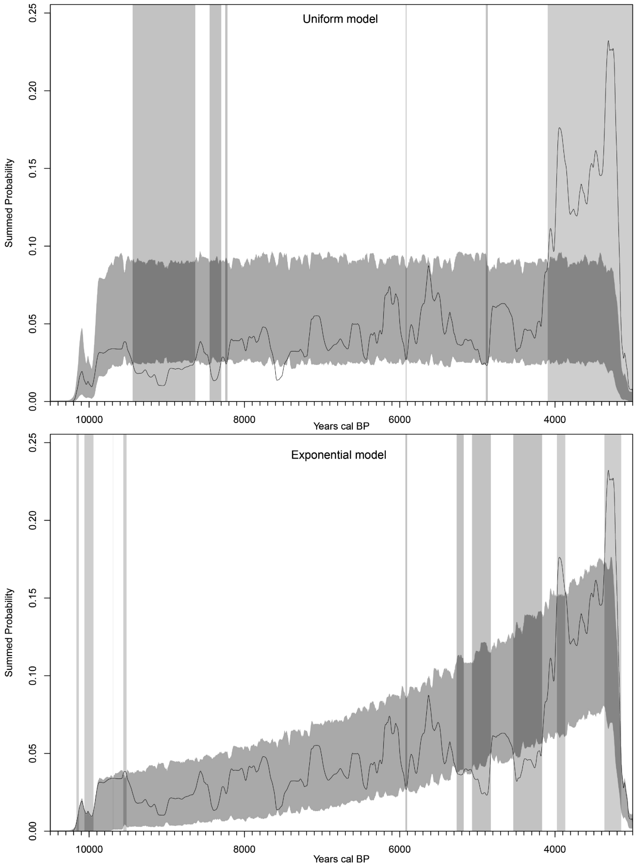

Figure 3.3 Sum probability distribution plot of radiocarbon dates (n = 589) from archaeological sites (n = 167) in coastal southeastern Norway. The dates are arranged in 200-year bins (n = 163). The empirical SPD is compared with a uniform (top) and exponential (bottom) null model. Positive and negative deviations are marked. The number of simulations is 1000. SPDs are created using *rcarbon* (Bevan & Crema 2018). *Source*: S. Solheim.

inspection and description of the SPD results, and the method was further developed and described in detail in later papers (Timpson et al. 2014; Crema et al. 2016; Edinborough et al. 2017; Bevan & Crema 2018). The method compares the empirical SPD with a growth model generated by simulating random dates, and allows the detection of statistically significant local deviations compared to a null model of, for example, exponential, uniform or logistical growth. The statistical analysis that is performed and the possibility to test different null models make this method more suitable for investigating population patterns compared to using the kernel density estimate (KDE) function in OxCal (Bronk Ramsey 2018; but see McLaughlin 2018).

Here, the radiocarbon dates are calibrated and aggregated in 200-year bins on site level to avoid potential bias caused by inter-site variability. This means that dates from the same archaeological site, when ordered chronologically, were given a new bin only if there was at least a 200-year gap between the considered date and the previous date. This accounts for oversampling, and sites with many dates and sites with few dates were equally weighted in the analysis.

The method uses randomized calendar dates sampled from the distribution defined by the null model, and are back-calibrated into radiocarbon dates (Timpson et al. 2014). In this study, 1000 simulations were performed to produce the statistical envelope of the null model. The summed probability distribution of radiocarbon dates from the archaeological sites was compared with simulated radiocarbon dates in the null model. Positive or negative deviation outside the 95% confidence interval of the null model was a statistically significant result according to the null hypothesis.

Results from the SPD

The SPD was plotted against two null models displaying uniform and exponential growth (Figure 3.3). The SPDs appear to indicate long-term growth in population size over time interrupted by short-term positive and negative deviations.

The uniform model shows several significant negative deviations, with the most pronounced being 9400–8600 cal BP, 8450–8300 cal BP and 7600–7500 cal BP. A positive deviation can be seen between 4100 and 3000 cal BP. There are also minor variations within the statistical envelope of the null model. The exponential model shows uninterrupted growth during the Mesolithic and the Early Neolithic, with a few short-term positive deviations during the Middle Mesolithic period, all dated between 10 200 and 9500 cal BP. The empirical SPD also deviates positively at c. 3900 and 3350 cal BP. Growth during the Mesolithic is interrupted by a short-term decline c. 5900 cal BP. Later in the Neolithic, there are local negative deviations at shorter periods, with the most pronounced being c. 5100–4800 cal BP and c. 4530–4150 cal BP.

Based on statistical analysis of radiocarbon dates, Zahid et al. (2016) have suggested that the population growth in foraging societies was similar to that of agricultural societies, thus challenging the causal link between the introduction of agriculture and population growth. This argument is in line with Silva and Vander Linden's (2018) study where they found no evidence for a major population increase related to the introduction of farming in several different areas of northern Europe. The overall pattern is one of gradual exponential growth during the Early and mid-Holocene, with some short-term fluctuations, similar to the pattern observed by Zahid et al. (2016). These observations thus suggest that an exponential growth model is the best fit to analyze the data in the case of southeastern Norway. Hence, an argument can be made for a stable and slowly increasing population, interrupted by fluctuations, throughout the Holocene.

Faunal remains and isotope data from humans

There is limited direct evidence for a Mesolithic subsistence economy in coastal southeastern Norway. Only a few sites contain faunal remains that can provide information about what animal species were hunted and utilized (Glørstad 2010; Mansrud & Persson 2017). However, by considering the larger regional context and by including other parts of coastal Norway as well as the Swedish west coast, the empirical basis for understanding the economy and diet greatly increases. Even though the environmental and cultural context in other parts of coastal Norway is not directly comparable with southeastern Norway, it provides insight into the economy of hunter-gatherer groups situated in coastal areas of the region. The west coast of Sweden had environmental as well as cultural similarities to southeastern Norway during large parts of the Mesolithic, and can be understood as a part of the same cultural context (Glørstad 2010; Eigeland 2015; Solheim & Persson 2016).

Taphonomic processes, related to natural processes and prehistoric human activity, confine the information potential of the faunal assemblages. Due to preservation conditions, it is difficult to assess how representative the faunal remains actually are for determining the subsistence economy, for establishing a ratio between marine and terrestrial species and for considering temporal variation in a subsistence economy. No faunal remains have been recovered from Early Mesolithic sites in southern Norway in general (Åstveit 2014); however, several sites can provide information on which species were utilized during the Middle and Late Mesolithic periods (Bergsvik 2001; Mansrud 2014).

Glørstad (2010) and Mansrud and Persson (2017) have recently presented overviews of Middle and Late Mesolithic faunal material from archaeological sites in southeastern Norway and western Sweden. According to Mansrud and Persson's (2017:9–13) analysis of faunal remains from Middle Mesolithic sites (n = 12), a variety of marine and terrestrial mammals were hunted and utilized along with fish and birds (Solheim & Persson 2016). Glørstad's review of Late Mesolithic sites (n = 12) shows a larger variation and more frequent finds of marine compared to terrestrial species. He concludes that marine species constituted the backbone of the economy (Glørstad 2010:82–86).

The faunal data is presented in Tables 3.1–3.3. While this data doesn't reflect the diet of the Mesolithic people directly, it can be argued that the presence of different species at the sites provides a general pattern of resource strategies. Terrestrial mammals are present at all but one of the sites. Big game such as moose, deer and wild boar were probably hunted for food and raw materials, while small mammals were used as a food source as well as for their fur. Marine mammals, especially pinnipeds, which are regarded as central to the Early Mesolithic subsistence economy but are not preserved (Bjerck et al. 2016; Boethius 2018), are present in the faunal assemblages from the later Mesolithic phases (see above). Fish bones occur more frequently and several sites have relatively many fragments of fish bones from a large variety of different species (Solheim & Persson 2016:268–289). Codfish are most commonly present at the sites. Some of the bone fragments come from deep-water fish, such as ling, while other species such as the Ballan wrasse are commonly found in more shallow waters near land. The variation in species possibly indicates different fishing techniques (Pickard & Bonsall 2004; Schaller Åhrberg 2007; Bergsvik 2017; Chapter 11 [Bergsvik & Ritchie] this volume).

If we accept the larger regional contexts as a relevant backdrop to discuss the subsistence economy, we can, in addition to faunal assemblages, include results from stable isotope analysis of human remains. Isotope analyses provide information on an individual's main dietary components and important insight into the subsistence economy. The isotopic measurements of teeth primarily reflect the diet consumed during childhood and the adolescent years, while bone collagen reflects the long-term diet averaged over 5–20 years (Richards et al. 2002; Hedges et al. 2007). Figure 3.4 presents all published isotope values of Mesolithic individuals from Norway (n = 4), as well as individuals from western Sweden, Scania and middle Sweden (Lidén et al. 2004; Eriksson et al. 2016; Schulting et al. 2016; Skar et al. 2016). By far, the richest record of isotope data in Scandinavia comes from Denmark and isotope data from both Mesolithic and Neolithic individuals is included here (Fischer et al. 2007).

The $\delta^{13}C$ values of Norwegian individuals range from −13.5 to −14.7‰ (Figure 3.4). This provides convincing evidence for the high consumption of marine foods. The $\delta^{15}N$ values, ranging from 18.4 to 20.5‰, strongly suggest that proteins were derived from high trophic–level species, such as marine mammals and/or piscivorous fish (Schulting et al. 2016). In fact, the $\delta^{15}N$ values of Norwegian individuals, especially those from Hummervikholmen (n = 6 samples), are the highest values measured for Mesolithic individuals in Scandinavia. Although the number of sampled individuals (n = 4) is limited, the data indicates that the diet of these persons was largely focused on marine resources (Skar et al. 2016). The individuals from western Sweden are from sites located in a similar landscape to that of southeastern Norway, and the signatures of the Mesolithic individuals from Uleberg and Huseby Klev demonstrate a high intake of marine foods with a contribution from terrestrial resources (Lidén et al. 2004:28–29).

Table 3.1 Finds of bone fragments from terrestrial mammals at Middle and Late Mesolithic sites in southeastern Norway and western Sweden. 1 = presence of species

Terrestrial mammals	*Site*	*Balltorp*	*Huseby Klev*	*Huseby Klev*	*Bua Västergård*	*Ölmanäs*	*Balltorp 2*	*Dammen*	*Prestemoen 1*	*Tørkop*	*Søndre Vardal 3*	*Skutvikåsen 3*	*Langangen Vestgård 1*	*Vinterbro 3*	*Saugbruk 1*	*Saugbruk 2*	*Saugbruk 3*	*Frebergsvik*	*Torpum 9*	*Nøstvet*	*Skoklefald*	*Gåshult*	*Gamla Lillebyvegen*	*Hälta 130*	*Rottjärnslid*	*Huseby klev*	*Total*
Mammalia indet.																	1	1	1	1	1	1	1		1	1	9
Bos primigenius	Aurochs	1	1																								2
Alces alces	Elk		1?	1	1					1															1		4
Cervus elaphus	Red deer	1	1	1	1	1	1	1	1				1			1	1						1		1		13
Capreoleus capreoleus	Roe deer	1	1		1	1	1	1									1					1			1		9
Cervus/Rangifer	Deer/reindeer															1	1						1		1		4
Cervidae	Ungulate family				1					1																	2
Artiodactyla	Cloven-hooved animal														1		1				1			1			4
Sus scrofa	Wild boar	1	1	1	1	1	1	1	1	1																	9
Castor fiber	Beaver	1	1		1	1		1	1	1											1						8
Ursus arctos	Brown bear		1										1	1													3
Lutra lutra	Otter	1	1	1	1												1	1							1		7
Lepus timidus	Hare/Mountain hare	1		1													1				1						4
Arvicola terrestris	Ground vole																								1		1
Rodentia	Rodent																1							1			2
Felis silvestris	Wild cat	1	1	1	1?																						3
Sciurus vulgaris	Squirrel	1		1				1			1																4

(*Continued*)

Table 3.1 Continued

Terrestrial mammals	*Site*	*Balltorp*	*Huseby Klev*	*Huseby Klev*	*Bua Västergård*	*Ölmanäs*	*Balltorp 2*	*Dammen*	*Prestemoen 1*	*Tørkop*	*Søndre Vardal 3*	*Skutvikåsen 3*	*Langangen Vestgård 1*	*Vinterbro 3*	*Saugbruk 1*	*Saugbruk 2*	*Saugbruk 3*	*Frebergsvik*	*Torpum 9*	*Nøstvet*	*Skoklefald*	*Gåshult*	*Gamla Lillebyvegen*	*Hälta 130*	*Rottjärnslid*	*Huseby klev*	*Total*
Vulpes vulpes	Red fox	1	1		1			1										1									5
Martes martes	Pine Marten	1						1																			2
Mustelidae	Mustelid																1							1			2
Sus scrofa	Wild boar														1	1	1		1				1		1		6
Canis familiaris	Dog	1	1?	1?	1			1																			3
Canis familiaris/ Canis lupus	Dog/wolf							1																	1		2
Sum		12	9	7	9	4	3	9	3	4	1		2	1	2	3	10	3	2	1	4	2	4	3	9	1	108

Source: Data from Glørstad (2010) and Mansrud and Persson (2017). Sum specifies number of different species at sites and in total.

Table 3.2 Finds of bone fragments from marine mammals at Middle and Late Mesolithic sites in southeastern Norway and western Sweden. 1 = presence of species

Marine mammals	*Site*	*Balltorp*	*Huseby Klev*	*Huseby Klev*	*Bua Västergård*	*Ölmanäs*	*Balltorp 2*	*Dammen*	*Prestemoen 1*	*Tørkop*	*Søndre Vardal 3*	*Skutvikåsen 3*	*Langangen Vestgård 1*	*Vinterbro 3*	*Saugbruk 1*	*Saugbruk 2*	*Saugbruk 3*	*Frebergsvik*	*Torpum 9*	*Nøstvet*	*Skoklefald*	*Gåshult*	*Gamla Lillebyvegen*	*Hälta 130*	*Rottjärnslid*	*Huseby klev*	*Total*
Lagenorhynchus albiostris	White-beaked dolphin	1	1	1														1									4
Phocoena phocoena	Harbour porpoise	1	1	1				1										1									5
Phocidae	Seal family	1										1						1				1	1				5
Halichoerus grypus	Grey seal		1	1		1	1																		1	1	6
Phoca vitulina	Harbour seal		1															1									2
Cetacea	Whale sized as porpoise																	1									1
Sum		3	4	3		1	1	1				1						5				1	1		1	1	23

Source: Data from Glørstad (2010) and Mansrud and Persson (2017).
Sum specifies number of different species at sites and in total.

Table 3.3 Finds of fish bone fragments from Middle and Late Mesolithic sites in southeastern Norway and western Sweden. 1 = presence of species

Fish	*Site*	*Balltorp*	*Huseby Klev*	*Huseby Klev*	*Bua Västergård*	*Ölmanäs*	*Balltorp 2*	*Dammen*	*Prestemoen 1*	*Tørkop*	*Søndre Vardal 3*	*Skutvikåsen 3*	*Langangen Vestgård 1*	*Vinterbro 3*	*Saugbruk 1*	*Saugbruk 2*	*Saugbruk 3*	*Frebergsvik*	*Torpum 9*	*Nøstvet*	*Skoklefald*	*Gåshult*	*Gamla Lillebyvegen*	*Hälta 130*	*Rottjärnslid*	*Huseby klev*	*Total*
Pisces	Fish, unspecified											1					1	1	1	1	1	1	1		1		9
Gadus morhua	Cod	1	1	1	1	1		1	1	1	1						1				1		1	1	1	1	15
Molva molva	Ling		1	1	1	1		1	1																1	1	8
Melanogrammus aeglefinus	Haddock		1	1				1		1															1	1	6
Merlangius merlangus	Whiting			1				1	1		1												1			1	6
Merluccius merluccius	Hake		1	1		1		1																			4
Pollachius pollachius	Pollack		1	1				1	1	1																	5
Pollachius virens	Saithe		1	1	1			1	1		1																6
Pollachius pollachius/ Pollachius virens	Pollock/Saithe			1															1		1					1	4
Gadidae	Codfishes	1								1																	2
Sebastes marinus	Rose fish										1																1
Scomber scombrus	Mackerel		1	1			1	1																	1	1	6
Clupea harengus	Herring	1		1				1	1												1		1			1	7
Eutrigla gurnardus	Grey gurnard			1				1	1	1													1			1	6
Hippoglossus hippoglossus	Halibut			1?																							1
Labrus bergylta	Ballan wrasse								1																1		2
Limanda limanda	Common dab			1																							1
Pleuronectidae	Righteye flounders																						1				1

Platichthys flesus	Flounder		1	1																				1	1	1	5
Pleuronectes platessa	Plaice			1																							1
Pleuronectidae	Flounder-fishes		1	1	1			1	1	1																	6
Psetta maxima	Turbot			1																							1
Raja clavata	Thornback ray			1																							1
Conger	Sea eel																					1					1
Anguilla anguilla	Eel					1		1																1		1	4
Squalus acanthias	Spiny dogfish							1																1		1	3
Sprattus sprattus	Sprat							1																			1
Zoarces viviparus	Eelpout							1																			1
Gobius Niger	Black goby							1																			1
Salmonidae	Trout/Salmon								1	1	1																3
Esox lucius	Pike	1																									1
Acipenser sturio	Sturgeon																								1		1
Sum		4	9	17	4	4	1	16	10	7	5	1					2	1	2	1	5	1	8	2	8	11	119

Source: Data from Glørstad (2010) and Mansrud and Persson (2017).Sum specifies number of different species at sites and in total.

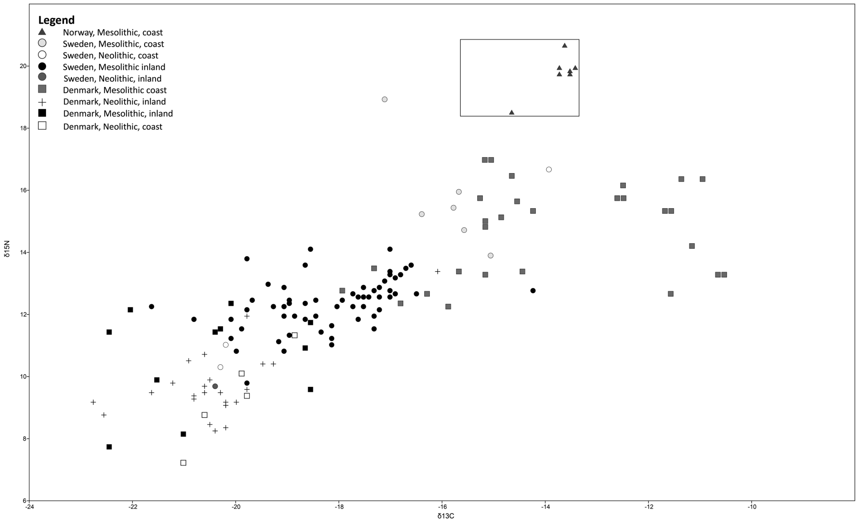

Figure 3.4 Isotope $^{13}C/^{15}N$ values from human bones and teeth from Scandinavia, Mesolithic (n = 111), Neolithic (n = 34). The square marks the spread of values from Norwegian Mesolithic individuals (n = 4). Data from Lidén et al. (2004), Fischer et al. (2007), Eriksson et al. (2016), Skar et al. (2016), and Schulting et al. (2016). *Source*: S. Solheim.

Results and discussion

It is suggested that marine environments are more ecologically stable than inland regions, and offer the potential to exploit a wide range of different ecological niches within short distances (Yessner et al. 1980). The ethnographical record shows that a high percentage of sedentary groups that settled in Boreal regions primarily exploited aquatic resources, and also that aquatic resources tended to make up a larger proportion of the diet in regions with low effective temperatures than in warmer regions (Binford 2001:215–216; Kelly 2013:41–43). Depending on the geographical location, the season and the hunting technique, aquatic and marine species give high return rates (kcal/hrs), and it is suggested that residential mobility gradually reduced as dependence on aquatic resources increased (Kelly 2013:54–58).

Recently, it has been suggested that, already in the Boreal period, Mesolithic groups in southern Norway and Sweden were permanently settled in coastal regions or at specific settlements (Solheim & Persson 2016; Boethius 2017; Mansrud 2017). With reference to Sutton (2016) and Rowley-Conwy and Zvelebil (1989), Boethius (2017:2) has pointed out that if a group lives in a sedentary manner over an extended time period, it is of central importance that the region can meet the population's dietary requirements on a yearly basis. This can explain why early sedentary societies were often located in ecotone environments, such as coastal regions. Faunal remains from the Oslo fjord region indicate that several ecological niches were utilized for different purposes, a trend that can also be discerned from palynological records (Wieckowska-Lüth et al. 2018). The Mesolithic groups had a high intake of marine and aquatic resources, but terrestrial resources were also utilized. The data points to a broad spectrum economy with a strong marine orientation, and also demonstrates the potential for year-round settlement in the coastal region (Nordqvist 2000:226–227; Glørstad 2010:82; Solheim & Persson 2016:272–273; Boethius 2017).

Settlement patterns and subsistence are closely related, and a settlement pattern is largely an effect of subsistence and the environment (Binford 1980). The location of Mesolithic sites in southeastern Norway and the natural topography they were settled in can be considered as proxies for marine adaptation. During the Mesolithic period, the sites were located in the inner and outer archipelago, and on small islands at various distances from the coast (e.g. Nyland 2012; Solheim et al. 2017). The general site location points to the importance of the coastal landscape for habitation, communication and the economy. This is further reflected in the relation between radiocarbon dates in archaeological contexts and the shoreline displacement curve, strongly suggesting that the preferred choice of site location was related to the shifting shorelines (see Bjerck 2008:550). Except for sites located in the forested inland region, in the mountain forest or along the large river systems (Boaz 1998; Stene et al. 2010; Eigeland et al. 2016; Mjærum 2017), few Mesolithic sites, to my knowledge, deviate from this pattern in southeastern Norway.

The location of Stone Age sites has been scrutinized by Berg-Hansen (2009) who has argued that dominant survey strategies have resulted in a bias in our data and an incorrect picture of settlement locations. By extensive surveying and test pitting within an approximately 1 km^2 area at Lista, Vest-Agder, Berg-Hansen has demonstrated that the entire landscape, from the shoreline to higher-lying inner parts, was utilized in the Stone Age. These results are important and challenge our idea of settlement patterns. However, as she states, the quality of the data makes it difficult to assess what the different small find spots actually represent. A potential explanation might be, as suggested Berg-Hansen, that many of the small lithic scatters represent limited, short-time activity, rather than actual settlement sites (Berg-Hansen 2009:121; see also Bergsvik 2001:13). As such, Berg-Hansen's data is in accordance with what is presented above. Radiocarbon dates from sites and lithic tools occurring as stray finds indicate Mesolithic activity that was not shore bound in the coastal areas; however, what is important here is the fact that very few excavated settlement sites show substantial traces of Mesolithic activity that was not shore bound or situated very close to the contemporary shoreline. If an abundance of settlement sites was located away from the concurrent shorelines, there should be stronger indications of this from the available data. At this stage, the available settlement data strongly points to a preferred location of settlement sites close to the shoreline.

Of course, this does not mean that coastal groups did not utilize the surrounding landscape or other ecological niches other than the coastal and marine landscape. Furthermore, it does not imply that some or all members of a group did not travel inland, or that terrestrial resources were not exploited during the Mesolithic and Neolithic periods (Bang-Andersen 2003; Solheim 2010; Wickham-Jones 2014; Breivik & Callanan 2016). The faunal assemblages demonstrate that terrestrial resources were utilized and it is suggested that coastal groups travelled inland along the water systems and built pitfalls to trap moose (Bergstøl 2015). Pollen data also suggests that humans repeatedly used the forested landscape immediately behind the coast for different purposes, as there are signs of both unintentional impact and deliberate human manipulation of the woodlands during the Mesolithic (Wieckowska-Lüth et al. 2017, 2018). A possible exception to the settlement pattern established above has recently been excavated in Eidsberg, Østfold County, but similar to the above-mentioned sites, this site is interpreted as a specialized site, more specifically used for hunting moose (Mjærum 2017). Different raw materials were used at this site compared to contemporary coastal sites, which might point to either specialized use by groups residing in the coastal areas or that the activity should be interpreted in light of groups settled in areas other than the coastal landscape (Mjærum 2017; Damlien & Solheim 2017).

How does the described settlement pattern and use of the coastal areas affect development in population sizes? Shennan (2009) has suggested that a population decline took place throughout the Mesolithic in Europe and culminated in unusually low population sizes among Late Mesolithic hunter-gatherers. The low population size has been explained by the development of a thick forest cover causing decreased animal population densities (Shennan 2009:343–344). Furthermore, in several regions of Europe, a drastic population increase is observed at the start of the Neolithic (Hinz et al. 2012; Timpson et al. 2014; Bevan et al. 2017; Nielsen et al. 2019). Ultimately, this seems to have led to a population crash after a few hundred years and low population levels during the Middle Neolithic period (see Crombé & Robinson 2014; Sørensen 2014:27–28 for a critique of this approach).

An exception to the general development in population patterns seen in the continental region is found in coastal and riverine regions with rich resources, such as southern Scandinavia (Shennan 2009:342–343). Binford (2001:215–216) has suggested that a possible way to increase sustainability in colder environments is through the exploitation of aquatic resources. Accordingly, we should expect stability in the demography of southeastern Norway because of the resource situation. This is supported by site count data from the region (Breivik et al. 2017:13–14), and also by the SPD presented above (see Figure 3.3), which indicates that population levels were consistent on the long-term scale without any severe fluctuations during the Mesolithic (see also Solheim & Persson 2018). While other coastal regions in Scandinavia show fluctuations in population sizes following climate events or environmental changes (Apel et al. 2017; Jørgensen 2018), such fluctuations have not been identified in southeastern Norway (Breivik et al. 2017; Solheim & Persson 2018), even though paleoenvironmental records indicate the local influence of cold events (Nesje & Dahl 2001; Antonsson & Seppä 2007; Wieckowska-Lüth et al. 2017). A possible explanation for this pattern of stability in population sizes or human activity is adaptation to the coastal region and access to an abundance and variety of marine and terrestrial resources.

Conclusion

The productivity of coastal regions varies across Europe and offers different opportunities for resource exploitation and settlement (Erlandson & Fitzpatrick 2006:9). This does not mean that all coastal regions were attractive for settlement or resource exploitation as coasts can be variable and offer unstable conditions or even appear as a barrier (Bailey 2011:316; Bjerck & Zangrando 2016:5). There are different social and practical advantages to living in coastal regions. In this chapter, settlement, population size and a subsistence economy have been used to demonstrate the relevance of this environment for Mesolithic groups in southeastern Norway. Other aspects such as seaborne transport and communication as well as cosmology must have been an essential part of coastal life and could also have been discussed in order to support the views put forward here (Glørstad 2013; Lødøen & Mandt 2015:285–287).

In all parts of Norway, and in different climatic and ecological zones, a strong marine orientation is evident throughout the Mesolithic (Bergsvik 2001; Bjerck 2009, 2017). In southeastern Norway, marine adaptation and coastal settlement go back to the beginning of human occupation of the region (Glørstad 2016). Despite changes in material culture and lithic technology, most likely caused by the arrival of migrating groups at different time stages (Eigeland 2015:382–383; Damlien 2016), the settlement close to the shifting shorelines remains a stable feature during the Mesolithic in southeastern Norway. Settlement sites were concentrated along the coast in the Mesolithic and early parts of the Neolithic, and it is only in the Late Neolithic that we see a significant shift in settlement patterns, from a coastal orientation to areas suitable for agriculture. This shift is also reflected in the SPD where a massive increase in population size is evident from c. 4200 cal BP.

Table 3.4 Overview of radiocarbon dates from Figure 3.2

Site	*Lab.no*	*C14-age*	±	*Sample material*	*Reference*
Bakke	TUa-7853	6915	40	Charcoal	Nyland and Amundsen 2012
Dørdal	Beta-417123	7120	30	Charcoal	Solheim 2017b
Dørdal	Beta-417122	7070	30	Charcoal	Solheim 2017b
Gunnarsrød 4	UBA-19158	7210	38	Charcoal	Reitan 2014a
Gunnarsrød 4	UBA-19159	6941	36	Charcoal	Reitan 2014a
Gunnarsrød 5	UBA-19147	7582	47	Charcoal	Reitan 2014b
Gunnarsrød 5	UBA-19145	7336	38	Charcoal	Reitan 2014b
Gunnarsrød 7	UBA-19129	5563	30	Charcoal	Fossum 2014
Hegna vest 1	Ua-50485	8788	34	Charcoal	Solheim 2017b
Hegna vest 1	Ua-51462	8732	40	Charcoal	Solheim 2017b
Hegna vest 1	Ua-51466	6816	36	Charcoal	Solheim 2017b
Hegna vest 1	Ua-51466	6816	36	Charcoal	Solheim 2017b
Hegna vest 2	Ua-50497	8708	38	Charcoal	Solheim 2017b
Hegna vest 2	Ua-53190	4900	30	Animal bone, burned	Solheim 2017b
Hegna øst 2	Ua-50501	6318	26	Charcoal	Solheim 2017b
Hovland 1	Ua-45675	8623	50	Charcoal	Solheim 2013
Hovland 1	AAR-16884	8582	33	Birch resin	Solheim 2013
Hovland 1	TRa-3410	8465	55	Charcoal	Solheim 2013
Hovland 3	Ua-45507	8609	54	Charcoal	Solheim 2013
Hovland 3	Ua-45515	8606	50	Charcoal	Solheim 2013
Hovland 3	Ua-45509	8594	48	Charcoal	Solheim 2013
Hovland 3	Ua-45508	8591	50	Charcoal	Solheim 2013
Hovland 3	Ua-45504	8584	49	Charcoal	Solheim 2013
Hovland 3	Ua-45514	8552	50	Charcoal	Solheim 2013
Hovland 3	Ua-45517	8540	51	Charcoal	Solheim 2013
Hovland 3	Ua-45505	8467	53	Charcoal	Solheim 2013
Hovland 3	Ua-45511	8465	48	Charcoal	Solheim 2013
Hovland 3	Ua-45506	8458	48	Charcoal	Solheim 2013
Hovland 3	Beta-325802	8450	40	Charcoal	Solheim 2013
Hovland 3	Ua-45516	8428	50	Charcoal	Solheim 2013
Hovland 3	Ua-45522	8398	49	Charcoal	Solheim 2013
Hovland 3	Ua-45520	8387	47	Charcoal	Solheim 2013
Hovland 3	Ua-45519	8383	47	Charcoal	Solheim 2013
Hovland 3	Ua-45503	8376	51	Charcoal	Solheim 2013
Hovland 3	Ua-45512	8348	47	Charcoal	Solheim 2013
Hovland 3	Ua-45518	8291	48	Charcoal	Solheim 2013
Hovland 4	Ua-45500	8747	64	Animal bone, burned	Solheim 2013
Hovland 4	Ua-45499	8630	49	Charcoal	Solheim 2013
Hovland 4	Ua-45493	8568	51	Charcoal	Solheim 2013
Hovland 4	Ua-45494	8526	52	Charcoal	Solheim 2013
Hovland 5	Ua-45490	8775	52	Hazelnut shell	Solheim 2013
Hydal 4	Ua-51477	6049	36	Hazelnut shell	Solheim 2017b

Table 3.4 Continued

Site	*Lab.no*	*C14-age*	±	*Sample material*	*Reference*
Hydal 4	Ua-51476	5944	35	Charcoal	Solheim 2017b
Langangen Vestgård 1	TRa-4117	8030	55	Charcoal	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-4118	8005	45	Charcoal	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-4121	7945	45	Charcoal	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-4120	7875	45	Charcoal	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-4114	7870	45	Charcoal	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-4119	7850	45	Charcoal	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-4116	7800	45	Charcoal	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-4122	7795	40	Animal bone, burned	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-1994	7785	40	Animal bone, burned	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-2243	7780	70	Charcoal	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-1995	7760	40	Animal bone, burned	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-4123	7745	35	Animal bone, burned	Melvold and Eigeland 2014
Langangen Vestgård 1	TRa-4115	7740	45	Charcoal	Melvold and Eigeland 2014
Langangen Vestgård 5	TRa-2255	5695	50	Charcoal	Reitan 2014c
Langangen Vestgård 5	TRa-2254	5645	45	Charcoal	Reitan 2014c
Langangen Vestgård 5	TRa-2257	5085	50	Charcoal	Reitan 2014c
Langangen Vestgård 5	TRa-2256	5015	55	Charcoal	Reitan 2014c
Langangen Vestgård 5	TRa-2252	5005	45	Charcoal	Reitan 2014c
Langangen Vestgård 6	UBA-19139	5057	28	Charcoal	Reitan 2014d
Langangen Vestgård 6	UBA-19141	5055	27	Charcoal	Reitan 2014d
Langangen Vestgård 6	UBA-19137	5021	28	Charcoal	Reitan 2014d
Langangen Vestgård 6	UBA-19138	5017	29	Charcoal	Reitan 2014d

(*Continued*)

Table 3.4 Continued

Site	*Lab.no*	*C14-age*	±	*Sample material*	*Reference*
Langangen Vestgård 6	UBA-19143	5010	27	Charcoal	Reitan 2014d
Langangen Vestgård 6	UBA-19142	4939	47	Charcoal	Reitan 2014d
Langangen Vestgård 6	UBA-19140	4931	31	Charcoal	Reitan 2014d
Langangen Vestgård 6	UBA-19144	4891	31	Charcoal	Reitan 2014d
Langangen Vestgård 6	UBA-19161	4813	46	Charcoal	Reitan 2014d
Langemyr	Ua-52063	8853	43	Hazelnut shell	Koxvold 2018
Anvik	Ua-46951	7875	52	Charcoal	Eymundson 2013
Anvik	Ua-46950	7818	49	Hazelnut shell	Eymundson 2013
Anvik	Ua-46952	7744	49	Charcoal	Eymundson 2013
Anvik	Ua-46953	7678	49	Charcoal	Eymundson 2013
Pauler 2	Beta-234404	6990	40	Charcoal	Nyland 2012
Pauler 2	Beta-234403	6910	40	Hazelnut shell	Nyland 2012
Prestemoen 1	Ua-45176	8671	45	Hazelnut shell	Persson 2014
Prestemoen 1	Ua-45177	8620	45	Animal bone, burned	Persson 2014
Prestemoen 1	Ua-45178	8593	46	Hazelnut shell	Persson 2014
Rugtvedt	Ua-3667	5950	60	Charcoal	Odgaard 1994
Rugtvedt	Ua-3669	5860	75	Charcoal	Odgaard 1994
Rugtvedt	Ua-3668	5505	65	Charcoal	Odgaard 1994
Rødbøl 19	TUa-5868	6615	35	Plant remain	Gjerpe 2008
Rødbøl 54	TUa-5558	8630	45	Hazelnut shell	Gjerpe 2008
Stokke/ Polland 1	Ua-48259	5353	101	Charcoal	Solheim 2017b
Stokke/ Polland 1	Ua-48264	4911	39	Charcoal	Solheim 2017b
Stokke/ Polland 1	Ua-48265	4667	39	Charcoal	Solheim 2017b
Stokke/ Polland 1	Ua-48262	4583	38	Charcoal	Solheim 2017b
Stokke/ Polland 5	Ua-48256	6196	40	Charcoal	Solheim 2017b
Stokke/ Polland 5	Ua-48258	6177	42	Charcoal	Solheim 2017b
Stokke/ Polland 5	Ua-48257	6098	40	Charcoal	Solheim 2017b
Torsrød	T-1425	5350	70	Charcoal	Østmo 1975
Torstvet	TRa-3406	8460	55	Charcoal	Solheim 2013
Torstvet	TRa-3407	8425	55	Charcoal	Solheim 2013
Vallemyrene 1	Ua-45182	5770	35	Charcoal	Reitan 2014e
Vallemyrene 1	Ua-45181	5748	35	Charcoal	Reitan 2014e

Table 3.4 Continued

Site	*Lab.no*	*C14-age*	±	*Sample material*	*Reference*
Vallemyrene 1	Ua-45180	5373	34	Charcoal	Reitan 2014e
Vallemyrene 4	Ua-45169	6489	50	Animal bone, burned	Eigeland and Fossum 2014
Vallemyrene 4	Ua-45170	6381	37	Animal bone, burned	Eigeland and Fossum 2014
Vallemyrene 4	Ua-45172	6197	40	Charcoal	Eigeland and Fossum 2014
Vallemyrene 4	Ua-45171	6067	41	Charcoal	Eigeland and Fossum 2014

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4 'They made no effort to explore the interior of the country'

Coastal landscapes, hunter-gatherers and the islands of Ireland

Graeme Warren and Kieran Westley

Introduction and background

Research into the Mesolithic of Ireland has long been characterized by assumptions about the significance of coastal landscapes. In the second half of the 19th century, before the Mesolithic as we know it had been recognized, antiquarians found that coastal locations – particularly dunes and uplifted palaeo-shorelines – were good sources of prehistoric material culture. Considerable lithic collections were amassed via numerous expeditions and (unscientific) excavations (Gray 1879; Knowles 1889), representing the result of the interplay of prehistoric activities, landscape change and particular histories of research. Discussion of the lifeways and activities of the prehistoric people in question was limited to speculation based on contemporary ethnographic observations viewed through the lens of Victorian-era thinking. Prehistoric Irish populations were interpreted as primitive shell-fishers – the poor relations of inland, monument-constructing agricultural societies, 'a lower class who pursued this mode of living [shellfish collection] as the easiest … ignorant of progress and quite content in their seclusion' (Brunicardi 1914:208). This attitude prevailed into the mid-20th century, and even as the Irish Mesolithic became distinct from later prehistory, the marginal character of the hunter-gatherer settlement of the island of Ireland was stressed. R. Macalister (1935:8), for example, argued that the first settlers were 'content with the molluscs of the shores, with trapped birds or captured fish. Thus easily satisfied, they made no effort to explore the interior of the country, where all was unknown and full of dread'. F. Mitchell's (1956:26) account of his excavations at Sutton, Co. Dublin, imagines the Mesolithic occupants of this shell midden watching the tree-clearing fires and swinging axes of Neolithic colonists in 'amazement' and retreating to their 'island refuge'. This spatial peripheralization of hunter-gatherers supported 20th-century narratives of Irish state formation and the importance of agriculture to national identity (Finlayson & Warren 2010:49). Consigning hunter-gatherers to the coasts had two effects. Firstly, it never allowed them

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to really occupy Ireland – or at least not in the same way that farmers did, by taking and shaping the environment to human design. Secondly, this assigned them to a clear cultural stereotype as 'strandloopers' or 'beachcombers' – a status with limited cultural complexity.

With the benefit of nearly a century of more research, we now recognize that, once Mesolithic populations were established, contra to Macalister's perspective, they certainly did 'explore the interior of the country'. Late Glacial human populations were present in Ireland at the end of the Bølling/Allerød interstadial – based on a cut-marked bear patella from Alice and Gwendoline Cave (Co. Clare) dated to 12 810–12 590 cal BP (Dowd & Carden 2016) – and the Early Holocene – based on a second cut-marked bear vertebra from the nearby Catacombs Cave (11 080–10 400 cal BP; Dowd & Carden 2016), but we understand little in detail of these groups. More substantial evidence, probably reflecting long-term settlement, only began shortly after 10 000 cal BP, and is represented by the Mount Sandel Mesolithic occupation site (10 290–9790 cal BP; Bayliss & Woodman 2009). The Neolithic appears shortly after 6000 cal BP, and the intervening period is commonly divided into Earlier and Later Mesolithic phases on the basis of a distinctive transition from microlithic to macrolithic stone tool industries at c. 8800–8600 cal BP, which is not seen elsewhere in the British Isles except for the Isle of Man (Woodman 2012). Sites of Mesolithic date are found across the full extent of Ireland (Figure 4.1), including many locations some distance from marine environments. We now recognize that Mesolithic activities shaped the landscape, structuring in subtle ways the ecology – not least through the deliberate introduction of large animals (Warren et al. 2014). Mesolithic communities built monuments, such as markers for the locations of the dead (Little et al. 2017), and a variety of structures, some substantial (Woodman 1985a). Yet, the potential role of coastal landscapes must remain a consistent theme in any attempt to make sense of the period: Mesolithic colonizers arrived by boat, they routinely used islands and they maintained contact overseas. If we assume a broad definition of a coastal site as meaning a site which was located on or near its contemporary coastline, key Mesolithic sites (identified in Figure 4.1) include many coastal examples.

Aside from the detail of the Irish material, general models of the northwest European Mesolithic have stressed the importance of coastal landscapes, and coastal resources in particular: G. Bailey (2008:357), for example, sees a reliance on marine food as one of the 'defining characteristics of Mesolithic exploitation patterns'. At a European level, broad links between coastal resource abundance and the potential for Mesolithic sedentism and social complexity are common (for critique, see Warren 2017a). Few detailed models exist of the organization of Mesolithic society in Ireland and complexity is rarely discussed. However, the potential role of the coast in Irish Mesolithic life has been reinforced by evidence that Ireland's native fauna was impoverished relative to other areas of Europe – lacking large game such as red deer and aurochs that were important

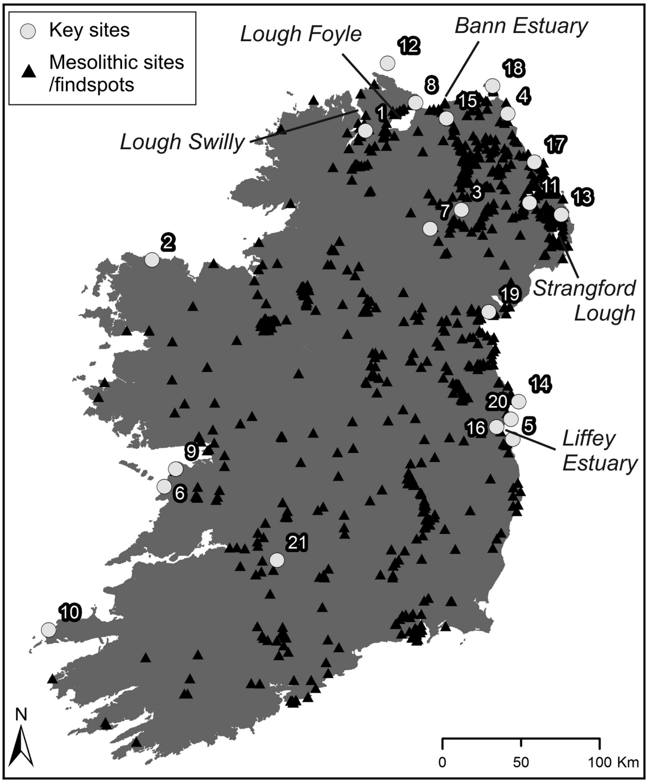

Figure 4.1 Map showing all Mesolithic sites and findspots on the island of Ireland with sites mentioned in the text indicated by numbers. 1. Inch Island sites (Baylet, Ballymoney, Castlequarter, Drumboy, Grange); 2. Belderrig; 3. Brookend; 4. Cushendun; 5. Dalkey Island; 6. Doolin; 7. Drumnafern; 8. Eleven Ballyboes; 9. Fanore 1 & 2; 10. Ferriter's Cove; 11. Glendhu; 12. Inishtrahull; 13. Kilnatierney; 14. Lambay Island; 15. Mount Sandel; 16. North Wall Quay; 17. Port of Larne; 18. Rathlin Island; 19. Rockmarshall; 20. Sutton; 21. Killuragh Cave (data from the Woodman [2015] Mesolithic database). Place-names mentioned in the text are shown in italics.

elsewhere (Woodman et al. 1997). Coastal resources have therefore appeared even more important. Thus, P. Woodman (2015:202) argues that a maritime economy was critical in enabling colonization.

Coastal landscapes are therefore likely to have been important to hunter-gatherers living in Ireland, and should be important in our attempts to make sense of those lives. C. Gosden and L. Head (1994:113) describe landscape as being a 'usefully ambiguous' term for archaeologists, noting that 'the fragmentary nature of the evidence and the timescale over which it accumulates … require us to reformulate the notion of the social landscape'. Following this lead, understanding the coastal landscapes of the Irish Mesolithic should involve three themes:

- the changing physical form of the coastline;
- the archaeological evidence for material forms of interaction with the coast through which people engaged with the environment;
- the influence of time on the evidential basis for these relationships (Bailey 2007).

The remainder of this chapter follows this three-part structure, before concluding with some observations about research problems.

The physical form of the coast

Ireland's present coastline is geomorphologically diverse; its eastern and southeastern portions are typified by wide embayments and unconsolidated sediments while its southwestern, western and northern coastlines are characterized by extensive rock cliffs, headlands and long indented bays, interspersed with sand and gravel beaches (Westley & Edwards 2017). The character of this coastline has changed considerably since the Mesolithic. Relative sea level (RSL) has fluctuated, moving shorelines across the continental shelf and inducing changes in geomorphology via attendant shifts in depositional and erosional processes. This is particularly complex in Ireland due to its glaciation history. Considerable ice cover during the Last Glacial meant that regional-scale glacio-isostatic crustal movements overprinted meltwater-driven increases in global ocean volume. This resulted in spatiotemporally variable patterns of RSL change across the island (Edwards & Craven 2017; Westley & Edwards 2017).

Significant efforts have been made to obtain accurate constraints on past RSL and to model changing glacio-isostatic adjustment (GIA; Brooks & Edwards 2006; Brooks et al. 2008; Bradley et al. 2011; Kuchar et al. 2012; Plets et al. 2015). In general, the broad pattern of change has been established: greater isostatic rebound and a shallower RSL lowstand in northeast Ireland versus reduced rebound and a deeper lowstand moving south and west (Figure 4.2; Edwards & Craven 2017; Westley & Edwards 2017). However, our understanding is still incomplete, as the RSL data – comprising quantifiable sea-level index points (generally lithostratigraphic transitions between terrestrial and marine sediments supported by microfossil evidence) or less accurate limiting dates (e.g. dated freshwater peat or marine shells) – used to constrain the models become sparser further back in time (Brooks & Edwards 2006).

The precise elevations and timing of RSL highstands and lowstands remain fuzzy and debated (Edwards et al. 2008). Nevertheless, if we assume that the initial Mesolithic colonization/settlement of Ireland occurred sometime between c. 11 000–10 000 cal BP (based on the dates of the Catacombs Cave bear vertebrae and Mount Sandel), then RSL was lower than present: c. –2 to –13 m

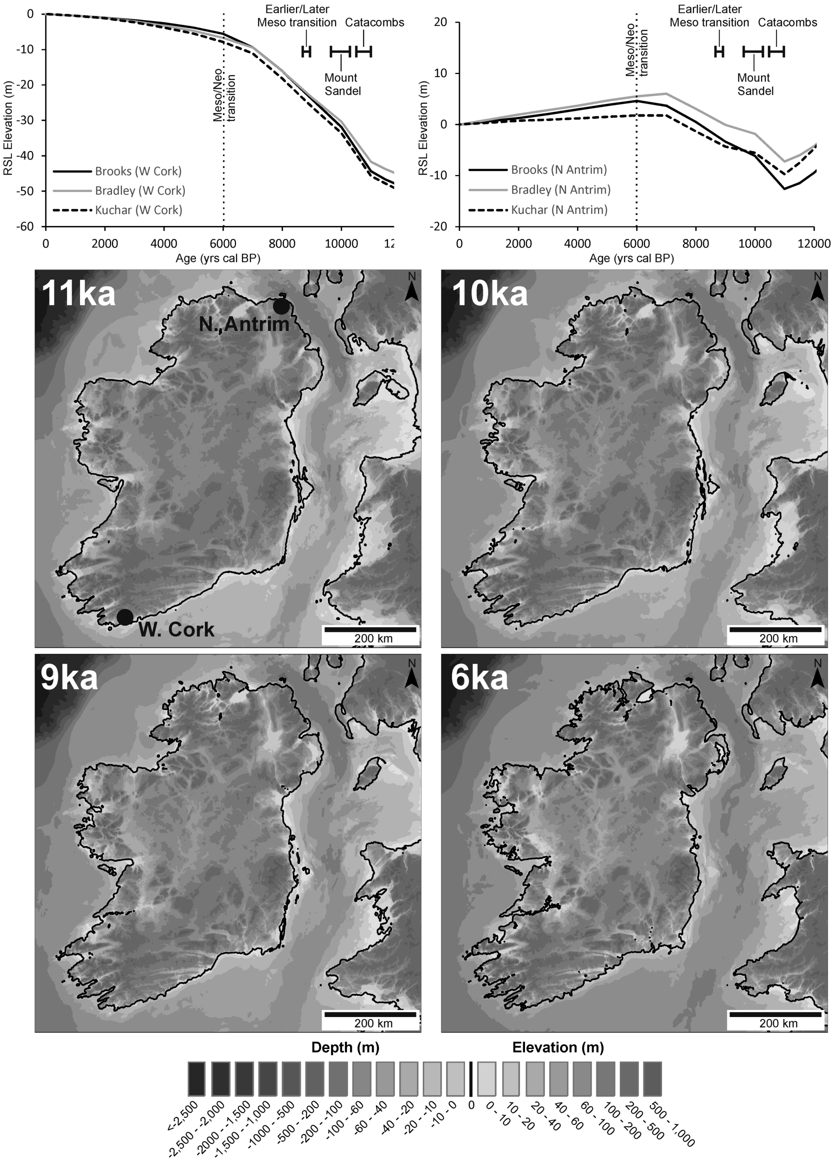

Figure 4.2 RSL and palaeogeographic change during the Mesolithic. Representative RSL curves for northeast and southwest Ireland (North Antrim and West Cork, respectively) derived from Brooks et al. (2008), Bradley et al. (2011) and Kuchar et al. (2012) GIA models. Low-resolution palaeogeography at key intervals based on the Brooks et al. (2008) model: 11 000–10 000 cal BP – earliest Mesolithic occupation; 9000 cal BP – Earlier/Later Mesolithic transition; 6000 cal BP – Later Mesolithic/Neolithic transition. Underlying Digital Elevation Model (DEM) is from GEBCO (2014).

for the northeast versus –30 to –45 m for the southwest. By the end of the Mesolithic, RSL had risen such that it was at or above present in the northeast, but remained below present elsewhere (minima of –5 to –10 m; Edwards & Craven 2017; Westley & Edwards 2017).

At an island scale, this effectively extended coastal plains during RSL lowstands, pushing shorelines out onto the modern seabed. Given the lowstand depths in question, coupled with Ireland's nearshore bathymetry, this probably only resulted in extensions of kilometres to low tens of kilometres (Figure 4.2; Brooks et al. 2011). More significantly, this was sufficient to cut Ireland off from mainland Great Britain from 16 000–15 000 cal BP onwards, with implications for its postglacial faunal and human colonization (Montgomery et al. 2014; Woodman 2015; Warren 2017b).

At the regional scale, we also need to consider that coastal change did not simply involve shoreline migration. On local scales (kilometres or less), further variation in coastal geomorphology was present in space and time. These variations were driven by changes in sedimentary regimes, nearshore wave processes and tidal regimes, which themselves changed in response to RSL and wider climate changes. A handful of examples highlight some of the potential variation present. For instance, P. Wilson and J. McKenna (1996) describe the transformation of the River Bann Estuary (c. 7 km downstream from Mount Sandel) from a narrow channel flanked by dunes and lagoons to a broad funnel-shaped estuary during the Early- to Mid-Holocene RSL rise. At the Port of Larne, Woodman (2012) identified a ridge of glacial deposits, occupied between 9200 and 7500 cal BP, which was initially transformed into an island and eventually buried under metres of beach shingle by rising RSL. Unfortunately, we rarely have highly detailed palaeogeographic reconstructions around some of the most significant coastal sites (e.g. Ferriter's Cove, North Wall Quay). This arises partly from taphonomic reasons, namely submergence, burial or erosion of the necessary evidence, and partly from logistical reasons. The expense and logistics of sampling submerged or deeply buried deposits means that the requisite geological data (seismic profiles, cores/boreholes) are not usually collected as part of archaeological projects. Where such data do exist, they have usually been collected for geological (Plets et al. 2015) or geotechnical investigations (Westley et al. 2014) and not sited with archaeological questions in mind. Redressing this would require improved palaeogeographic reconstructions which integrate onshore and offshore geological data to more accurately represent RSL and geomorphological change. From an archaeological point of view, emphasis should be placed on areas with significant sites/assemblages or where there are clear archaeological questions.

Nonetheless, we can reasonably surmise from the extant evidence that, in general, Ireland's Mesolithic occupants probably had access to a range of coastal environments including open coasts, dunes, barriers, lagoons, rocky shores, cliffs, estuaries and offshore islands. However, each environment would have experienced significant change during the Mesolithic, with the rate and nature of change varying according to local characteristics. Steep rocky cliffs, for instance, may have changed very little, but beaches, estuaries, bays and sea loughs could have experienced much more extensive transformations (e.g. Movius et al. 1940; Wilson & McKenna 1996; Westley et al. 2011; Plets et al. 2015).

Evidence for Mesolithic interactions with the coast

As noted above, we define coastal sites as those located on or near their contemporary coastline, recognizing that due to RSL change, in some locations, such as Strangford Lough, sites which are now located on the coast were inland at the time of their use. Although a coastal location indicates the likely significance of the coast to Mesolithic settlement, detail of the character of interactions with the coast is provided by excavated coastal sites. Excavations of coastal sites go back into the earliest phases of Mesolithic research in Ireland. The data set is therefore uneven, and many primary archives are problematic. This is especially true of the three east coast shell middens at Rockmarshall, Sutton and Dalkey Island (Liversage 1968; Mitchell 1947, 1949, 1956). A modern assessment of the remaining archaeological potential of these sites would be an important contribution. Thus, dating evidence for all sites is variable in quality (Table 4.1). Because of RSL change which might have led to the transgression of Early Mesolithic sites, the data set is dominated by Later Mesolithic sites, many of which are very late within the Mesolithic. There is limited data for Earlier Mesolithic use of coastal landscapes (Woodman 2015:242). A key challenge going forward is therefore the identification of Earlier Mesolithic coastal (not estuarine) sites. Identification and accessibility are difficult (though not

Table 4.1 Simplified chronology for key coastal sites. Light boxes indicate problematic dating. The dominance of Later (latest) Mesolithic sites is notable

Site name	*10–9 kya*	*9–8 kya*	*8–7 kya*	*7–6 kya*	*References*
Baylet			■	■	Milner and Woodman (2007)
Belderrig				■	Warren (2009)
Cushendun		▒			Movius et al. (1940)
Dalkey Island			▒	▒	Woodman et al. (1997)
Fanore 1				■	Lynch (2017)
Fanore 2				■	Lynch (2017)
Ferriter's Cove				■	Woodman et al. (1997)
Kilnatierney				■	Murray (2011)
Mount Sandel	■				Woodman (1985a)
North Wall Quay			■		McQuade and O'Donnell (2007)
Port of Larne		■			Woodman (2015)
Rockmarshall				■	Woodman et al. (1997)
Sutton			▒	▒	Woodman et al. (1997)

impossible) due to submergence and, given the high energy conditions around Ireland, the loss or reworking of much of the material evidence (e.g. Westley 2015).

Boats and maritime mobility

We know that the Holocene (re)colonization of Ireland involved boats, and the distribution of archaeological material on islands (see below) clearly implies routine maritime mobility, but direct evidence of boats is rare. A poorly preserved 6 m long logboat from Drumnafern, Co. Tyrone, was found in peat overlying hazel charcoal dating to 6550–6400 cal BP (Dunlop & Barkley 2016). Though not directly dated, it is possibly Mesolithic in date. A possible boat from Brookend, Co. Tyrone, dates to 7440–7196 cal BP and is even more poorly preserved (Fry 2000). Both of these examples were recovered inland, the former at the edge of a small stream, the latter on the shore of a large lake. Logboats are well known in the Mesolithic of northwest Europe. They are highly suitable for estuarine or sheltered coastal conditions (Robinson 2013). Unmodified logboats are less suitable for the open sea (McGrail 2001) and their use for medium- to long-distance seafaring is debated (Bjerck 2013; Glørstad 2013). It may be that skin or hide boats were a more seaworthy alternative, particularly in the Earlier Mesolithic when suitable trees for boat-building were sparse (Bonsall et al. 2013; Woodman 2015).

The use of boats on open water is attested to by sea crossings. Mesolithic activity is known on east coast islands: on Dalkey Island, at Sutton (on Howth, an island at the time) and on Lambay Island. Earlier Mesolithic artefacts have been found on Inishtrahull, c. 7 km north of mainland Ireland's most northerly point (Woodman 2015). Later Mesolithic material has been found on Rathlin Island, also situated a few kilometres off the north coast (Cooney et al. 2012). Both northern islands were cut off from the mainland by deep water even during the RSL lowstand (Quinn et al. 2012). Though relatively close to shore, they are surrounded by exposed, often choppy waters and regular strong tidal currents. The latter represent the most difficult crossings of all those made to Mesolithic islands in Ireland.

That these people and their boats were also capable of longer journeys of up to tens of kilometres is confirmed by affinities between the lithic industries of Ireland and the Isle of Man, notably the presence of distinctive macrolithic Later Mesolithic forms unlike those of contemporary British industries (Garrow & Sturt 2011; Warren 2017b). Further circumstantial evidence of these seafaring capabilities is provided by the appearance, during the Mesolithic, of non-native large animal species, such as boar, dogs and possibly bear (Warren et al. 2014) which, by implication, must have been imported via sea crossings.

On the basis of this, it can be said that seafaring was likely a key skill for (at least parts of) Mesolithic communities, and people's interactions with boats were part of the formation of communities of practice, even if details are obscure (Bjerck 2017, for Mesolithic examples from Norway). Boats themselves, be they of hide or timber, were probably significant items: they were a substantial investment of labour and technical skill, and in some anthropological accounts, such 'delayed return systems' are associated with degrees of social complexity (Woodburn 1980). Elsewhere in Europe, e.g. in Denmark, boats were sometimes treated with some formality and were utilized in funerary ritual (Andersen 2013).

The resources of the coast

Detailed understanding of the physical form of specific coastal landscapes is often lacking, and our ability to reconstruct key features of the coastal environment that people interacted with remains a work in progress, with little detail. This concerns, for example, the character of the wooded landscapes of coastal environments, which would have contained a wide range of useful resources, likely including a range of edible woodland plant resources – nuts, fruits, roots – as well as raw materials. Regardless, it is clear that the coast provided rich opportunities for hunter-gatherers, including food and raw materials for manufacturing tools or jewellery.

Raw materials

Lithic raw materials found on beaches were used in stone tool industries: pebble flint, for example, being widely used in the east and northeast. The reliance on pebble sources in some areas created a significant structure to the organization of lithic usage across the landscape (Woodman 2015). L.-J. Costa and F. Sternke (2007) argue that the Earlier Mesolithic's tightly structured approach to blade production required pebbles of high-quality raw material from the coasts, which placed major constraints on mobility. The distinctive reorganization of lithic technology in the Irish Later Mesolithic, including much greater use of lower-quality, locally abundant raw material, can therefore be seen as a way of breaking the dependency created by the use of the pebble resources.

This provides an example of the enabling and constraining affordances of the coast: flint pebbles were embedded into a social and technological structure which enabled certain kinds of actions and mobility, but limited others. Over time, these constraints were transcended by changes in technical organization.

Beach materials provided important sources for a range of coarse stone tools – elongated pebbles, hammerstones, etc. In many instances, we understand little about the social context of raw material procurement from beaches, but at Doolin (Fisherstreet), Co. Clare, shale beach cobbles provided material for axe roughouts in the Later Mesolithic (Lynch 2017): the natural shape of the beach cobbles providing 'pre-formed' blanks for simple flaking. Cooney (2000) has argued that these blanks may have been seen as 'provided by the living earth'. Today, Doolin is a rather unusual landscape, with a river which vanishes into an underground cave system and significant variations in beach composition over time. In the Mesolithic, it was, however, a coastal site. If these features were present in the Mesolithic, they may have made the raw materials appear even more special (Gilhooly 2017).

The recent discovery of a small number of perforated cowrie shells (*Trivia* sp.) in very late Later Mesolithic contexts at Fanore 2, Co. Clare, and Later Mesolithic/Early Neolithic contexts at Baylet, Co. Donegal, shows coastal resources as raw materials for jewellery (Lynch 2017). Perforations on Mesolithic cowries from Britain have been demonstrated to be produced with stone tools (Barton & Roberts 2015; contra Hardy 2010). At a northwest European level, shell beads are argued to replace the stone beads characteristic of the Early Mesolithic. They appear to have been items of some significance: sometimes found in burial contexts or with funerary associations (at Téviec, Brittany, 3839 perforated *Trivia* were recovered from a Mesolithic cemetery [Barton & Roberts 2015]). The perforated cowries provide a clear link between Ireland and broader patterns of Late Mesolithic activity in northwest Europe.

The wider funerary associations of perforated cowries provide a link to an argument that the coast was associated with death and ancestry in the Irish Mesolithic. Drawing parallels with other sites in Europe, A. O'Sullivan (2002) argued that the deliberate placement of fragments of human bones in coastal shell middens – for example at Rockmarshall or Ferriter's Cove – was a practice that recognized and maintained the great social significance of coastal landscapes for Irish hunter-gatherers, creating links to the ancestors. Since that time, it has become clear that the presence of small amounts of human bone is common on many Mesolithic sites across Europe – not just coastal ones. The preservation conditions of shell middens bias our understanding of the preservation of human bone across the Irish landscape and it is unlikely that the placement of human remains on coastal sites was influenced by the specifically coastal aspect of these sites.

Food and subsistence

The range of possible marine foods found on archaeological sites gives us some indication of people's interaction with the coasts, although of course the relationship between the deposition of food remains and the reconstruction of diet and activity is very complex. The summaries here draw on updates to Warren (2015) and Woodman (2015).

Thirteen coastal sites have fish bone assemblages which allow us to say something of the exploitation of fish species (Table 4.2; for discussion of inland fishing, see Little 2009). Synthesizing these data is difficult, because it is difficult to tell whether variation in classification reflects preservation or variations in practice by analysts over many years and variation in reporting standards, especially in how frequency of remains is reported. A reanalysis of all extant fish bone to consistent modern standards would help clarify the significance of the apparent patterns.

Table 4.2 Fish species from Irish Mesolithic sites. Data based on the synthesis of extant reports and limited grouping where possible; for references see Warren (2015)

Species		*Mount Sandel*	*Cushendun – Deposit E*	*Port of Larne*	*North Wall Quay*	*Baylet*	*Belderrig*	*Ferriter's Cove*	*Kilnatierney*	*Fanore 1*	*Fanore 2*	*Rockmarshall*	*Sutton*	*Dalkey Island (possible)*
Fish (indet.)					░								░	
Cod family	Gadidae		░	░		▓	░	▒						░
cod/saithe/pollack						▒		░		░	░			
Conger eel	*Conger conger*			░		░	▒	░						░
Eel	*Anguilla anguilla*	░		░		░		░						
Flatfish, plaice/flounder	*Pleuronectes platessa/Platichthys flesus*	░								░	░			
Flatfish	Pleuronectidae								▒			░		
Flatfish, tope	*Pleurotremata* (*? Galeus*)			░				░				░		░
Plaice	*Plueronectes plates*					░								
Gurnards	Triglidae							░						
Haddock	*Melanogrammus aeglefinus*							░						
Halibut						░								
Herring	*Clupea harangus*					▒		░						
Ling	*Molva molva*							░						
Mullet	*Mugil* sp.							░				░		░
Perciformes order							▒							

(*Continued*)

Table 4.2 Continued

Species		*Mount Sandel*	*Cushendun – Deposit E*	*Port of Larne*	*North Wall Quay*	*Baylet*	*Belderrig*	*Ferriter's Cove*	*Kilnatierney*	*Fanore 1*	*Fanore 2*	*Rockmarshall*	*Sutton*	*Dalkey Island (possible)*
Salmon	*Salmo salar*	▓						░						
Trout	*Salmo trutta*	▓												
Sand eel	Ammodytidae								░					
Scad	*Trachurus trachurus*							░						
Sea bass	*Dicentrarchus labrax*	░		░		░								
Bream										░	░			
Sea bream/Porgies	Sparidae							░						
Shark-type species	Elasmobranches							░						
Ray						░								
Thornback ray	*Raja clavata*							░						
Whiting	*Merlangius merlangus*			░		░		▓						
Wrasse	Labridae			░			▒	▓	▓	░	░			░

░ Present; ▒ Common; ▓ Abundant

On the basis of four sites, Woodman (2015:273) argued that the most important coastal fish were wrasse, whiting and pollack/saithe. A wider data set (Table 4.2) demonstrates that cod/cod family (eight sites, including one where cod is common and one where it is abundant), wrasse (seven sites, two abundant, one common), flat fish (eight sites, one common) and conger eel (five sites, one common) are the species found most frequently. Eel is found on riverine sites and some coastal sites. The Perciformes order and herring are only common on some sites. Many species are found in small quantities on individual sites.

Data for the earlier parts of the period are biased to estuarine environments and indicate the importance of eel and salmon/trout – a picture confirmed by inland lacustrine sites (e.g. Lough Boora; Ryan 1980). Because of the scarcity of Earlier Mesolithic coastal sites, it is not possible to assess whether the dominance of cod, wrasse, flat fish and conger eel on Later Mesolithic sites is due to a change over time in practice – it is, however, possible.

The range of species means that for the Later Mesolithic at least, inshore environments, sometimes rocky, were important; this is a key habitat for conger eel, wrasse and the cod family. Some fish are small to medium in size, which supports arguments for an inshore fishery. In common with other locations in northwest Europe, there is little evidence for open or deep-sea fishing (Pickard & Bonsall 2004). It is interesting to note that conger eel from the inshore sites of the Port of Larne and Belderrig both include examples described as large (>1 m in length in the latter case). Cod, flatfish, wrasse and conger eel were therefore an important source of food throughout the later part of the Mesolithic. Their availability may have influenced the location of settlements, with other species perhaps reflecting local environmental conditions, short-term variation, varying capture techniques or combinations thereof. The persistent pattern of key species shows a continuity in practice over the *longue dureé* – perhaps as long as 2000–3000 years.

Sea mammals are rare on Irish Mesolithic sites (see Warren 2015; Woodman 2015). Seals are found at Dalkey Island, Baylet and Rockmarshall. Cetaceans are present at Bay Farm, Dalkey Island and Rockmarshall. If the latter are reliably Mesolithic, they most probably represent chance exploitation of strandings. The only land mammals recorded on coastal/estuarine sites are boar, bear and dog and a range of sea and land birds are also present (Warren 2015).

Mesolithic communities also used shellfish. There is great variation in the range of species identified, but oysters, limpets, periwinkles and carpet shells were important (Warren 2015). At Kilnatierny, Co. Down, the presence of oyster and scallops suggests that some deeper water was exploited, requiring boats or underwater swimming (Murray 2011). In some places, shellfish remains accumulated in large middens, but many sites, such as Ferriter's Cove and Fanore, saw smaller accumulations representing short-lived episodes of activity (Murray 2007).

Woodman et al. (1999) make the important argument that repeated Mesolithic activities over time at Ferriter's Cove did not always leave behind the same archaeological traces, but taken as a chronological aggregate, some common patterns on coastal sites are apparent. On many coastal sites, Later Mesolithic routines of occupation do not seem to be associated with large structural features. Instead, more ephemeral features such as hearths, occasional stake holes and some pits are often present; a possible exception being the poorly understood postholes at Glendhu (Woodman 1985b). Many sites do include deposits rich in cultural material, such as the 'stony layers' at Belderrig which contain fish/mammal bone, charcoal, charred plant remains and many lithics. The range of material contained within these deposits is very similar to that occurring in shell middens – without the presence of the shells and the particular preservation conditions they enable. Our analytical distinction between shell middens and non-shell-bearing occupation soils may be obscuring similarities in practice.

It is not clear how the occupation of coastal sites relates to other locations within the landscape, nor to what extent coastal sites were locales of long-term seasonal settlement. A small number of seasonality studies have been undertaken on different materials. Accepting that these can only indicate approximate seasons of presence, and not absence, the evidence consistently suggests spring/summer/autumn activity. At Glendhu, oyster gathering is argued to have taken place in April and May, and at Rockmarshall from March to August (Woodman 2001). Varied strands of evidence from Ferriter's Cove suggest short-term activities in the summer and autumn (Woodman et al. 1999). In many cases, coastal sites appear to have been (re)occupied over many centuries, forming the distinctive deposits mentioned above, and it may be significant that they were persistent places in the *longue durée*, even if they were not places of permanent settlement.

Direct dietary evidence from isotopic analysis (for review, see Warren 2015) indicates that some humans (Ferriter's Cove) and dogs (Dalkey Island) consumed very large amounts of marine protein, whereas the human femur found in a coastal shell midden at Rockmarshall had a mixed marine/terrestrial signal. Others, such as individuals from the Early and Late Mesolithic at Killuragh Cave, show little sign of a significant marine contribution, although Woodman (2015) suggests that their reliance on eels masks a marine carbon signature. *If* the Killuragh evidence is taken at face value, it highlights that while the coasts were important to some Mesolithic communities in Ireland, it was possible to be a hunter-gatherer without relying on the sea for food. Although the three sites with evidence of high levels of marine protein consumption lie late within the Mesolithic, given the size of the data set and the absence of early coastlines, it is not appropriate to interpret this as a change over time.

Comparatively few pieces of technology that demonstrably relate to the direct exploitation of coastal resources survive. While many artefacts may have served a function in this context, such as the oft-stated association of Bann flakes and eel fishing, they may also have had other uses (see Woodman 2015:271). Intertidal fish traps are known from North Wall Quay on the north of the Liffey estuary (8050–7670 cal BP; McQuade & O'Donnell 2007, 2009). The traps included weirs and baskets and the dates may indicate two main periods of use. Basket fish traps are also known from lacustrine contexts in Ireland (Mossop 2009). The hazel rods used in the North Wall Quay traps indicate some form of coppicing or regular cutting, perhaps on an 8–9 year cycle (McQuade & O'Donnell 2007), although this may not have equated to formal woodland management (Warren et al. 2014). The traps highlight the craft skills of their makers, the potential landscape impacts of such activity and the ways in which Mesolithic lives on the shore were woven with the movement of the tides. A reliance on traps also forces the users into a cycle of maintenance and repair. The use of traps is also another classic example of a 'delayed return technology' which is sometimes considered to lead to the development of territorial claims on place.

Time and coastal landscapes

It is clear that Irish Mesolithic societies understood the coastal environment, engaged with at least some of its resources and their use of these resources provided opportunities and constraints to the formation of their social routines. It is also apparent that the historical depiction of a people tied completely to the coast is a considerable oversimplification. What is less clear is how much variation there was in the use of coastal landscapes over the Mesolithic and into the Neolithic transition, and how much spatial variation in practice existed across the island. Given the spatiotemporal variation in RSL, coastal processes and geomorphology discussed above, we would expect there to be some degree of corresponding variation in landscape affordances (e.g. prime fishing/shellfishing localities, raw material sources, advantageous travel routes) and human practices, but as yet, the picture is incomplete.

Partly, this arises from the deficiencies of the archaeological evidence base. RSL change has meant that likely inhabited and utilized coastal localities are now, at best, submerged (e.g. Eleven Ballyboes; Westley 2015) or, at worst, lost to coastal erosion. Given the pattern of RSL change, this affects not only the Earlier Mesolithic across the island, but also the Later Mesolithic in the south and southwest (Westley & Edwards 2017). In any case, these gaps mean that any inferred spatial patterning comes with considerable caveats.

Temporal resolution

The incomplete picture is also a product of the (often) different temporal and interpretive resolution of the purely 'archaeological' versus the 'landscape/environmental' evidence. Taking RSL and palaeogeographic change, we can currently use modelled RSL change combined with digital elevation models to create progressive reconstructions which show the evolution of the coastline at time steps of 500–1000 years (Sturt et al. 2013). Such reconstructions are useful for assessing 'big picture' questions, such as the presence/absence of a landbridge between Ireland and Britain (Brooks et al. 2011), but they do not necessarily translate directly to a precise examination of human interaction with the coast.

Firstly, at this scale they cannot account for localized patterns of sedimentation and erosion, which are crucial in determining what the physical coastal landscape actually looked like and the affordances it offered. Secondly, there is temporal alignment: do such large time steps fit with the rhythms of daily or seasonal activity which structure much of what we see in the archaeological record? The difficulty of relating the temporal resolution of palaeogeographic reconstructions to human lifetimes and perceptions also means that it is very difficult to assess causal relationships between RSL change and human activity.

This is not to dismiss such models entirely. As mentioned above, they are well-suited to some questions. In addition, if we can integrate them into archaeological evidence of comparable resolution, they can at least provide signposts as to possible environmental factors that were important to past people. Such evidence would consist of distribution patterns which could be phased in accordance with time-stepped palaeogeographic reconstructions.

The following example is centred on the Inishowen Peninsula on the north coast. Evidence of Mesolithic occupation has been gathered mainly by local collectors who have identified numerous findspots of lithic material (Westley & Woodman 2018). A few localities – including several shell middens radiocarbon dated to the later part of the Mesolithic – have also been subject to archaeological investigation (Kimball 2000; Milner & Woodman 2007; Westley 2015). Aside from these, Mesolithic attribution is typology based, and can only be refined into broad Earlier (c. 9800–8700 cal BP) and Later (c. 8700–6000 cal BP) periods (Woodman 2012). This lack of chronological resolution results in large temporal groupings loosely tied to broad-scale palaeogeographic reconstructions (Figure 4.3).

The reconstructions shown in Figure 4.3 were created by applying modelled RSL change (Brooks et al. 2008) to onshore topographic (SRTM: NASA JPL 2013) and offshore bathymetric (EMODnet: EMODnet Digital Bathymetry DTM 2016) digital elevation models. The estimate of the intertidal area is based on the application of the modern tidal range of 3–3.5 m for Loughs Foyle and Swilly. The reconstructions suggest that both loughs were subaerially exposed during the initial Earlier Mesolithic (Figure 4.3a). Over time, RSL rise gradually converted these terrestrial floodplains into embayments (Figure 4.3b–d). The small number of verifiably Earlier Mesolithic sites hinders attempts to determine activity patterns in the earliest part of the record. Nonetheless, the significant hotspot of Eleven Ballyboes could have been situated on the flank of the palaeo-Foyle estuary (Westley 2015). This would accord with previous suggestions of the role of estuarine environments in this period (e.g. Port of Larne, Mount Sandel; Woodman 2015). If estuarine and riverside locations were a focus of activity, then it may be that the lack of Earlier Mesolithic evidence is a product of submergence. As such, the submerged/intertidal context of the Eleven Ballyboes assemblage hints at the nature of the material that could be underwater (Westley 2015).

Taking the reconstructions at face value, coastal change was initially rapid (Figure 4.3a and b), then slowed as RSL decelerated and peaked (Figure 4.3c

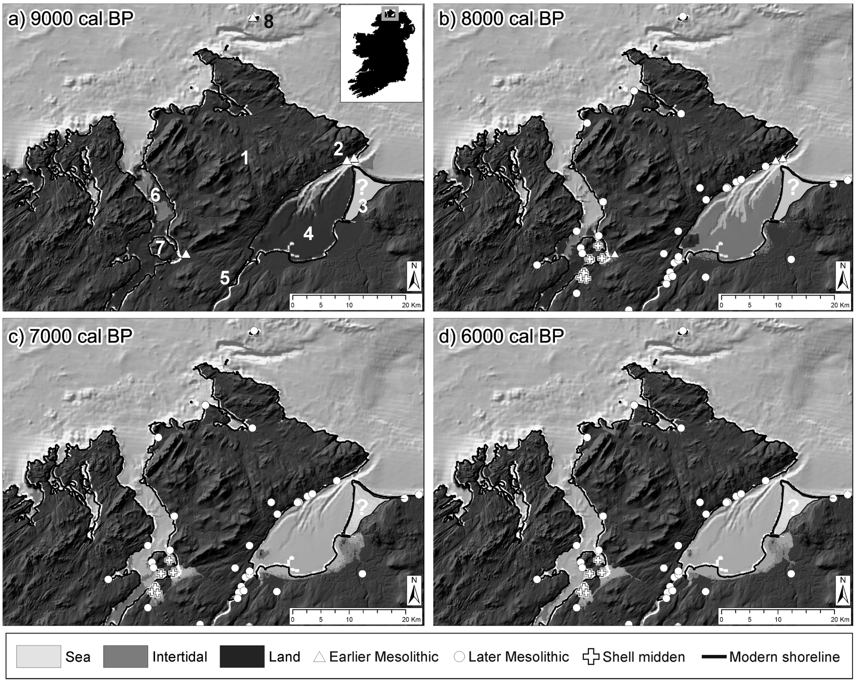

Figure 4.3 Low-resolution Early- to Mid-Holocene palaeogeographic reconstructions for the Inishowen Peninsula with known Mesolithic sites/findspots superimposed. Numbered locations indicate place-names mentioned in text: 1. Inishowen Peninsula; 2. Eleven Ballyboes; 3. Magilligan Foreland; 4. Lough Foyle; 5. River Foyle; 6. Lough Swilly; 7. Inch Island; 8. Inishtrahull. Reconstructions do not correct for sedimentation/erosion, hence the uncertainty over Magilligan Foreland (a Late Holocene landform). Site distributions generated from the Woodman (2015) database and material found by local collectors (Westley & Woodman 2018). RSL change was derived from the Brooks et al. (2008) GIA model. Onshore DEM is from the Shuttle Radar Topography Mission (SRTM: NASA JPL 2013) and offshore DEM is from European Marine Observation and Data Network Bathymetry portal (EMODnet Digital Bathymetry DTM 2016).

and d). The upshot was more persistent estuarine and intertidal areas in the inner bays and a stabilization of affordances. By c. 7000 cal BP, Lough Foyle had been transformed into a large open embayment, especially given the likely absence of Magilligan Foreland, which only formed after c. 6000 cal BP (Wilson 2002). Lough Swilly was also open by this stage, and crucially, significant embayments had opened up around Inch Island. Currently, these areas are largely reclaimed land, but during the transgressive and stabilization phase, they could have formed extended shallow water and intertidal areas. These, and similar locations at the present mouth of the Foyle River, appear to have been a focus of Later Mesolithic activity (Figure 4.3c and d; see also Kimball 2000; Woodman 2015:fig. 4.29–4.30). Five shell middens on, or adjacent to, Inch Island potentially date to the Later Mesolithic (Castlequarter, Grange, Drumboy, Ballymoney, Baylet; Milner & Woodman 2007), which implies that these sheltered areas were productive zones for shellfish, and therefore attractive places revisited persistently over time. The fish assemblage from one midden – Baylet – is characteristic of inshore environments (Table 4.2) and thus indicates that the sheltered waters of Lough Swilly, which opened up after c. 8000 cal BP, were actively exploited.

However, there are two caveats. Firstly, there is the accuracy of the palaeogeographic reconstructions, particularly since they are based on modern depth/elevation surfaces (there is insufficient data to account for post-transgression sedimentation or erosion). Secondly, this concerns the variable nature of the archaeological data: only four middens have produced Mesolithic radiocarbon dates (Baylet, Ballymoney, Castlequarter, Drumboy; Milner & Woodman 2007), fish and faunal remains are limited to Baylet and the vast majority of evidence is based on surface-collected lithic scatters of variable size (<5 to >1000 individual items; Westley & Woodman 2018). Nevertheless, by linking the coarse but spatially extensive archaeological record with the temporally continuous but also low-resolution palaeogeographic reconstruction, we can start to explore questions of how landscape change influenced preservation bias (e.g. submergence of coastal landscapes) and altered affordances over time (e.g. the location of shellfish beds).

Local variation

At the other end of the analytical scale, some sites do have detailed geological information, which reveals more about how the physical coastal landscape changed over time, and thus redresses the limitations of the low-resolution models. While useful indicators of the kinds of changes experienced by Mesolithic people, there are once again temporal disconnects between the archaeological and geological evidence. Often, in these contexts, the archaeological material is derived rather than in situ, and the geological evidence, while detailed in terms showing geomorphological change, is not well constrained chronologically. In many instances, this stems from the lack of datable material. Consequently, the sequence of landscape changes is broken into analytical units based on interpreted environments, with little indication of the rate of landscape change or the persistence of a given landform (e.g. lagoon, estuary) over time.

These issues are clearly manifest in a classic Irish Mesolithic sequence. H. Movius' excavations at the Warren, Cushendun, Co. Antrim, revealed a sequence showing human activities near the coast transformed by significant landscape change (Movius et al. 1940). At present, the site lies 300 m from the shoreline, on the left bank of a small river (Figure 4.4). The excavation comprised a c. 15 m long by 9 m high vertical section cut into the landward face of a bay-head ridge which backs the nearby beach and extends across the mouth of the valley (Figure 4.5).

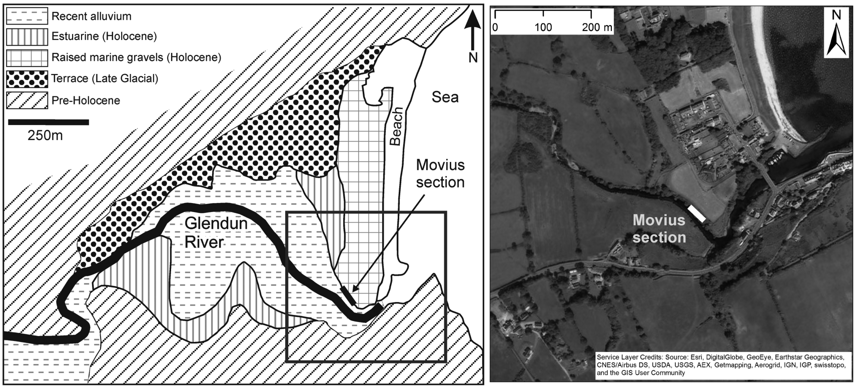

Figure 4.4 Location of the Movius section at Cushendun in relation to Holocene deposits (redrawn after Carter 1982). Grey box indicates the area covered by the aerial photo which shows the present-day landscape context of the Movius section.

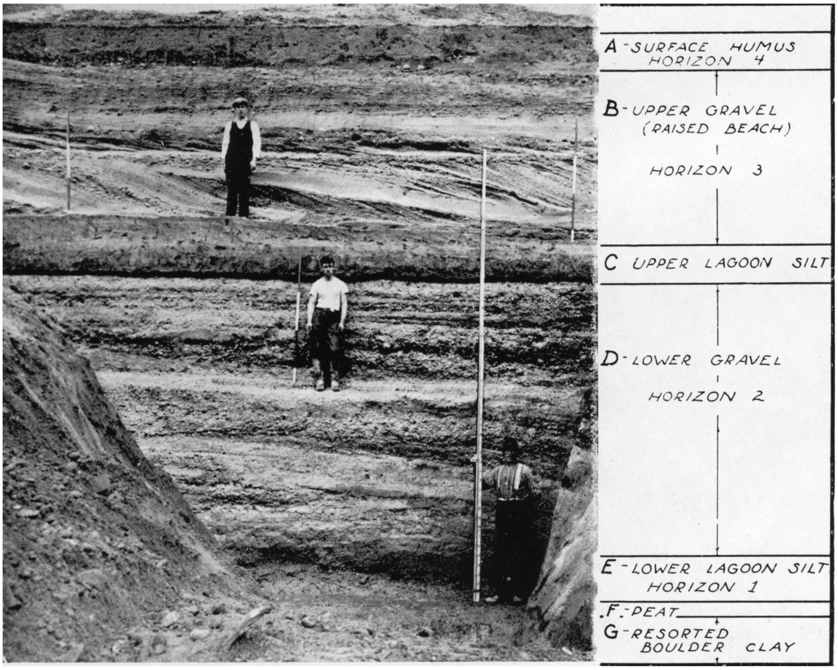

Figure 4.5 The classic Cushendun section, Co. Antrim, excavated in 1934 (Movius et al. 1940: plate IV, fig 2). *Source*: Reproduced by permission of the Royal Irish Academy.

Near the base of this section, Boreal peats indicate a period where RSL was low. There is no evidence of human activity. This is sealed by silts ('E') deposited in a tidal lagoon during a period of marine transgression. A small artefact assemblage from these silts includes fresh and rolled lithic artefacts as well as cod and pig bones. Movius argues that these remains were probably lost directly into the deposit, whereas Woodman (2015:224) argues that they have 'washed in from the edge of an adjacent shoreline settlement'. Radiocarbon dates on derived charcoal and wood from these silts are of limited value but lie in the period 9000–8000 cal BP. The artefacts indicate settlement at any stage before or during the formation of the lagoon and have no meaningful association with the radiocarbon dates.

RSL rise continued, leading to the formation of sub-marine gravel spits ('D'). These contain fresh flint artefacts. Movius and colleagues (1940:31) argued that 'the flints from this horizon are sharp and practically unrolled, which indicates that the sea rapidly invaded occupation sites along the coast and swept up the refuse material, transporting it by swift currents to a position further inland'. These artefacts represent settlement at some stage prior to the final formation of the spit on a now lost landform further seaward. RSL at this time may have been c. 4 m higher than present.

Layer D is sealed by Layer C, clays deposited in 'a relatively flat, sand-bottomed, tidal lagoon' (Movius et al. 1940:28). No artefacts are known. Following this period of inundation, RSL retreated again as isostatic rebound continued, and gravel beach deposits formed (Layer B). These contained 'heavily rolled' artefacts, again reworked from another location. The 'humus' of Layer A is argued to contain 'Neolithic' artefacts, and this layer itself was sealed by peat, now cut.

Cushendun clearly highlights the three issues of analytically engaging with coastal landscapes noted above. It requires landscape reconstruction, not only modelling sea-level change, but also reconstructing the physical form of the landscape and the recognition that places within the landscape, potentially focal points for hunter-gatherer coastal activity, have been destroyed. The archaeological material speaks of long-term relationships between human societies and the coast but lacks the resolution to really characterize these in detail. Finally, using material from Cushendun to make sense of 'coastal landscapes' requires moving from artefacts accumulated in silts deposited over an unknown time period, to those redeposited from unknown locations – again, over unknown time periods. These have accumulated into analytical units distant from the relationships between objects that constituted their contexts of use and representing radically different temporal relationships.

Conclusion

While Mesolithic communities certainly did 'explore the interior' of the island, understanding the coastal landscapes of the Mesolithic in Ireland is clearly a very important problem if we are to make sense of how hunter-gatherers successfully occupied a large Atlantic island with a distinctive ecology and environment. However, considerable challenges remain in our understanding of the Mesolithic coastal landscapes. Critical problems, as highlighted above, include the identification of Earlier Mesolithic coastal (not estuarine) site(s) through more systematic investigation of submerged/buried contexts, perhaps including the development of archaeological and geomorphological predictive models in order to target areas of high potential. Such a contribution may also help us better understand the nature and timing of the colonization of Ireland.

Although not all Irish Mesolithic communities need have based their lives around the sea, for many, the sea and the coastal landscapes it produces was likely part of their routine practices: if not daily, most likely at some stage of the year. Many aspects of their relationships with these coastal landscapes remain obscure to us. While it is possible to highlight some aspects of these interactions – the influences of the tides on the timing of daily activities, the changing realities of sea-faring at different times of the year – these statements remain at comparatively high levels of generality. More intimate moments, such as possible evidence for diving to collect shellfish at Kilnatierny, can be set against this background. Such details create a possibility for imaginative experiential engagements with the Mesolithic past. But they tell us very little about the specific forms of social organization that structured these moments in the past.

In this chapter, we have followed Gosden and Head's argument that landscape is a 'usefully ambiguous' term – and we have highlighted how understanding the coastal landscapes of Ireland requires reconciling data sets of fundamentally different scales of resolution: both spatial and temporal. Ambiguity is therefore inevitable in accounts of how the coast influences archaeological discussions of Mesolithic lives in Ireland and how the coast influenced the lives of hunter-gatherers in Ireland. This ambiguity runs through an important and underappreciated data set which, even in its current form, highlights key aspects of the changing lives of the Mesolithic occupants of Ireland over a period of more than 4000 years.

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5 Transformations of coast and culture

A view from the Latvian shore of the Baltic

Valdis Bērziņš

Introduction

In relation to the world pattern of sea-level change at the end of the Pleistocene and during the Holocene, Fennoscandia along with adjacent areas of northern Europe constitute a rather special region. Here, global sea-level rise – totalling approximately 125 m since the Last Glacial Maximum (Fleming et al. 1998) – has been exceeded by the land uplift that followed the melting of the Scandinavian ice sheet. Accordingly, the prevailing pattern experienced in this region over the millennia has been one of falling, rather than rising, water levels. The Baltic Sea Basin occupies the eastern and southern parts of this uplifting zone, along with part of the surrounding zone where the earth's crust has been sinking (Figure 5.1). This has resulted in a complex pattern of shore displacement within the Baltic Sea Basin, a pattern further complicated by the circumstance that during part of the Holocene it was isolated from the world ocean, existing as a freshwater basin with a water level above that of the ocean.

As the crustal movements and corresponding landscape changes around the basin largely occurred during the time of human occupation, they have been widely factored into assessments of coastal settlement and subsistence, especially with respect to early prehistory. Geological and palaeoenvironmental research has made ever more precise shore displacement models for particular areas available to the archaeologist, and has given an increasingly detailed picture of past landscapes, which have been so important in shaping patterns of human subsistence along the shores.

Despite this growing wealth of information, the big picture of how the pattern of shore displacement and associated environmental changes impacted human lifeways in early prehistory across the Baltic Sea Basin is only just emerging. It is a theme that transcends the traditional national boundaries of archaeological research, since the studies conducted in different countries, different parts of this extensive region, can potentially contribute essential pieces to the jigsaw.

Against the background of shoreline displacement patterns across the Baltic Sea Basin, this chapter looks at recently obtained archaeological evidence from the Baltic Sea coast of Latvia, attempting to set this evidence in a wider

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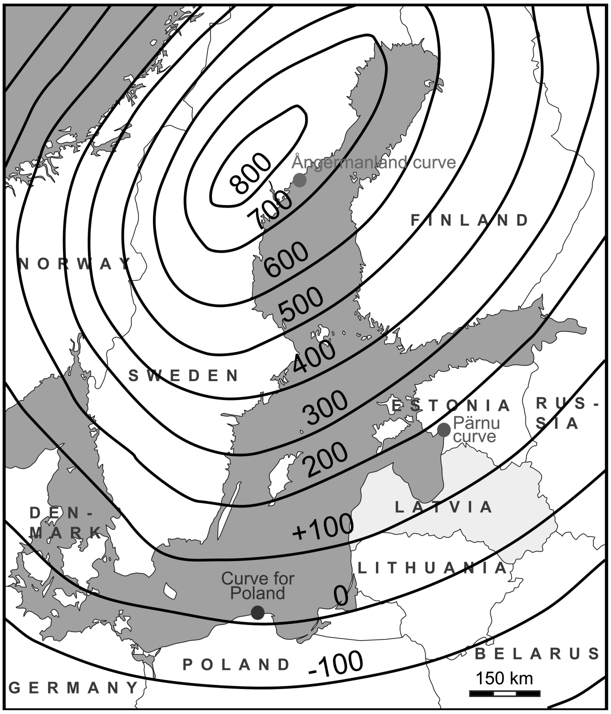

Figure 5.1 The amount of absolute postglacial uplift of the Fennoscandian Shield, and the surrounding subsidence trough in the area of the Baltic Sea Basin (after Mörner 2015) with the locations of the shore displacement curves shown in Figure 5.2. Illustration: V. Bērziņš.

context and help progress towards a more integrated, supra-national picture of how natural changes in the Baltic Sea Basin affected the people inhabiting its shores.

Widely diverging patterns of shore displacement and the early development of the basin

Because of the differences in the rate of land uplift between different parts of the Baltic Sea Basin, the patterns of shoreline displacement during the Holocene (Figure 5.2) are radically different. In the northern and western-central part of the basin, the rapid land uplift has resulted in almost continuous regression. Thus, the shore displacement curve for Ångermanland in northern Sweden shows a fall in the relative height of the shoreline by approximately 270 m. In the southern part of the basin, transgression has prevailed under the impact of crustal subsidence and rising water levels. This is exemplified by the shore

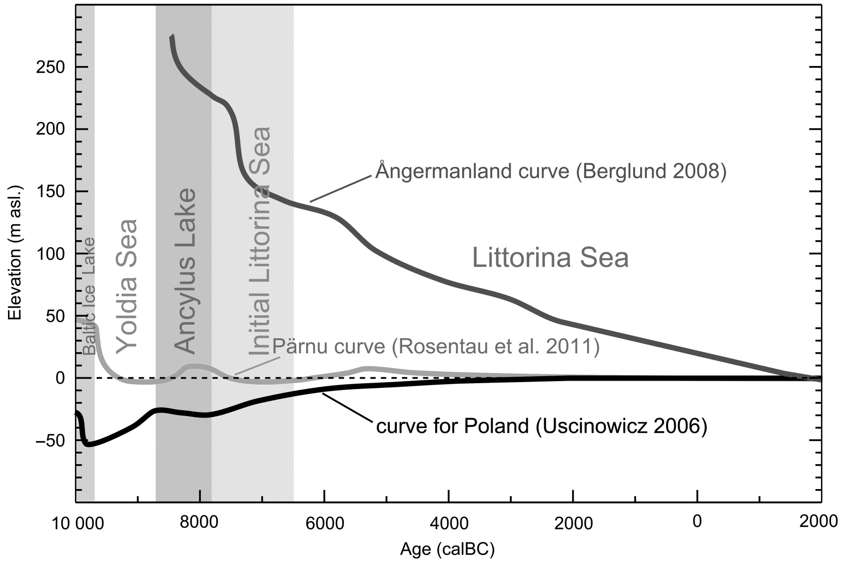

Figure 5.2 Shoreline displacement curves from different areas of the Baltic Sea Basin: Ångermanland in northern Sweden (Berglund 2004), Poland (Uścinowicz 2006) and the Pärnu area in southwestern Estonia (Rosentau et al. 2011). Illustration: V. Bērziņš.

displacement curve for the coast of Poland (Figure 5.2), with a relative increase in the water level of about 55 m.

Meanwhile, in the intermediately located zone of the basin, which corresponds to southern Sweden, western Latvia, southwestern Estonia and the eastern end of the Gulf of Finland, these areas being located at the periphery of the isostatic uplift zone, postglacial rebound has been comparable in magnitude to Holocene water-level changes in the Baltic Sea Basin. Accordingly, this intermediate zone has experienced a series of transgressions and regressions. For example, the curve for the Pärnu region of Estonia in Figure 5.2 shows that during the Holocene the relative height of the shoreline fluctuated between a maximum of about 12 m above present sea level to a few metres below present sea level. As described below, the situation in western Latvia is rather similar. Compared to central Scandinavia, for example, the eastern shore of the Baltic Sea Basin has a very flat coastal landscape. (In Latvia, for example, the coastal belt has no relief higher than 50 m a.s.l.) Accordingly, even a relatively minor change in the water level will result in the flooding or exposure of a large area.

At the end of the last glacial, while the level of the ocean was much lower than that of today, the Baltic Sea Basin filled with glacial meltwaters, forming what is known as the Baltic Ice Lake, with a water level high above that of the ocean and no direct connection to it (Andrén et al. 2011). In Latvia, the shorelines of the Baltic Ice Lake appear conspicuously in the landscape as abrasion scarps (Veinbergs 1979).

At about 9700 cal BC (Andrén et al. 2011), with the melting of the Scandinavian ice sheet, the waters of the Baltic Ice Lake suddenly found a route to the ocean across central Sweden, resulting in a rapid fall in the water level in the Baltic Sea Basin, equalizing with the level of the ocean, and eventually an influx of marine water began. During this stage, the Yoldia Sea stage, the basin experienced a relatively brief brackish water phase (Heinsalu & Veski 2007; Andrén et al. 2011). The water level in northwestern Latvia may have been similar to that of today, but the Yoldia stage shorelines were evidently destroyed during the subsequent stages of the basin's development. In southwestern Latvia, by the border with Lithuania, where land uplift was less, the shoreline of this time has been identified submerged far out at sea, at a depth of approximately 50 m (Bergman & Timofeev 1972).

The Ancylus Lake stage and settlement in the early part of the Middle Mesolithic

As a result of continued rapid land uplift, at about 8700 cal BC the outlets to the ocean became too shallow to drain the outflowing water from the Baltic Sea Basin, the water level of which rose above that of the ocean, bringing into existence a vast freshwater lake, known as the Ancylus Lake (Andrén et al. 2011). Due to meltwaters from the dwindling Scandinavian ice sheet, the lake level rose very rapidly, reaching a maximum at around 8600–8200 cal BC (Berglund et al. 2005; Veski et al. 2005; Rosentau et al. 2013), when the waters found a new outlet to the North Sea through the Danish Straits (see Björck et al. 2008).

While in earlier decades, Mesolithic research in Latvia concentrated almost entirely on inland areas (see Zagorska 1993), more recently, through targeted survey, a string of Mesolithic sites has been discovered in the Užava River valley and the surrounding area of the coastal belt in the northwest of the country (Figure 5.3), and the lithic assemblages from several of these sites have now been analyzed from a technological perspective (Damlien et al. 2018).

In its lower course the Užava nowadays flows through a broad plain, constituting the southern part of the extensive Ventspils Bay that existed during the Ancylus Lake stage. Based on the data available today, a provisional, rather tentative shoreline displacement curve has been compiled for the area (Figure 5.4), although many uncertainties remain. There is little possibility of compiling a water-level curve from the isolation of basins, because the height of the isolation thresholds is unknown: such thresholds in our region consisted of sand and other soft sediments; in some cases, they have subsequently been completely eroded by the sea along with parts of the basins, and even where they are still preserved, the soft sediment has been subject to erosion and deposition by water and wind, changing the height of the surface. Instead, we need to focus on the ancient shorelines: a task for the future is to map beach ridges

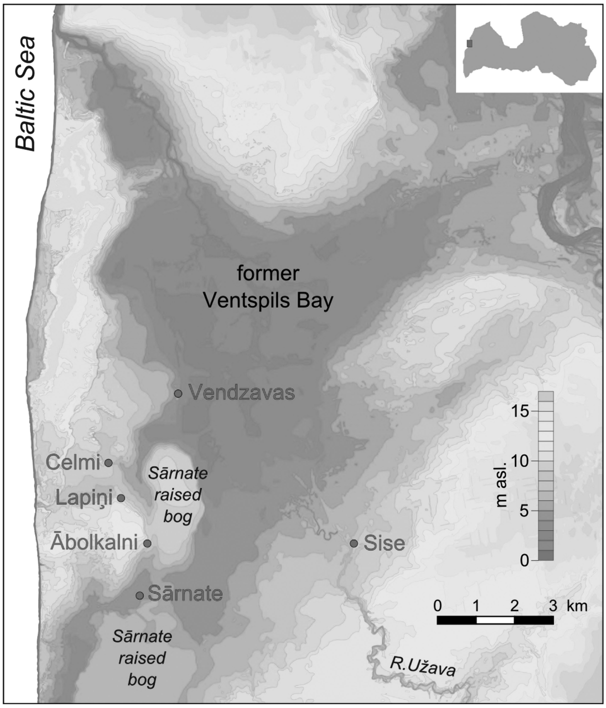

Figure 5.3 Mesolithic and Neolithic sites in the Užava area. Map: V. Bērziņš.

from light detection and ranging (LIDAR) data and date them, applying optically stimulated luminescence (OSL) and radiocarbon dating.

It may be noted that sites relating to the former shore of the Ancylus Lake will only be found here in the northwestern part of Latvia, since in the rest of the country, which has experienced less land uplift, the Ancylus shorelines are below present sea level. The only excavated habitation site dated to the Ancylus stage is the recently investigated Lapiņi site (excavated 2012, 2014–2015), located on a former shoreline on the western (seaward) side of the ancient bay at an elevation of 9–10.5 m a.s.l. In the waterlogged part of the site at the base of the slope a large piece of pine wood was preserved, probably worked artificially, that has given a radiocarbon date of 8487–8241 cal BC, i.e., approximately corresponding to the time of the maximum level of the Ancylus Lake. A much later date, 5071–4842 cal BC, was obtained from charcoal associated with flint flakes in a nearby feature filled with sandy gyttja, also at the base of the slope (Table 5.1).

Most of the small lithic assemblage from Lapiņi (208 pieces) derive from the unstratified sandy subsoil on the upper part of the slope. The assemblage includes subconical cores, micro-blades and blade sections, utilizing locally available pebble flint as well as high-workability imported flint

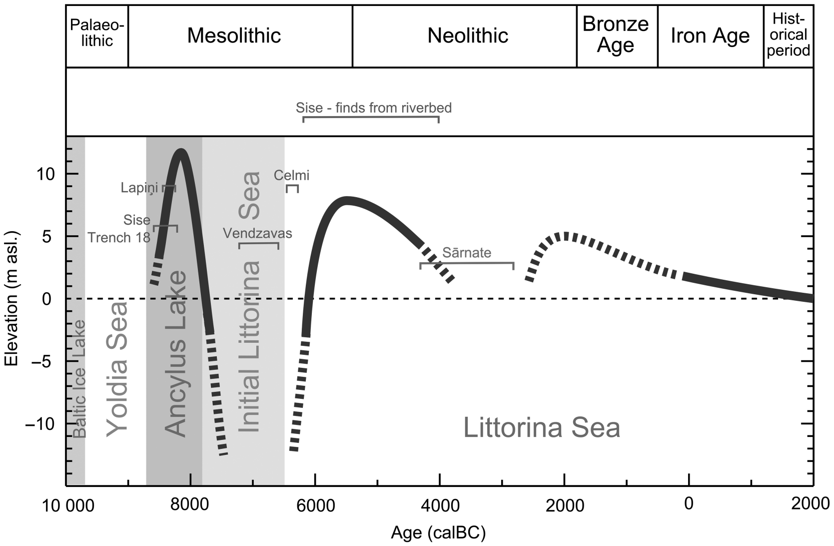

Figure 5.4 Tentative shoreline displacement curve for the Sise study area showing the age and elevation of excavated Mesolithic and Neolithic sites. The curve is based on research in the area of the former Ventspils Lagoon (Straume et al. 1970; Dzhinoridze et al. 1967; Veinbergs 1979), using dating evidence from the Sise site and from research in neighbouring regions (Saarse et al. 2003; Veski et al. 2005; Berglund et al. 2005; Rosentau et al. 2013); Baltic Sea Basin stages after Andrén et al. (2011). Illustration: V. Bērziņš.

(Figure 5.5: 1–8). Although the small size of the assemblage precludes any firm conclusions, there is some indication of chronological mixing: thus, a find of a tanged point (Figure 5.5: 7) is consistent with the idea of habitation during the earlier part of the Mesolithic, i.e., in the Ancylus Lake stage, whereas a microlith (Figure 5.5: 8) corresponding to the characteristic Janisławice Culture triangles (V. Asheichyk, National Academy of Sciences of Belarus, personal communication, 2016) rather suggests re-occupation in the Late Mesolithic/ Early Neolithic, i.e., during the Littorina Sea stage.

No faunal remains have been recovered at Lapiņi, but the initial choice of this locus for habitation can be explained by the presence of the Ventspils Bay of the Ancylus Lake, which would have provided a major concentration of freshwater aquatic resources.

In a wider cultural context, Lapiņi may be grouped together with other sites so far known in the former coastal belt in the northeastern part of the Baltic Sea Basin dating from around the time of the maximum level of the Ancylus Lake, with lithic assemblages that belong to a wide tradition of blade-making using a pressure technique that spread westward during the Mesolithic. These include pioneer settlement sites of southern Finland with flint assemblages, notably

Table 5.1 Radiocarbon datings for sites discussed in the chapter

Site	*Material*	*Radiocarbon date, 14C yr* BP *± 1σ*	*Calibrated date* BC *(95.4% confidence)*	*Archaeological period*	*Reference*
Lapiņi	Large piece of worked (?) wood (*Pinus*)	9119 ± 65 (Tln-3477)	8538–8511 (3.3%) 8487–8241 (92.1%)	Early Middle Mesolithic	Bērziņš and Doniņa (2014)
	Charcoal fragment (*Alnus*)	6067 ± 41 (Ua-47075)	5202–5176 (3.0%) 5071–4842 (92.4%)	Early Neolithic	
Vendzavas	Charcoal fragment	8160 ± 60 (Ua-34544)	7340–7048	Late Middle Mesolithic	Bērziņš et al. (2009)
	Charcoal fragment (Pomoideae)	7815 ± 35 (KIA-40957; date from humic acid fraction)	6750–6533		Damlien et al. (2018)
Sise	Wooden pile (*Corylus*)	8873 ± 75 (Tln-3465)	8246–7754	Early Middle Mesolithic	Bērziņš et al. (2016)
	Arm of wooden eel clamp (*Corylus*)	9240 ± 30 (KIA-48973)	8561–8331		
	Wooden tool handle (*Corylus*)	8990 ± 27 (KIA-48974)	8283–8205 (94.0%) 8033–8022 (1.4%)		
	Antler baton	7105 ± 95 (LuA-5396)	6210–6136 (6.3%) 6121–5777 (89.1%)	Late Mesolithic	
	Antler sleeve	6765 ± 30 (KIA-43698)	5717–5630		
	Worked antler tine	6895 ± 30 (KIA-43699)	5843–5720		
	T-shaped antler axe	5236 ± 23 (KIA-50030)	4222–4211 (2.0%) 4156–4133 (5.1%) 4066–3975 (88.3%)	Early Neolithic	

Conventional radiocarbon ages calibrated using the IntCal13 atmospheric curve (Reimer et al. 2013) and OxCal v4.2.4. For a full list of dates from Sise, see Bērziņš et al. (2016).

Ristola and Saarenoja 2 (Takala 2009; Sørensen et al. 2013), along with Pulli in southwestern Estonia (Kriiska & Lõugas 2009) and Kunda Lammasmägi on the southern shore of the Gulf of Finland in northern Estonia (Lõugas 1997). Technological analysis indicates that the flint assemblage from Lapiņi, like those from other Mesolithic sites of coastal western Latvia, belongs within this pressure-blade tradition (Damlien et al. 2018).

This same period of settlement is also represented at the Sise site, on the opposite shore of Ventspils Bay in the area of the former mouth of the River Užava. No undisturbed Mesolithic occupation layer has been discovered yet, but there is *in situ* evidence of human activity in the shallow waters of the bay. Thus, in the excavation of 2012, a pointed pile or post of hazel wood was uncovered in a vertical position, along with two small wooden implements, namely a lateral arm from an eel clamp and a tool handle. These finds, recovered from a sequence of sand and silt layers, have given three radiocarbon dates, all of which indicate the time around the Ancylus maximum (Bērziņš et al. 2016).

The Ancylus Lake tends to be seen as cold and nutrient poor, and, by implication, relatively unattractive for human adaptation to aquatic resources. However, the actual evidence for food resources from the Ancylus Lake deserves more attention than it has received so far. The fauna of the great lake is still poorly known, but bone remains from several sites along the eastern and western shores of the Gulf of Bothnia show that at least one species of seal, the ringed seal (*Pusa hispida*), was present (Ukkonen et al. 2014) and is likely to have been hunted by the people living along the lakeshore.

Although there is little direct evidence of fish species that we can associate with the Anclyus Lake itself (on subfossil remains see Janits 1991; Schmölcke et al. 2006), it is considered that most of the freshwater fishes common in the lakes and rivers of this basin today were already present during the time of the Ancylus stage (Lõugas 1997; Paaver & Lõugas 2003), and many of them would have been widespread in the lake itself. DNA studies indicate that salmon were also present in the Baltic Sea Basin by this time, having already colonized it during the preceding stages (Säisa et al. 2005), and we may presume that they were feeding in the lake itself and migrating into the rivers to breed, potentially providing a major seasonal food source.

We might be tempted to suggest that the fishing equipment of this time was rather simple compared with that of the later Mesolithic and the Neolithic, restricted to individually used weapons such as fish spears, were it not for the classic find of the Antrea net in Karelia: a large net that would have been some tens of metres long, with pine bark floats and heavy stone sinkers, recovered from a former strait of the Ancylus Lake and dated to the time of the Ancylus maximum, about 8400–8300 cal BC (Pälsi 1920; Miettinen et al. 2008). The above-mentioned wooden pile on the Sise site also provides a tentative indication that substantial wooden fishing structures were in use – presumably used to intercept migrating fish at the former mouth of the River Užava.

The Initial Littorina Sea stage (later Middle Mesolithic)

In the Initial Littorina Sea or Mastogloia Sea stage, the level in the Baltic Sea Basin equalized with that of the ocean, and weak marine water inflows are recorded in various parts of the basin (Berglund et al. 2005; Witkowski et al. 2005; Andrén et al. 2011). Increased organic carbon content in sediments from the later phase of this stage indicates a rise in primary production, and the conditions in the basin at this time have been likened to those of a huge eutrophic lake (Berglund et al. 2005). This is consistent with the climate evidence. Thus, the Greenland ice sheet core data (Alley 2004) indicate that the rapid warming during the period corresponding to the updammed Ancylus stage was followed by a relatively more stable, warm climate between c. 8000 and 6500 cal BC. A broadly similar picture of Early Holocene warming emerges from pollen, macrofossil and insect studies across the Baltic Sea Basin, although the evidence from this region tends to indicate significant warming also in the period after 8000 cal BC (Borzenkova et al. 2015). Additionally, the first marine water inflows would have provided additional phosphorus, also favouring increased primary production (see Bianchi et al. 2000).

In the Užava area, the Vendzavas site, located on a low sandy ridge along the western (seaward) shore of the former Bay of Ventspils and dated to c. 7300–6500 cal BC, provides some important data on subsistence and lifeways in the coastal belt during the Initial Littorina Sea stage. It must be said that the situation of the site at the time of occupation is rather unclear: we may note that, according to the water-level curve (Figure 5.4), this corresponds to a regression stage, when the adjacent depression previously occupied by the Ventspils Bay of the Ancylus Lake would either have been exposed as dry land or else remained as a freshwater body considerably above the level of the Initial Littorina Sea.

The occupation layer of the site, excavated in 1996, 1998 and 2000 (Bērziņš 2002), had been ploughed up almost entirely, and the vast majority of flint objects were either picked up from the ground surface or excavated from the ploughsoil layer. Nevertheless, in one area of the site, shallow subsoil features were preserved: the basal parts of pits filled with dark earth, extending into the white sand below the plough layer. No organic artefacts were preserved.

The lithic assemblage from Vendzavas consists of 3285 pieces, including conical, subconical and irregular cores, a large number of whole and broken micro-blades, along with scrapers and other tools made on blades, flakes and core fragments (Figure 5.5: 9–16). Overwhelmingly predominant in terms of raw material is locally available pebble flint (Bērziņš 2002). A detailed technological study (Damlien et al. 2018) allows the assemblage of cores and blades to be placed within the pressure-blade tradition, where it exemplifies a later stage of development compared with Lapiņi. The very high reliance on local pebble flint rather than imported raw material is a typical trait of assemblages from the later part of the Mesolithic in the region. Also very significant is a technological

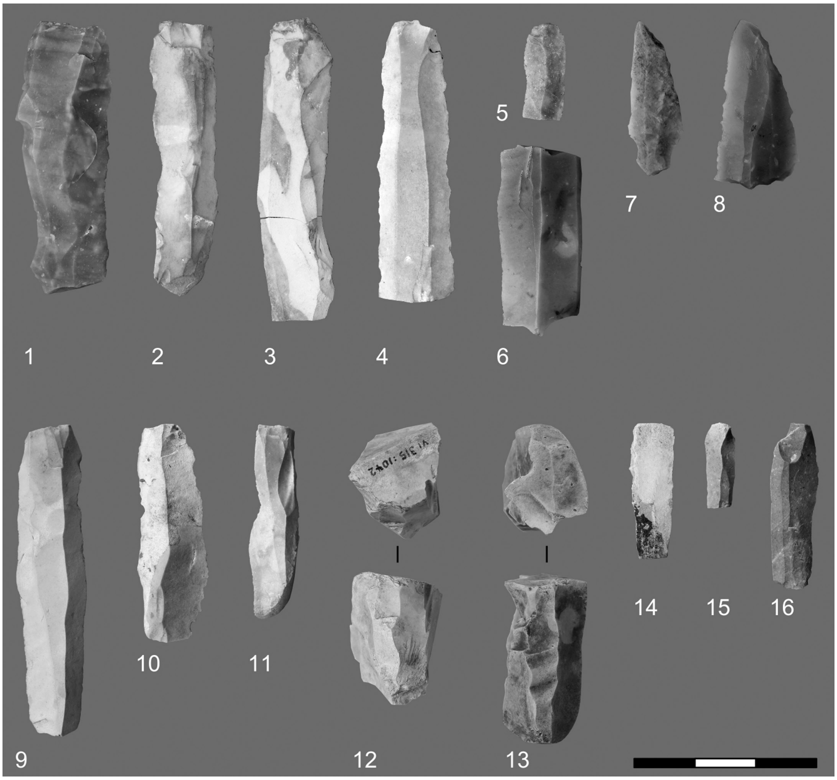

Figure 5.5 Lithic artefacts from the Lapiņi site (1–8) and the Vendzavas site (9–16). 1–6, 9–11, 15 and 16: blades and blade sections; 7: tanged point; 8: triangular microlith; 12 and 13: cores; 14: retouched blade section with traces of pitch. Photos: I. M. Berg-Hansen.

trait that set apart the pressure-blade technology as practiced at Vendzavas and other western Latvian sites from that used in neighbouring regions to the north and east, namely the general absence of systematic faceting on core platforms. Knapping experiments using the locally available flint pebbles suggest that the change to using unprepared core platforms may have been an adaptation to the properties of this raw material. It is a technological choice that may already have become an integrated element of the blade production concept by the time knowledge of this technique spread further west, to the southern Baltic region, thus making it an earlier and even more widely distributed phenomenon than previously thought – a finding of considerable significance in the context of the current effort to trace the spread of pressure-blade technology across northern Europe.

Analysis of the fish bone from Vendzavas (Table 5.2) revealed a spectrum of freshwater species that could have been living either in a bay of the lake/sea or in smaller lake basins or rivers. In addition to four species of terrestrial mammal and a significant number of bird bones, there is a high proportion of seal bone, some or all of which is ringed seal. This seal species is also present at other sites dated to the Initial Littorina Sea stage, namely Kunda Lammasmägi at the Estonian coast of the Gulf of Finland (Lõugas 1996, 1997) and Stora Forvär on an island off Gotland (Lindqvist & Possnert 1997).

Most surprisingly, a burial was also uncovered on the Vendzavas site (Figure 5.6), preserved immediately beneath the plough layer (Bērziņš 2002). The body had been placed in a contorted position on the stomach and covered with strips of organic material (bark?). The grave was unfurnished (the proximal section of a broken flint micro-blade found close to the skeleton may belong to the grave fill). In view of the very heavy plough damage, individual human bones scattered in this part of the site quite possibly derive from further burials that have been completely destroyed – although they could conceivably be loose human bones, i.e., bones that were not part of burials (e.g., Sørensen 2016).

Unfortunately, the recovered skeleton contains almost no collagen, and repeated attempts at radiocarbon dating have so far failed. Accordingly, it is not proven beyond doubt that we are dealing with a Mesolithic grave. However,

Table 5.2 Vendzavas faunal remains (from Lõugas 2002)

Fish
  Pike (*Esox lucius*) – 101
  Tench (*Tinca tinca*) – 58
  Roach (*Rutilus rutilus*) – 5
  Ide (*Leuciscus idus*) – 5
  Bream (*Abramis brama*) – 11
  Crucian carp (*Carassius carassius*) – 2
  Cyprinidae – 73
  Perch (*Perca fluviatilis*) – 8
  Pisces indet. – 500
Birds
  Eider (*Somateria mollissima*) – 1
  Aves indet. – 61
Mammals
  Elk (*Alces alces*) – 2
  Wild boar (*Sus scrofa*) – 1
  Brown bear (*Ursus arctos*) – 1
  Ringed seal (*Phoca hispida*) – 2
  Beaver (*Castor fiber*) – 20
  Rodentia indet. – 8
  Mammalia indet. – 248
  Man (*Homo sapiens*) – 17

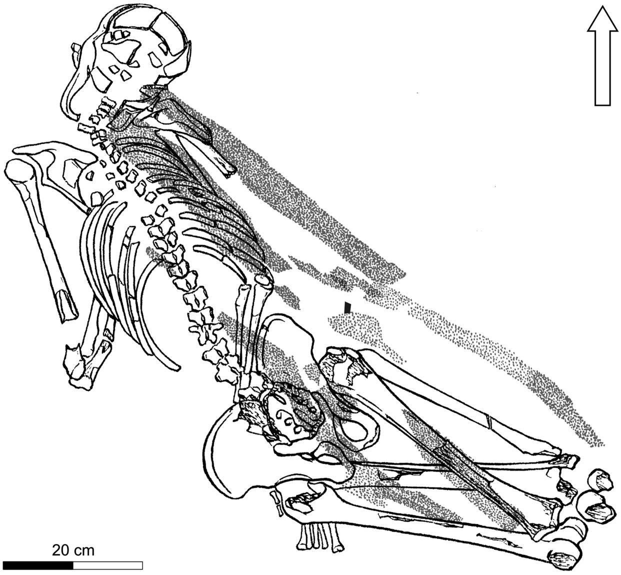

Figure 5.6 Plan of the burial excavated on the Vendzavas site. Illustration: V. Bērziņš.

the conditions of burial provide a strong indication of the relative chronology. Thus, had the grave been dug during or after the Mesolithic habitation, i.e., cutting through the occupation layer and into the white sand below, one would expect the fill to consist of a mix of white sand and dark, organic-rich earth with occupation refuse. Since this was definitely not the case – the fill consisted of white sand, inseparable from the natural subsoil, so that the contour of the grave was not distinguishable – it is concluded that the burial most likely preceded the intensive Mesolithic occupation in this part of the site.

The most unusual characteristic of the Vendzavas burial is the body position: prone and with legs flexed in a very unusual arrangement that could have been maintained by tying them. This contrasts with the evidence from the Zvejnieki cemetery in north-central Latvia: among the large number of Mesolithic burials here, the great majority were in extended supine position. Five extended prone burials were also recorded, and six burials on the side (Zagorskis 2004:79), but there seem to be no parallels at Zvejnieki for the leg position or for the organic covering of the Vendzavas burial. A possible parallel for the covering of the Vendzavas grave with strips of organic material may be identified in Grave 1 at Mszano, north-central Poland, dated to the early part of the 8th millennium cal BC. In this case, the body of a woman, buried on the left side together with a child, had been covered with a container of tree bark, of which large burnt fragments were preserved; in other respects, however, the burial practices at Mszano differ markedly from Vendzavas (Marciniak 1993).

The Littorina Sea stage (Late Mesolithic and Neolithic)

Starting from about 6500 or 6000 cal BC, there is evidence of a rising sea level in the Baltic Sea Basin and a gradual transition to brackish or marine conditions, which marks the beginning of the Littorina Sea stage (Berglund et al. 2005; Rößler et al. 2011; Rosentau et al. 2013). In the southern part of the basin, including Latvia, sea-level rise exceeded land uplift, so that fairly large areas of the coast were inundated. In the Užava area, an extensive bay was once again formed, with the River Užava flowing into it (Bērziņš et al. 2016). The conditions for habitation and subsistence in the coastal belt were considerably altered. Thus, the lower sections of river valleys were flooded by the sea, forming estuaries, bays and lagoons; and the influx of nutrient-rich marine water into the Baltic Sea Basin resulted in greatly increased primary production (Bianchi et al. 2000), along with the appearance of fauna not seen before, including various species of marine fish and marine mammals that were to become very significant as human food resources.

These changes approximately correspond in time to the Mesolithic–Neolithic transition, in accordance with the usage of these terms in Latvia. Thus, in Latvia and most adjacent regions, the Neolithic is deemed to have begun with the adoption of ceramic technology. It is by no means clear at the time of writing when actual neolithization, i.e., a transition to food production, occurred. Certainly, pottery appeared much earlier than domesticated plants and animals, and the ceramic vessels originally served as part of the toolkit of the hunter-fishers. In Latvia, the earliest dates for archaeological layers with pottery are approximately 5400 cal BC (Dumpe et al. 2011), although so far all this early evidence of ceramics comes from the eastern part of the country, and the timing of the adoption of pottery in coastal western Latvia is not precisely known.

In addition to the above-described remains from the time of the Ancylus maximum, the Sise site has also provided considerable evidence of human activities by the River Užava at the beginning of the Littorina Sea stage (Bērziņš et al. 2016). So far, despite extensive test pitting, no undisturbed occupation layer has been discovered on the riverbank; however, a great number of objects have been recovered from the riverbed. Antler and bone implements were brought up from the river during the course of the 20th century, and the collection has recently been supplemented with many such objects, as well as some lithic and pottery finds. This new material, mostly recovered in the course of an intensive and systematic survey of the riverbed, indicates that the river continues to erode strata rich in Stone Age archaeological material.

The Stone Age archaeology of the Baltic states is already known for its rich collections of bone and antler artefacts, and the assemblage from Sise represents another major collection of this kind – the only one from Latvia's coastal areas, or indeed from western Latvia. Presumably, these are objects discarded or lost in the water that were stratified in limnic or lagoonal deposits and are now being eroded by the river. The radiocarbon-dated objects fall in the period approximately 6200–4000 cal BC, i.e., corresponding to the end of the Mesolithic and the beginning of the Neolithic (Table 5.1).

Along with daggers, chisels, picks, axes and adzes, including sculpted and engraved pieces, the extensive assemblage of heavy implements made from red deer and elk antler includes a number of sleeves for stone axe or adze blades (Figure 5.7). In this riverine/estuarine context, these sleeves are readily interpretable as essential elements in the toolkit for carving out logboats and building fishing structures. The numerous antler sleeves might, in a sense, be seen as complementing the evidence provided by the plentiful finds of Nøstvet axes at the former sea coast, and at rivers and lakes, in eastern Norway – which are likewise interpreted as boatbuilding tools (Glørstad 2010)

The Neolithic site of Sārnate, located at the western margin of the depression, must also be mentioned. This extensively excavated habitation site has been treated at length elsewhere (Vankina 1970; Bērziņš 2008), and it may be sufficient to mention here that it offers a picture of the subsistence resources utilized, especially the range of tools and weapons used in food-getting activities, during the period approximately 4000–3000 cal BC, i.e., the Middle Neolithic, corresponding to the later part of the Littorina Sea stage, when the sea level had already fallen significantly, so that occupation was possible at an elevation of only about 4 m a.s.l. The diet included a mix of freshwater, marine and terrestrial foods. Although the sea coast would have been several kilometres distant at this time, one or more shallow, eutrophic lakes that had formed in the depression previously taken up by the Ventspils Bay provided a concentration of aquatic resources, on account of which this area retained its attractiveness.

Figure 5.7 Antler artefacts from the River Užava at Sise. 1, 3–5: sleeves; 2: pick with carved pattern. 1 and 5: Ventspils Museum (VVM 31460:24, 23); 2 and 3: National History Museum of Latvia (A 13899: 3; not accessioned); 4: Kuldīga Museum (KNM 1527). Photos: V. Bērziņš.

Discussion and conclusions

As described above, the archaeological evidence from the Užava area of western Latvia can be related to different developmental stages of the Baltic Sea Basin, starting approximately from the time of the maximum level of the Ancylus Lake at around 8200 cal BC. On the other hand, considerably more geological study is needed in order to refine the water-level curve and properly understand the environmental changes in the areas of the former Bay of Ventspils, with the aim, from the archaeologist's perspective, of achieving a credible and sufficiently detailed picture of how the pattern of human activities relates to the landscape transformations.

As explained at the beginning of this chapter, we are dealing in this area with fluctuations in water levels of just a few metres, rather than tens or even hundreds of metres, as is the case with shore displacement in much of northern and central Fennoscandia. On the other hand, the coastal terrain is very flat in our area. Essentially, the transgression of the Baltic Ice Lake already created a very flat, sandy coastal plain, and the subsequent transgressions and regressions have been shifting across it. Hence, every metre of water-level rise or fall has flooded or exposed quite large areas, and accordingly the experience of landscape change over the generations for the people living in these very different coastal environments must also have been rather different (Figure 5.8).

Multi-period sites are a feature of the study area, even though the situation is not one of landscape stability, where the conditions for resource extraction

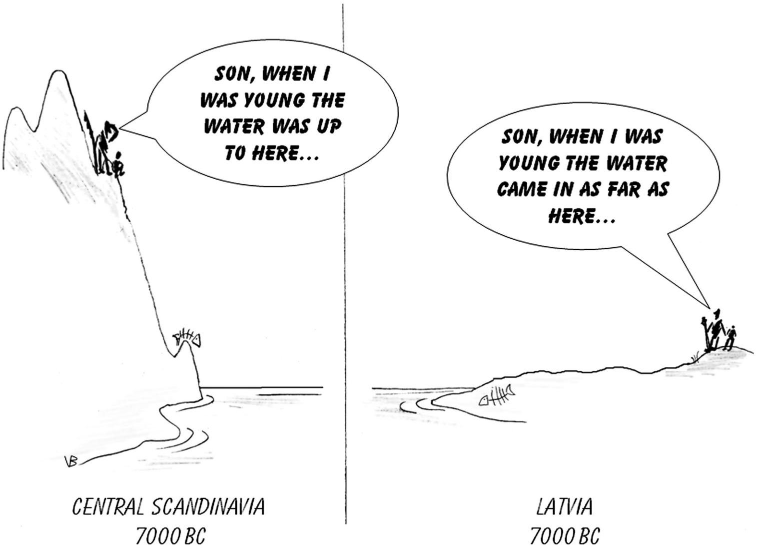

Figure 5.8 How water-level change may have been experienced in areas with different topography. Illustration: V. Bērziņš.

could be expected to have remained stable for a long time interval. In seeking to understand why certain locations were attractive to people in more than one period, we may first consider the effect of the oscillating pattern of shoreline displacement. Sise, for example, would have been an especially favourable location in at least two time intervals during the Ancylus and Littorina stages, when the mouth of the Užava was located at or near here. Additionally, even when it became an upriver site because the water level had fallen, Sise could nevertheless have been an attractive river fishing station. Also crucially important for the continued attractiveness of the area was the development of freshwater lakes, evolving from the remnants of the former Ventspils Bay. The Neolithic site of Sārnate is an excellent example, but the sequence bay>lagoon>lake essentially represents a typical pattern along many stretches of the Latvian coast, providing a basis for enduring human occupation with a strong dependency on aquatic resources (see Bērziņš 2008).

It may be added that the natural conditions and the pattern of landscape changes occurring in the study area – the flat landscape with a high groundwater level, the low vertical amplitude of shoreline displacement and the predominance of depositional over erosional processes – have provided very favourable situations for organic preservation at least on certain sites such as Sise and Sārnate. Accordingly, the finds recovered in this area can help fill gaps in our knowledge of lifeways and technology that occur in other regions because of the paucity of preserved organic remains. Indeed, the area retains high potential for yielding additional evidence of this kind.

Returning to a broader perspective, we may conclude that, with the large-scale natural changes in the Baltic Sea Basin providing a common thread, and with a spectrum of different patterns of shore displacement characterizing the various parts of the region, there is ample scope for a future region-wide, *longue durée* narrative of the shifting relationships between people, the coastal landscape and the waters of the basin.

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Part II

Coastal sites, mobility and networks

6 Diachronic trends among Early Mesolithic site types?

A study from the coast of central Norway

Heidi Mjelva Breivik

Introduction

The impacts of fluctuating temperatures, altering landscapes and changing resource situations on humans is a topic that has been of great interest in studies of the postglacial hunter–gatherers of Norway. The first humans who approached the seascapes of Norway some 11 500 years ago, met with a coastal environment influenced by cool temperatures, glaciers, seasonal sea ice, and inhabited by an Arctic fauna (Breivik 2014). Due to increasing temperatures, however, the conditions along the Norwegian coast were under constant alteration. A cold pulse, known as the Preboreal oscillation (PBO), hit Scandinavia and Europe c. 9300–9200 cal BC (e.g. Berner et al. 2010), and is identified by temperature drops on land and at sea, readvancing ice sheets and retreating forests. Midway through the Early Mesolithic period, c. 8800 cal BC, the Norwegian Atlantic Current was established, bringing warmer water masses along the coast. The ice melted away from all the large fjords and coastal waters, pushing the cold-tolerant fauna northwards, and providing stable and liveable conditions for a new range of marine species (Breivik 2014).

Recent studies of adaptive strategies related to these climatic and palaeoceanographic developments along the coast of Norway have suggested that the toolkit used by the Early Mesolithic hunter–gatherers remained unaffected throughout the whole period. The settlement pattern, however, changed from being almost exclusively connected to the outer coastal zone in the first half of the Early Mesolithic, to being relatively more related to the mainland coast and sheltered coastal locations during the second half (Breivik 2014; Breivik et al. 2017). It thus seems that generalized toolkits and flexible mobility systems were ways of coping with the changing environment. In this chapter, I explore if *site type* was also an active variable of their adaptive strategy within this period.

Several studies of sites on the Norwegian west coast point to a reorganization of site types and mobility patterns in the course of the *Mesolithic* period (Bang-Andersen 2003; Bergsvik 1991, 1995; Olsen 1992; Bjerck 1990, 2007, 2008a). A loose organization with small field camps and high mobility in the Early Mesolithic phase and a more sedentary lifestyle with larger residential bases in the Late Mesolithic are emphasized. The large archaeological projects

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around the Oslo fjord during the last decade point to similar trajectories. Here, more than 20 sites from the Middle Mesolithic have been detected and excavated, shedding light on a period that, until recently, was poorly investigated. These sites indicate a settlement system that was still quite mobile, but increasingly connected to certain places and landscapes (Solheim 2017). The changes in Mesolithic site organization patterns are suggested to be a result of the stabilization of marine resources, such as fish in the tidal channels (e.g. Bergsvik 1991, 1995; Bjerck 2008h). They may thus express alterations in the subsistence strategy that can be partly connected to environmental changes.

As outlined above, climatic fluctuations and a gradual stabilization of the marine environment seemed to occur already midway through the Early Mesolithic. In light of these results and hypotheses, I take a closer look at the Early Mesolithic coastal sites of central Norway: Does the present material reflect changes in site types parallel with the changing environment?

The forager-collector continuum and Early Mesolithic hunter–gatherers site types

The Early Mesolithic hunter–gatherers of Norway are commonly characterized as small groups with high mobility focused on marine resources. The archaeological record generally holds sites with similar signatures and a standard lithic tool inventory (e.g. Bjerck 2008h; Nærøy 2017). However, temporal differences have been detected in the material: In his studies of Early Mesolithic sites on the west coast, A.J. Nærøy (2000:69) finds that sites that predate c. 9500 uncal BP (i.e. 8800 cal BC) are similar in size, while they are more heterogeneous in the later phase. T.A. Waraas (2001:104–110) finds that sites from the late Early Mesolithic period tend to be larger in size and more abundant in lithic artefacts, than the earlier sites. Whether this is related to changes in the climate and environment is not thoroughly discussed in the cited publications. The purpose of this study is to explore site variation in light of the chronology of environmental changes, and an appropriate starting point is L. Binford's forager–collector continuum.

Binford (e.g. 1980, 2001) has shown how site structure (including size, organization, features and artefacts) can relate to environmental factors. By combining ethnographic and environmental data, he finds that the climate and availability of food resources dictate the choice of mobility and subsistence strategies, and that different strategies produce different site types.

According to Binford (1980), a group that has a purely residential mobility system ('foragers') – where the whole social unit moves from one resource area to another, staying on one site for only a short period of time – produces *residential bases*, as well as smaller *locations*. The *residential base* is 'the hub of subsistence activities, the locus out of which foraging parties originate and where most processing, manufacturing, and maintenance activities take place'. The *location* is 'a place where extractive tasks are exclusively carried out. […] only limited quantities [of foods or other raw materials] are procured there during any one episode, and therefore the site is occupied for only a very short period of time. [...] few if any tools may be expected to remain at such places' (Binford 1980:9).

A group that has a logistical mobility system ('collectors') – where the social unit is stationed at a certain location for a longer period of time, and smaller task groups bring specific resources back to the site – produces *residential bases*, *locations*, *field camps*, *stations* and *caches* (Binford 1980:10). The *field camp* is a temporary operational centre where a task group sleeps, eats and maintains itself while away from the residential base (Binford 1980:10). *Stations* are described as sites where task groups are localized when engaged in information gathering, while *caches* are temporary storages (Binford 1980:12).

Although the Early Mesolithic sites of Norway are quite uniform, they differ somewhat in terms of size, features and artefact composition. To my knowledge, the records show neither evidence of caches, nor long-term residential camps with permanent dwelling structures, a diversity of features and distinguished activity areas – site types that come with a logistical mobility system. Rather, we find sites that can be placed within the categories of short-term residential bases, field camps and locations. In Norwegian studies, these site types have also been referred to as base camps, secondary sites and activity sites or pit stops (Indrelid 1973; Bjerck 1990), and the Early Mesolithic hunter–gatherers are defined as foragers with purely residential mobility (e.g. Bjerck 2008h) or foragers with occasional logistical mobility (e.g. Bergsvik 1991, 1995; Olsen 1992; Bang-Andersen 2003; Breivik et al. 2016).

Several studies have sought to find archaeological parameters that articulate site variation. J. Chatters (1987) has reviewed a range of publications in order to define archaeological measures that relate to Binford's site types. Similar characterizations are made by S. Indrelid (1973) and H. Bjerck (1990). In this chapter, a customized version based on these studies will be applied (see below; Table 6.1).

Material and methods

Studying variations in site types

Referring to the discussion above, this analysis include the following site types: residential camps, field camps and locations. The factors used to distinguish between the different site types will be presented in the following, and their characteristics are systematized in Table 6.1.

Artefacts and tools: Looking broadly to the activities conducted, Binford's site types can be divided into *general-purpose* sites and *special purpose* sites. The general-purpose sites are the residential bases, where the whole social group is gathered for a longer or shorter period of time, and where a wide range of everyday tasks take place. This will manifest as a varied artefact assemblage with a wide range of tools, and lithic debitage from raw material procurement, manufacture, use, maintenance and discarded objects. On special purpose sites (field camps and locations), the narrower range of activities will generate low tool

Table 6.1 Definition of site types and archaeological measures used to classify sites in the study (based on Binford 1980; Indrelid 1973; Bjerck 1990)

Site type	***Residential base (Binford 1980)*** Base camp (Indrelid 1973; Bjerck 1990) *General-purpose site*	***Field camp (Binford 1980)*** Secondary camp (Indrelid 1973; Bjerck 1990) *Special purpose site*	***Location (Binford 1980)*** Activity site/pit stops (Indrelid 1973; Bjerck 1990) *Special purpose site*
Definition	The hub of subsistence activities, the locus out of which foraging parties originate and where most processing, manufacturing and maintenance activities take place	A temporary operational centre for a task group. It is where a task group sleeps, eats and otherwise maintains itself while away from the residential base	A place where extractive tasks are carried out. Generally 'low bulk' procurement sites
Duration of stay	Short/shorter than the residential bases of 'collectors' Is often revisited	Short May be revisited	Very short Usually revisited
Artefacts and tools	High tool diversity within the site Very high amount of production debris Artefacts from all steps of the production chain	Low tool diversity within the site Lower amount of primary production debris than residential camps Production, use, maintenance and discard of specialized tools	Few if any tools left on the site Low amount of artefacts/production debris Use, maintenance and discard of specialized tools
Size, layout and features	Large/quite large Low feature diversity within the site	Smaller than residential bases Low feature diversity within the site; fireplaces but no traces of permanent dwelling structures	Site area is very limited No features or traces of permanent constructions

diversity, and probably a higher share of tools in relation to debris (Chatters 1987:342; Bjerck 1990).

Another aspect is tool function. Among the lithic components, projectiles (tanged points and microliths) are most certainly connected to hunting activities. Also, unused blades may be related to the production of projectiles (e.g. Damlien 2016). Knives are cutting tools, perhaps used for butchering (e.g. Bjerck 1990), while scrapers, burins and borers are often associated with maintenance activities (e.g. Bølviken et al. 1982). Use-wear analysis has shown that Early Mesolithic adzes have filled different purposes including scraping, cutting, sawing and chopping (Solheim et al. 2018). This also goes for the informal tool category (flakes or blades with retouch and/or use-wear), which has been used for scraping, cutting, shaving, incision and boring (Nærøy 2000).

The tool inventory should be indicative of the site type. In the present analysis, the total artefact assemblages from each site are analyzed and organized into tool classes and according to the steps in an operational chain (see Eriksen 2000).

Size, layout and features: According to Chatters' review (1987:341–342), the size and layout may vary according to the number of residents and the activities carried out on the site. While general-purpose sites (residential bases) would be comparable in terms of size and layout, special purpose sites (field camps and locations) vary in layout and size according to their function.

Also, the duration of stay and the reuse of occupation areas are factors that influence site structure. The more time spent on a site, the more labour invested in the habitation. Thus, the residential bases are likely to exhibit a higher degree of camp organization in terms of dwelling structures and other features than do the field camps and locations (Chatters 1987:348).

In the analysis, the size of each site as expressed by the distribution of lithics ('site area') will be recorded. Also, the number of denser lithic concentrations will be investigated, as well as the presence of dwelling structures and fireplaces on each site.

The reoccupation of sites does, however, also have implications for site formation processes and the archaeological interpretation of the site: Archaeological palimpsests made up of multiple, short occupation events may resemble the signature of a residential base with continuous occupation over a longer period (e.g. Bergsvik 1991:36; Nærøy 2000:90–100). The presence of a wide variety of different flint qualities, observations of several lithic concentrations situated close to and/or partly on top of each other, or lithic concentrations clearly separated vertically or stratigraphically, are regularly understood as several occupation events. Most sites are not excavated and documented in a way that enables isolated analyses of different occupation events. Yet, in the present analysis, such observations will be used as an opening to discuss site use and occupation intensity.

The analyses of the above factors will be followed by a collated assessment of each site, informed by the respective archaeological reports, with the purpose of classifying the sites in terms of type, size and function. Finally, the results will be sorted chronologically and discussed in relation to the environmental and climatic changes occurring within the Early Mesolithic time span.

The Early Mesolithic sites on the coast of central Norway

Central Norway (Møre og Romsdal and Trøndelag counties, Figure 6.1) is a region with many Early Mesolithic sites. The majority of the c. 300 sites are situated on the outer coast; either on islands and peninsulas or on the mainland, but oriented towards the archipelago (Breivik & Bjerck 2018). Out of the list of 50 archaeologically investigated sites in the region, several criteria were considered when selecting comparable and representative objects for this study:

Geographic area and topographical setting: Although Early Mesolithic sites in Norway seem to share a list of characteristics, some regional variations are detected in the use of features, raw material and lithic reduction techniques (e.g. Hauglid 1993; Damlien 2016; Fretheim 2017). To include sites from a large geographical area in the present analysis would risk misinterpreting regional variations as diachronic developments. The same goes for the topographical situation: There seems to be differences in artefact composition between Early Mesolithic mountain and coastal sites – probably related to raw material accessibility and site function (Breivik & Callanan 2016). It is therefore important to compare sites that are located within a reasonably confined area and with comparable landscape settings.

Properly excavated and documented sites: A diachronic study that explores site layout and artefact composition is dependent on good excavation records.

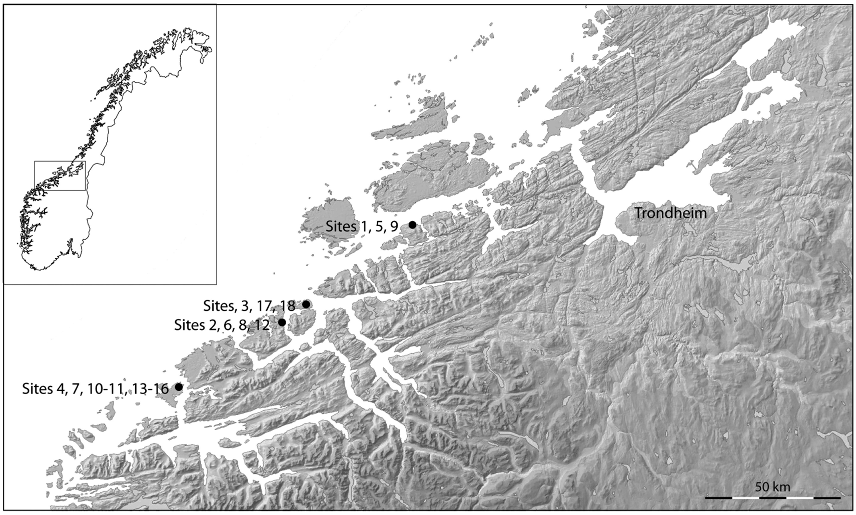

Figure 6.1 The geographic area and sites included in the study. Illustration: H.M. Breivik; based on map from www.kartverket.no.

The selected sites should be more or less fully excavated, and be comparable in terms of excavation method and documentation standards. The sites in this study are excavated using mechanical excavators to remove the topsoil, and proceed with manual excavation in square meters, removing layers of 5–10 cm in thickness at a time.

Reliable age determination: In order to place the sites under study chronologically, reliable age determination is essential. Only a few of the Early Mesolithic sites in the region are radiocarbon dated. The remaining sites may be dated by their elevation according to the present sea level, provided that accurate georeferences and altitude measurements are recorded. Sea-level dating is, however, potentially problematic as it only gives a maximum date for the site. The general assumption is that the coastal sites of the Early Mesolithic were positioned a few meters above the contemporary shoreline. Studies that have addressed this issue systematically by comparing radiocarbon dates and shore displacement curves from the same site, find that the models are quite reliable for the region under study (see Åstveit 2018). Yet, similar studies from northern Norway suggest that the sites must have been located 2–6 m from the contemporary shoreline (Blankholm 2008:5, with further ref.). Thus, by subtracting a span of 2–6 m of the measured m a.s.l., it can be assumed that we get a sea-level date that is likely to cover the actual occupation period (see Table 6.2). For my study area, a span of 2–6 m usually gives a discrepancy of 100–200 uncal BP years on generated shore displacement curves. This is actually more precise than some of the radiocarbon dates, and is at present the best for which we can hope.

Undisturbed context: A comparison of site types calls for clean contexts. Sites that were not significantly disturbed by post-depositional factors or reoccupations in later phases were thus preferred when selecting cases for the analysis. There are no certain ways to detect later disturbances in the material, and reoccupations or scavenging for material when the site was exposed would certainly have occurred. Nevertheless, sites with radiocarbon dates or tool types that indicated occupations in later chronological periods, as well as sites with more recent disturbances (e.g. erosion, ditching, ploughing, construction work) that obviously affected the layout or artefact distribution were eliminated from the study.

In the light of these requirements, 18 sites from Aukra, Aure, Averøy and Kristiansund municipalities in Møre og Romsdal County were selected (Figure 6.1, Table 6.2). This is a low number of sites, taking into account the 1500 years period they cover. As it turns out, however, the material clusters around three time slices that are convenient for the present diachronic study: Four sites can be dated to 9400–9200 cal BC (sites 1–4), seven sites can be dated to 9100–8800 BC (sites 5–11) and seven sites can be dated to 8800–8500 cal BC (sites 12–18; Figure 6.2). These time slices relate quite nicely to the environmental trajectory outlined in the introduction, with the cold PBO kicking in from 9300–9200 cal BC, and the change to a milder climate, less influenced by ice and melting water from c. 8800 cal BC. Despite the source-critical factors discussed above, it should be possible to detect diachronic trends with the material at hand.

Table 6.2 Information on the sites included in the analysis

Site name	*m a.s.l.*	*Excavated area (m²)*		*Radiocarbon dates*		*Sea-level date (m a.s.l. 2–6 m) (uncal BP)*	*Probable date (cal BC)*	*Year of excavation*	*Reference*
		By machine	*Manually*	*Uncal BP*	*cal BC*				
1. Seterbekken 3 Aure municipality	60	90	23			c. 9800–9900	c. 9300–9400	1995	Berglund (2001)
2. Hestvikholmane 2-2012 Averøy municipality	39–40	651	37			c. 9800–9900	c. 9300–9400	2012	Brede (2012)
3. Kvernberget Site 20 Kristiansund municipality	40–42		25			c. 9800–9900	c. 9300–9400	2007	Strøm and Breivik (2008)
4. Ormen Lange Site 51 Aukra municipality	22	900	109			c. 9800–9900	c. 9300	2003–2004	Bjerck (2008c)
5. Kalvheiane 5 Aure municipality	52		32			c. 9600–9700	c. 9000–9100	1993–1994	Berglund (2001)
6. Hestvikholmane Site 3 Averøy municipality	31–33		25			c. 9600–9700	c. 9000–9100	2006	Wammer (2006)
7. Ormen Lange Site 62 øvre Aukra municipality	17	450	30			c. 9500–9600	c. 8900–9000	2003–2004	Bjerck (2008d)
8. Hestvikholmane Site 2 Averøy municipality	30	715	25			c. 9500–9600	c. 8900–9000	2006	Fretheim (2007)
9. Kalvheiane 2a & b Aure municipality	44–50		157			c. 9400–9600	c. 8800–9000	1992–1994	Berglund (2001)
10. Ormen Lange Site 48 Aukra municipality	19–21	1962	572	9075 ± 50–9695 ± 95	c. 8500–9100*	c. 9400–9600	c. 8800–9000	2003–2004	Bjerck (2008b)
11. Ormen Lange Site 72 Aukra municipality	18.5	995	54	9480 ± 110; 9380 ± 70; 9480 ± 125	c. 9100–8600	c. 9400–9600	c. 8800–9000	2003–2004	Bjerck (2008e)
12. Hestvikholmane Site 6 Averøy municipality	27	81	26			c. 9400–9500	c. 8600–8900	2006	Sauvage (2007a)

13. Ormen Lange Site 73, Trench 1 Aukra municipality	15–17	1536	21			c. 9400–9500	c. 8700–8900	2003–2004	Bjerck (2008f)
14. Ormen Lange Site 73, Trench 2 Aukra municipality	14–15		3			c. 9400–9500	c. 8600–8800	2003–2004	Bjerck (2008f)
15. Ormen Lange Site 76B Aukra municipality	14–16	2461	7	9415 ± 65	c. 8800–8600	c. 9400-9500	c. 8600–8800	2003–2004	Bjerck (2008g)
16. Ormen Lange Site 76 Aukra municipality	14–16		50	9440 ± 70; 9155 ± 65	c. 8800–8300	c. 9400–9500	c. 8600–8800	2003–2004	Bjerck (2008g)
17. Kvernberget Site 1 Kristiansund municipality	35, 5–41	1468	363	9220 ± 55	c. 8600–8300	c. 9400–9800	c. 8600	2007	Fretheim (2008)
18. Kvennbergmyra Kristiansund municipality	30	413	17	9395 ± 50; 9320 ± 55	c. 8800–8300	c. 9300–9400	c. 8500-8600	2007	Sauvage (2007b)

The radiocarbon dates are calibrated in Oxcal. The sea-level dates are estimated subtracting a span of 2–6 m to cover the most likely occupation period.
*For Ormen Lange Site 48, the most reliable radiocarbon dates are presented.

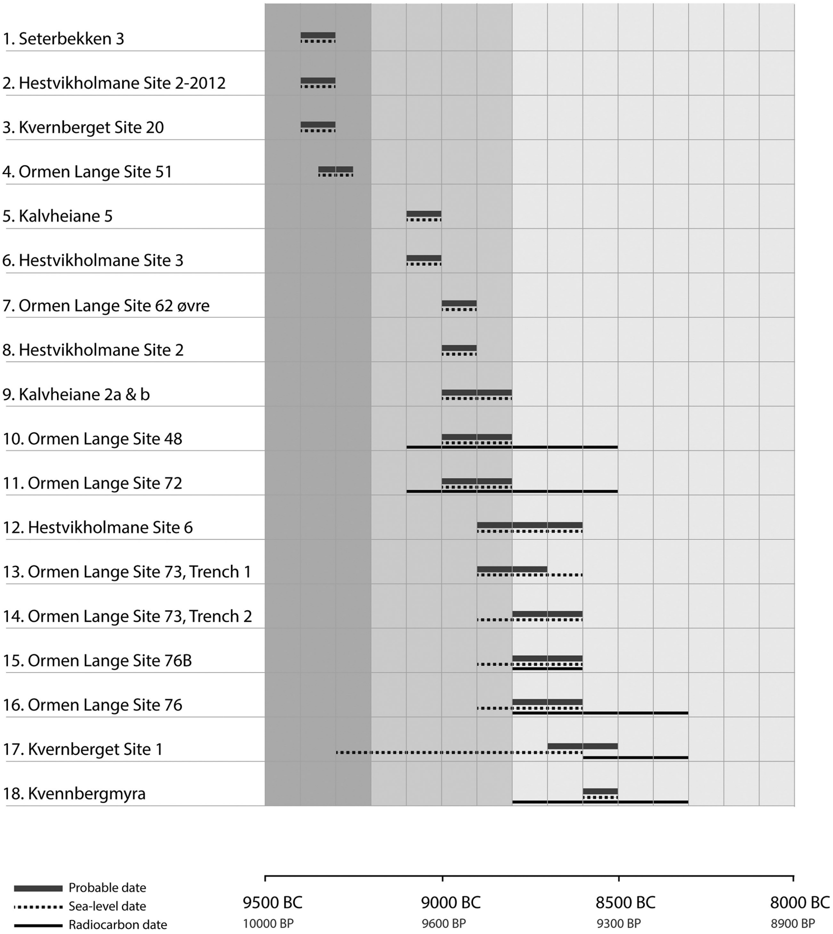

Figure 6.2 The time span of the sites in the study (indicated by thick black bars). Most sites are dated by sea-level only (the span indicated by dashed lines). For the sites with radiocarbon dates (the span indicated by thin black lines) the most likely dating span, when taking m a.s.l. into consideration, is marked (indicated by the grey bars). Illustration: H.M. Breivik.

Analysis

Artefacts and tools

There are very large differences in the total artefact number between the sites (Table 6.3). The assemblages range from under 200 to over 90 000. The earliest sites (sites 1–4) are mostly at the lower end of the scale, while the two largest sites are dated to 9000–8800 cal BC (sites 9 and 10). The three smallest assemblages in this study (sites 12, 15 and 18) are dated to the time span 8800–8500 cal BC.

Table 6.3 The tool categories present on each site in the study

Site name	*Artefact total*	*Tool total*	*Tools*							
			Projectiles	*Adzes*	*Knives*	*Scrapers*	*Burins*	*Høgnipen*	*Borers*	*Informal tools*
				9400–9200 cal BC						
1. Seterbekken 3	1061	23	8	1						14
2. Hestvikholmane 2-2012	3591	22	5							17
3. Kvernberget Site 20	753	15	4				1	2		8
4. Ormen Lange Site 51	1481	64	1	5	2					56
				9100–8800 cal BC						
5. Kalvheiane 5	10,380	205	8	2	3	23	9		7	153
6. Hestvikholmane Site 3	3958	18	1	1				2		14
7. Ormen Lange Site 62 øvre	5026	68	18		4	1				45
8. Hestvikholmane Site 2	1660	14	3							11
9. Kalvheiane 2a & b	92,568	773	229	9	4	3	1	11	4	512
10. Ormen Lange Site 48	71,462	967	290	54	15	22	32			554
11. Ormen Lange Site 72	2258	25	12	1						12
				8800–8500 cal BC						
12. Hestvikholmane Site 6	246	5	1						2	2
13. Ormen Lange Site 73, Trench 1	1734	27	4	1		2	2			18
14. Ormen Lange Site 73, Trench 2	346	2		2						
15. Ormen Lange Site 76B	193	8	2	1						5
16. Ormen Lange Site 76	1089	12		2			1			9
17. Kvernberget Site 1	15,428	336	57	8	10	1	1		2	257
18. Kvennbergmyra	327	5	1							4

Projectiles include single-edged points and microliths of different types; *adzes* include flake adzes and core adzes; *knives* include flake knives and blade knives; *scrapers* include flake scrapers and blade scrapers of different types; *burins* include all variants made on flakes, blades and cores; *Høgnipen* points are also known as drill-bits; *borers* are made on both flakes and blades; *informal tools* include flakes and blades with use-wear and/or retouch.

If we break up the tool assemblages, we see that the earliest sites exhibit a restricted set of tools. Even on Site 2 (Hestvikholmane 2-2012), with nearly 3600 artefacts, projectiles are the only formal tool category. However, more likely than being related to a chronological pattern, the tool repertoire seems to be connected to the assemblage size. The sites that contain only one (sites 2, 8 and 18) or two (sites 1, 11, 15 and 16) formal tool classes tend to be the smaller ones, while the very largest sites in the study have a more varied tool composition.

Table 6.4 illustrates the different artefact categories as sorted by the successive steps in an operational chain (see Eriksen 2000). All sites in the study hold the categories primary production debris, cores, blades and tools. A majority of the sites lack traces of maintenance and repair of tools. The sites with the largest assemblages of lithics contain artefacts from all steps in the operational chain, but otherwise there does not seem to be a direct relation between the number of artefacts and the categories present.

Looking chronologically at the relation between the different artefact categories in Figure 6.3, there is a tendency towards a higher percentage of tools (2–4%) in the oldest and youngest sites in the study, when compared to the sites dated to the 9100–8800 cal BC time span (around 1% tools). Secondary production debris is generally low in the oldest sites, while three of four sites have evidence of the use and repair of tools. Among the younger sites in the study, only one (site 17) holds artefacts that can be related to the maintenance and repair of tools.

Size, layout and features

Based on the data in Table 6.5, the sites can be divided into three different size categories: *small sized* (10–20 m^2); *medium sized* (30–100 m^2); and *large* (250 m^2 and up). According to the present record, no large sites have been found among the earliest ones – they seem to appear at a later stage.

The earliest sites are also characterized by one distinct concentration of artefacts; however, it must be emphasized that the number of lithic concentrations seems to increase with the size of the site. Also traces of fireplaces appear to be related to site size rather than age. Dwellings are found on small, medium and large sites, but there is a propensity towards a higher frequency on the larger sites.

A collated assessment of the sites

The earliest sites, 9400–9200 cal BC:

1. Seterbekken 3: During the excavation, the site appeared as scattered lithics with a denser concentration of artefacts in an area of 3–4 m^2. The concentration was associated with a fireplace, structured by large, fire-cracked rocks placed in a circle (Berglund 2001).

Table 6.4 The presence of different artefact categories on each site, sorted into the different steps in an operational chain (based on Eriksen 2000:80–82)

Site name	*N=*	*Step 0: Procurement of raw material*	*Step 1: Preparation*	*Step 2: Basic production*		*Step 3: Modification*	*Step 4: Use*	*Step 5: Discard*
		Raw material	*Primary production*	*Cores*	*Blades*	*Secondary production*	*Repair*	*Tools*
			9400–9200 cal BC					
1. Seterbekken 3	1061	53	947	9	28		1	23
2. Hestvikholmane 2-2012	3591	15	3493	44	9	8		22
3. Kvernberget Site 20	753		719	8	10		1	15
4. Ormen Lange Site 51	1481		1260	58	96	1	2	64
			9100–8800 cal BC					
5. Kalvheiane 5	10,380	5	9838	45	284	3		205
6. Hestvikholmane Site 3	3958		3862	18	45	15		18
7. Ormen Lange Site 62 øvre	5026	1	4817	38	96	6		68
8. Hestvikholmane Site 2	1660	1	1607	18	12	8		14
9. Kalvheiane 2a & b	92,568	63	88,634	167	2647	255	29	773
10. Ormen Lange Site 48	71,462	17	67,285	638	2234	174	147	967
11. Ormen Lange Site 72	2258	6	2154	12	21	38	2	25
			8800–8500 cal BC					
12. Hestvikholmane Site 6	246		230	3	7	1		5
13. Ormen Lange Site 73, Trench 1	1734	2	1687	6	10	2		27
14. Ormen Lange Site 73, Trench 2	346		339			5		2
15. Ormen Lange Site 76B	193		161	6	11	7		8
16. Ormen Lange Site 76	1089	17	1025	4	24	7		12
17. Kvernberget Site 1	15,428	21	14,488	157	398	19	9	336
18. Kvennbergmyra	327		307	6	9			5

Raw material includes pebbles and core preparations; *primary production debris* includes flakes, bladelike flakes, cortex blades and crested blades; *cores* include all types, fragments, platform rejuvenation and face rejuvenation; *blades* include all sizes, complete and fragmented, hinged and notched; *tools* include formal and informal types; *secondary production debris* includes micro burins, adze preparation flakes and burin spalls; *repair* includes edge rejuvenation and tip rejuvenation flakes.

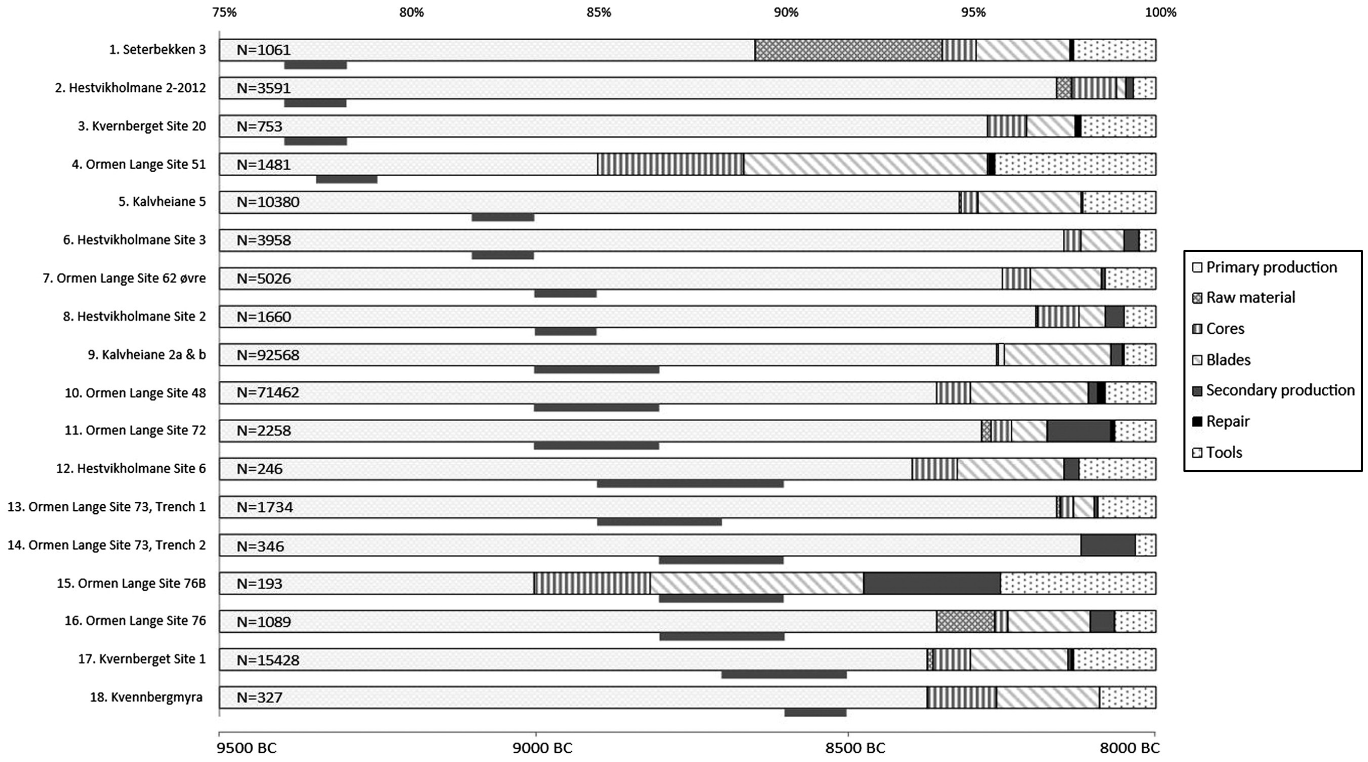

Figure 6.3 The relation between the different artefact categories on the 18 sites in the study. The sites are organized chronologically starting with the earliest at the top and the youngest at the bottom – the dating span is marked by the grey bar under each site (see Figure 6.2). N is the total number of artefacts in the assemblage. Illustration: H.M. Breivik.

Table 6.5 Site sizes and layout as expressed by lithic concentrations and traces of dwellings and fireplaces

Site name	*Site area (m²)*	*Fireplaces*	*Dwellings*
	9400–9200 cal BC		
1. Seterbekken 3	c. 10	1	
2. Hestvikholmane 2-2012	c. 45	0–2	1
3. Kvernberget Site 20	c. 20	1	1
4. Ormen Lange Site 51	c. 100		
	9100–8800 cal BC		
5. Kalvheiane 5	c. 35	0–3	
6. Hestvikholmane Site 3	c. 40	0–1	1–2
7. Ormen Lange Site 62 øvre	c. 30		
8. Hestvikholmane Site 2	c. 10	1	1
9. Kalvheiane 2a & b	c. 3750	4–9	2
10. Ormen Lange Site 48	c. 570	13–23	2–6
11. Ormen Lange Site 72	c. 250	2	2
	8800–8500 cal BC		
12. Hestvikholmane Site 6	10–15	1	1
13. Ormen Lange Site 73, Trench 1	50–75		
14. Ormen Lange Site 73, Trench 2	c. 4		
15. Ormen Lange Site 76B	c. 10	1	
16. Ormen Lange Site 76	c. 25	2	
17. Kvernberget Site 1	c. 500	3–6	1–2
18. Kvennbergmyra	c. 10	1	

From the present analysis, it is evident that raw material procurement, as well as the production, use and maintenance of tools, has taken place. The lithic assemblage contains a narrow tool repertoire with its flake adze, projectiles and small amount of informal tools. However, the number of projectile points (8) is actually quite high, compared to similar sites in the study. According to Table 6.1, it is reasonable to interpret the site as a small *field camp* where the preparation of hunting tools and perhaps the butchering of prey took place.

2. Hestvikholmane 2-2012: The site appeared as an area of c. 45 m² packed with stones and artefacts. A circular area of 9–10 m², which was cleared of stones, held a denser lithic concentration. This was interpreted as traces of a tent or temporary dwelling. Two small deposition points within the living space, containing small flint fragments, secondary production debris, blades and projectiles, were interpreted as knapping areas. Close to the living space, two areas with heat-fragmented flint were suggested to be traces of fireplaces. Based on the tool repertoire (projectiles), the site was interpreted as a hunting station. Because the site had several deposition points and activity areas, as well as considerable investment in the dwelling, it was thought to be visited two or more times (Brede 2012).

The present analysis shows that projectiles are the only formal tool category (5). However, there is debris from adze production, and a relatively large amount of informal tools, suggesting a site function comparable to Seterbekken 3 above. It is therefore classified as a medium-sized *field camp*.

3. Kvernberget Site 20: The excavation uncovered a small site with a more concentrated artefact deposition of c. 7 m^2. The concentration partly coincided with a ring of stones interpreted as traces of a tent with an internal fireplace. The site was thought to represent one short-term stay (Strøm & Breivik 2008).

The present analysis shows a narrow selection of tools that include four projectiles, two Høgnipen points and a burin, in addition to informal types. The cores and blades point to the production of at least preforms, and use and maintenance of tools have been carried out. According to the archaeological criteria presented in Table 6.1, it is classified as a small *field camp*.

4. Ormen Lange Site 51: The site appeared as an activity area of c. 100 m^2, with a denser concentration of lithics at the centre of the artefact distribution. No distinct features were detected. An axe dated to the Early Neolithic period was recovered from the fringes of the activity area, but there were no other clear indications of later use of the site (Bjerck 2008c).

The present analysis shows that the assemblage holds a relatively high share of tools – mostly informal, but adzes, knives and a projectile are present. All steps in the operation chain (from primary production to repair and discard) have been conducted on the site. It seems reasonable to place it in the general-purpose site category – a medium-sized *residential base*.

Sites from 9100 to 8800 cal BC:

5. Kalvheiane 5: The uncovered area of 32 m^2 was seen as more or less coinciding with Early Mesolithic occupation. An area of c. 8 m^2 contained a denser concentration of artefacts. The excavation team observed a decrease in the number of artefacts per quadrant in mechanical layer IV, before an increase in layers V–VI. This was interpreted as reuse of the site at least once. Flake adzes were recovered from both levels, suggesting that the reoccupation took place within the Early Mesolithic time span – and most likely within the suggested period 9000–9100 cal BC. No traces of dwelling structures were detected, but three smaller stone circles were interpreted as possible fireplaces (Berglund 2001).

In the present analysis, the site is placed in the medium-size category. The site contains a relatively high number of artefacts (>10 000), and the assemblage exhibits a wide range of tools and artefacts that reflect the gathering and testing of raw materials, the production of tools and blanks (blades), as well as the use and discard of formal tools. The site must be interpreted as a medium-sized *residential base* that was visited several times.

6. Hestvikholmane Site 3: The site appeared as lithics scattered over an area of c. 40 m^2. As the excavation proceeded, a dense concentration of artefacts (7–8 m^2) was recovered centrally on the site. A ring of tent stones with an internal fireplace lay a few meters away from the artefact concentration. Artefacts were also found in a layer beneath the tent stones, suggesting an earlier occupation event. A second, more dubious feature was interpreted as a possible ring of tent stones. Additionally, a small collection of adze preparation flakes and other lithic debris recovered within the site seemed to denote a production area (Wammer 2006).

The present analysis shows that the lithic assemblage of almost 4000 artefacts holds a restricted tool repertoire: two Høgnipen points, a fragment of a flake adze and a microlith, in addition to some informal tools. The site also has a very low tool ratio compared to other sites in this study. The artefact composition points to production and maintenance activities, and the tent rings and the two occupation layers indicate investment and repeated use of the site. Based on this, the site is interpreted as a medium-sized *residential base*.

7. Ormen Lange Site 62 Øvre: The site was part of a large Stone Age settlement area, estimated to be c. 950 m^2. The Early Mesolithic component was excavated in an area of 33 m^2, which more or less coincided with the activity area. A denser concentration of artefacts (2–3 m^2) was detected centrally on the site. No features were recovered but the restricted distribution of artefacts may indicate that a tent was erected on the site (Bjerck 2008d).

In the present study, the site belongs to the medium size category, but with quite a high number of artefacts (>5000). The assemblage contains all the steps in the operational chain from production and use, to repair and discard. In the published report, the site was interpreted as a delineated activity area where tool production was conducted. Referring to the measures in Table 6.1, it is placed in the *field camp* category.

8. Hestvikholmane Site 2: The artefact concentration on this small site was clearly defined, and coincided with a ring of stones thought to be traces of a tent. Two denser deposition points within the lithic concentration were interpreted as individual knapping sequences. An internal fireplace, situated near what was believed to be the tent wall, was also recovered (Fretheim 2007).

In the excavation report, the site was presented as a single visit, where tool production was kept within the tent. In the present analysis, the site is among the smallest, and three projectile points are the only formal tool category. It may be compared with Sites 1 and 2 above, and should be classified as a *field camp*.

9. Kalvheiane 2a & b: In the part of the site named Kalvheiane 2a, an area of 77 m^2 was excavated. Within the site, three denser artefact concentrations were detected – one large of c. 25 m^2 and two smaller of 4–5 m^2. A stone circle, measuring c. 6 m in diameter, was recovered in connection with the largest artefact concentration. The structure had a floor of even-sized stones, and was interpreted as traces of a dwelling – probably a tent. Up to four possible fireplaces were detected on the site. Almost 40 000 artefacts were collected, but it was not possible to differ between several occupation events (Berglund 2001).

On Kalvheiane 2b, an area of 80 m^2 was excavated. The 50 000 artefacts recovered were distributed vertically all the way down to mechanical layers 5 and 6. Three denser concentrations were detected within an area of c. 20 m^2 – each measuring 5–6 m^2. A circular feature of c. 3 m in diameter, with two internal fireplaces, was interpreted as the traces of a tent. Up to three additional fireplaces were recovered on the site (Berglund 2001).

The distance between the excavated areas was c. 60 m, but positive test pits indicated a coherent activity area. From the artefact inventory, presented in this study, the site appears as a large *residential base* of dimensions and layout that may be comparable to Ormen Lange Site 48 (see below). It is likely that this site too has been visited several times by small groups within a residential mobility system.

10. Ormen Lange Site 48: The site covered an area of over 500 m^2. Within the excavated area, 18 artefact concentrations measuring 7–27 m^2 were identified, each containing one or two denser deposition points. Most of the concentrations were associated with central fireplaces. Six tent rings were also recovered, but four were of a more dubious character. In the published report, it was emphasized that the 18 assemblages contained more or less the same repertoire of tools and debris, and the site complex was interpreted as a location that was visited repeatedly by small groups within a limited period in the Early Mesolithic (Bjerck 2008b). The present study supports a classification as a large *residential base*.

11. Ormen Lange Site 72: The site consisted of two artefact concentrations of 15–20 m^2 situated approximately 15 m from each other. Together, the settlement area covered c. 250 m^2. The concentrations were comparable with the units detected on the nearby Ormen Lange Site 48 (see above), with denser deposition points measuring 6–7 m^2. Each of the artefact concentrations was associated with traces of a fireplace and a tent floor – areas of 6–8 m^2 packed with even-sized stones. Also, the artefact composition was comparable to the Ormen Lange Site 48, and the site was interpreted as a *residential base* used at the same time as Site 48 (Bjerck 2008e). The present study supports the classification.

The later sites, 8800–8500 cal BC:

12. Hestvikholmane Site 6: The site appeared as a limited area with a small lithic accumulation. A denser artefact concentration of c. 9–10 m^2 was recovered within the area. The distribution coincided with an area cleared of stones suggestive of a tent floor. A nearby concentration of charcoal and smaller stones was interpreted as a fireplace (Sauvage 2007a).

In the present analysis, the site is categorized as small, and it holds a very low number of artefacts (246 in total). The tool inventory consists of two borers and a projectile, and the site probably represents a single visit, perhaps just an overnight pit stop. It is thus classified as a small *location*.

13. Ormen Lange Site 73, Trench 1: The main excavation area held a loosely structured artefact concentration, with two or three denser deposits. Due to the undefined character of the lithic distribution, it was suggested that the location was used more than once (Bjerck 2008f). Two flake adzes and production debris were found 15 m away from the deposits (see Site 14 below).

From the present analysis, we see that the tool repertoire is quite varied, and holds forms that are associated with maintenance activities (adzes, scrapers and burins) as well as hunting activities (projectiles). Both the production and discard of tools have taken place on the site. The site has a very high amount of primary production debris, and it seems reasonable to interpret the site as a medium-sized *residential base*.

14. Ormen Lange Site 73, Trench 2: Two flake adzes were found 15 m away from the artefact concentration of the previous site. A trench of 3 m^2 was opened around the artefacts, exposing production debris with the same flint quality as the adzes. The site was interpreted as an episodic event, probably related to another larger site in the vicinity (Bjerck 2008f). It is categorized as a small *location* in the present analysis.

15. Ormen Lange Site 76B: This site was situated beneath a beach ridge that was deposited during the Tapes transgression c. 8000–6000 cal BC. The excavation revealed an artefact distribution within a defined area of c. 10 m^2. The lithics were centred on a fireplace (Bjerck 2008g).

In the present analysis, the site has relatively high amounts of cores, blades, secondary production debris and tools, in comparison with other sites. However, the low total rate of artefacts (193) makes the assemblage vulnerable for these kinds of analysis; the tool category is, for instance, represented by only two projectiles, one adze and five informal tools. According to the excavation report, the site had an episodic character, and it seems reasonable to interpret it as a short pit stop where gearing up was the main task. In light of this, the site is classified as a small *location*.

16. Ormen Lange Site 76: The main activity area on this site was visible as an artefact concentration of c. 10 m^2 that held three smaller lithic deposits. Two of the deposits had associated fireplaces. A fourth lithic deposition was discovered in the nearby squares, and it was suggested that this represents a second unit of c. 12 m^2 (Bjerck 2008g). Considering this, the site measures at least 25 m^2 and is characterized as a medium-sized site in the present study.

The site was interpreted as one short-term occupation in the published report, and a large part of the artefacts was related to the production of flakes from one core (Bjerck 2008g). The present analysis of artefact composition shows that it has a narrow range of tools: two adzes and a burin, in addition to a few informal forms. It is therefore classified as a *field camp*.

17. Kvernberget Site 1: The site appeared as artefacts scattered over an area of c. 500 m^2. During the excavation, five denser concentrations of lithics were recovered. The largest concentration (c. 20 m^2) had one or two associated fireplaces, where one of them seemed to have been used more than once. The concentration was interpreted as a living space, maybe traces of a tent. Of interest is also the dwelling structure, measuring 3 × 3.5 m and distinguished by a cultural layer consisting of artefacts, decomposed organic material and eroded pebbles. A fireplace, probably used several times, was situated near the wall. The feature was related to one of the artefact concentrations (Fretheim 2008).

In the present analysis, the site is comparable with Ormen Lange 48 and Kalvheiane 2a & b, as all steps in the operational chain are present, and the tool inventory is varied. The site seems to represent several visits, and the dwelling remains and cultural layer suggest that some of the occupation events were probably longer than what was common for other Early Mesolithic sites. The signature of the inventory and site puts it in the *residential base* category.

18. Kvennbergmyra: The site appeared as a small, confined distribution of relatively few artefacts (327). A denser lithic concentration of c. 9–10 m^2 was connected to a fireplace. The fireplace was distinguished by heat-fragmented stones and sooty sediments. The site was interpreted as an episodic event, where up to four knapping sequences were performed (Sauvage 2007b).

The artefact analysis in the present study shows that a microlith is the only formal tool found on the site. Additionally, four informal types are registered.

The overall impression of the assemblage is that primary production has taken place, and that blanks and tools have been taken away from the camp and used elsewhere. It is reasonable to interpret it as a short pit stop where gearing up and maintenance took place, and may be classified as a small *location*.

Diachronic trends among Early Mesolithic site types?

In the analysis, three types of sites were identified: residential bases, which vary in size according to the number of times they had been visited; small and medium-sized field camps where a narrow range of activities had taken place; and very smallest pit stops or locations (Table 6.6).

Table 6.6 Classification of sites in the study in terms of size, site type, reuse of the sites and number of lithic concentrations

Site name	*Size category*	*Site type*	*Reuse of site*	*Lithic concentrations*
		9400–9200 cal BC		
1. Seterbekken 3	Small	Field camp	No	1
2. Hestvikholmane 2-2012	Medium	Field camp	Yes	1
3. Kvernberget Site 20	Small	Field camp	No	1
4. Ormen Lange Site 51	Medium	Residential base		1
		9100–8800 cal BC		
5. Kalvheiane 5	Medium	Residential base	Yes	1
6. Hestvikholmane Site 3	Medium	Residential base	Yes	1
7. Ormen Lange Site 62 øvre	Medium	Field camp		1
8. Hestvikholmane Site 2	Small	Field camp		1
9. Kalvheiane 2a & b	Large	Residential base	Yes	6
10. Ormen Lange Site 48	Large	Residential base	Yes	18
11. Ormen Lange Site 72	Large	Residential base		2
		8800–8500 cal BC		
12. Hestvikholmane Site 6	Small	Location	No	1
13. Ormen Lange Site 73, Trench 1	Small	Residential base	Yes	3–4
14. Ormen Lange Site 73, Trench 2	Small	Location	No	1
15. Ormen Lange Site 76B	Small	Location	No	1
16. Ormen Lange Site 76	Medium	Field camp	No	2
17. Kvernberget Site 1	Large	Residential base	Yes	5
18. Kvennbergmyra	Small	Location	No	1

From a diachronic perspective, there are several interesting things to point out. In the earliest phase (9400–9200 cal BC), the predominant site category is the *field camp*. Here, we find small and medium-sized sites that contain one lithic concentration, a low amount of artefacts and a restricted repertoire of tools. Sites 1–3 are interpreted as short-term occupations where a narrow set of activities were carried out. Site 4 is larger, and is interpreted as a residential base, although the tool repertoire is quite limited here as well.

In the time span 9100–8800 cal BC, the predominant site category is the *residential base*. Here, we find the largest sites in the study, both in terms of size and artefact assemblage. With the artefact abundance follows a varied tool repertoire, but the share of tools in relation to debris is very low. Most of the sites contain traces of fireplaces and dwellings. Three of the largest site complexes in the study (sites 9–11) are dated to the same 200-year period (9000–8800 cal BC). They are all interpreted as residential bases, and it is likely that small, mobile groups returned frequently over a period of time. Although smaller in size, Sites 5 and 6 also seem to have been visited several times, and it is likely that they are residential bases comparable with the units on the larger sites.

The youngest sites (8800–8500 cal BC) are varied in size, layout and artefact composition. The four smallest sites (sites 12, 14, 15 and 18) in the study belong to this phase, and they are interpreted as small, random pit stops – *locations* – where gearing-up sessions took place. There are also, however, larger and more complex sites. Site 17, in particular, includes an unusual dwelling structure that may speak of longer occupation, yet it is not comparable with the later Mesolithic sites with thick cultural layers that have accumulated over a longer period of use.

In the introduction to this chapter, an environmental trajectory for Early Mesolithic Norway was outlined: A cold pulse (the PBO), identified by readvancing ice sheets and retreating forests, occurred c. 9300–9200 cal BC. Several studies suggest that although the Preboreal oscillation may have had a negative impact on the terrestrial resources, this climatic event could actually have enhanced the marine productivity along the Norwegian coast (Breivik 2016). A skeleton of a bearded seal, found in the Trondheimsfjord and dated to this phase (Rosvold & Breivik 2018), verifies that Arctic marine species were present in this region. Arctic seals have been emphasized as a prime motivator for the initial colonization of the Norwegian coast (e.g. Bjerck 2016, 2017). The small field camps dated to the early phase in this study speak of a settlement pattern where new locations were sought each time, and it is tempting to relate them to an economy that was based on targeting highly mobile pinnipeds.

Midway through the Early Mesolithic period, c. 8800 cal BC, the Norwegian Atlantic Current was established, bringing warmer water masses along the coast. The ice melted away, pushing the cold-tolerant fauna northwards and providing stable and liveable conditions for a new range of marine species. It is interesting that the large site complexes in this study appear in the period when the marine environment stabilized, and it seems likely that they represent predictable hunting places that were revisited several times. The change in the use of site types seems to occur parallel with an orientation towards more retracted locations along sheltered waters (see above), indicating that perhaps fish was on the diet (see e.g. Bergsvik 1991, 1995, 2001).

The site variation that we see in the final phase of the Early Mesolithic could be a further development, where the residential sites become central in a mobility pattern that to a larger degree includes special purpose sites.

The study points to a development from short visits where hunting activities and gearing up were the focus in the earliest part of the Early Mesolithic, to a more stable site pattern where residential bases were established near predictable food resources. This happens parallel with the environmental and climatic fluctuations, and it is likely that these trajectories are related. It also fits with theories of authors such as Bang-Andersen (e.g. 2003) about landscape learning and adaptations to a new resource situation in the stages of the pioneer colonization of the Norwegian coastal landscape.

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7 The Mesolithic coastal exploitation of western Scotland

The impacts of climate change and use of favoured locations

Steven Mithen, Karen Wicks and Inger Marie Berg-Hansen

Introduction

The Mesolithic period provides archaeologists with an opportunity to explore long-term processes of social and economic change, while also reconstructing the short-term activities of hunter-gatherers as they respond to their social and cultural environments. We address both time frames within this review of Mesolithic coastal exploitation in western Scotland. By collating 163 radiocarbon dates from 33 Mesolithic sites and analyzing these for activity events, we are able to monitor the variation in the intensity of activity between the Pleistocene/Holocene transition at c. 11 650 cal BP and the appearance of the Neolithic at c. 5800 cal BP. We attribute the majority of the variation to changes in population density arising from the impact of climate change. We then select a number of Mesolithic sites which had been especially favoured locations and explore the nature of the activities that were undertaken, and how these contributed to an overall pattern of coastal exploitation. To begin this review, we provide a brief introduction to the history of Mesolithic research in western Scotland, the character of the archaeological record and the methodology of activity event analysis.

History of Mesolithic research

Western Scotland stretches from the Isle of Lewis in the north to the Isle of Arran in the south. It has a heavily indented mainland coast and many islands known as the Hebrides. The landscapes and seascapes are diverse, ranging from high mountains to coastal plains, and from estuaries and sheltered bays to expanses of open water subject to westerly gales (Figure 7.1). There has been a long history of antiquarian and archaeological research concerning the Mesolithic within this region. Particularly important antiquarian studies are those undertaken by W. Galloway and S. Grieve on Oronsay between 1881 and 1884, and then by A. Henderson Bishop and M. Buchanan on the

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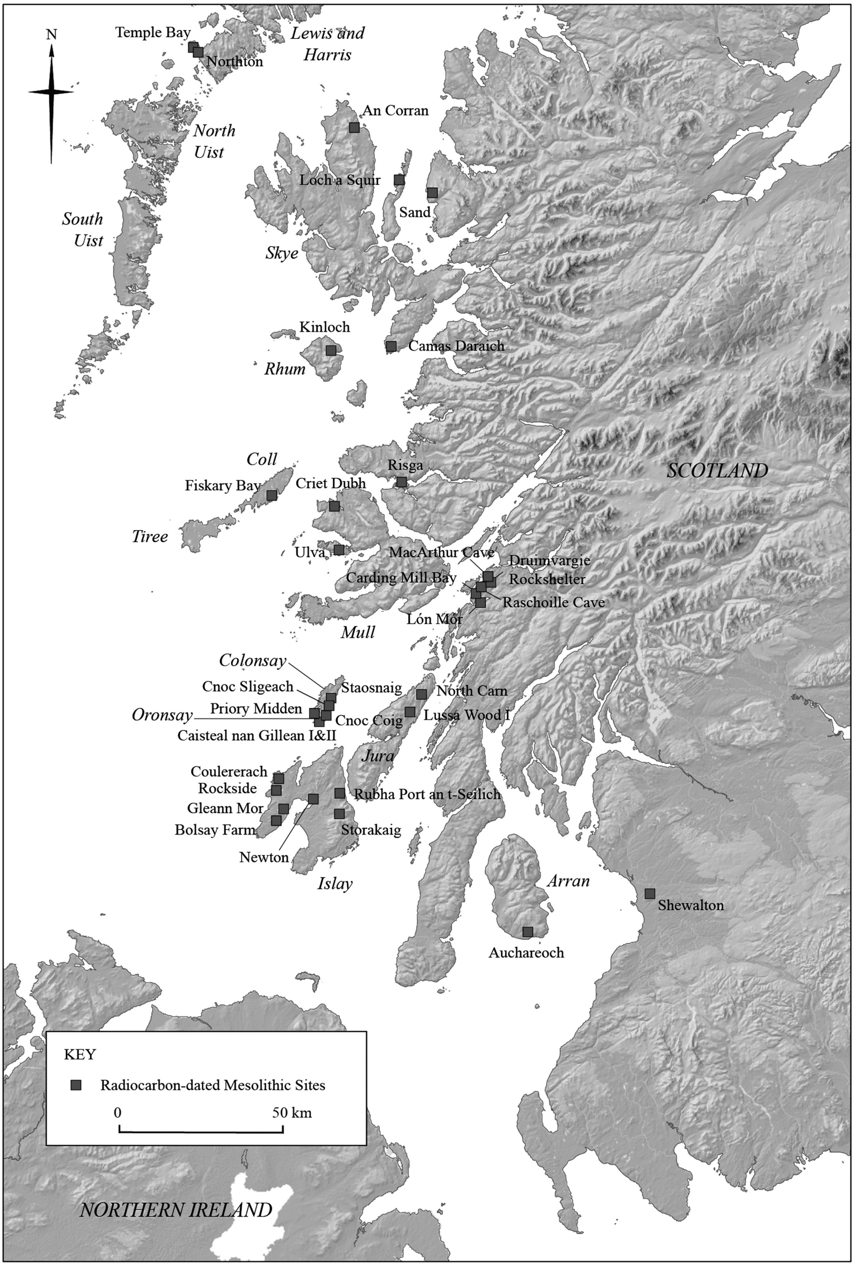

Figure 7.1 Western Scotland, with radiocarbon-dated Mesolithic sites.

same island between 1910 and 1913 (Mellars 1987:117–132). The end of the 19th century also saw the discovery of midden deposits in caves and rock shelters at Oban by Dr J. Anderson, notably in MacArthur Cave in 1894 and Druimvargie rock shelter in 1897 (Saville 2004). Visits were also made to the islands of Tiree and Coll by Henderson Bishop and Ludovic Mann at the start of the 20th century, resulting in collections that would now be designated as Mesolithic (Mann 1906; MacKie 1964).

J. de Vere Loder's (1935) book *Colonsay & Oronsay in the Isle of Argyll* was the most important publication between the wars, providing a concise description and insightful interpretation of the Oronsay shell middens while also collating evidence from Colonsay that he termed Azilian, this being prior to the adoption of 'Mesolithic' terminology. A.D. Lacaille's (1954) *Stone Age of Scotland* provided the first synthesis of the Mesolithic evidence from Scotland, marking the start of the modern era of Mesolithic research.

Western Scotland has now benefitted from a relatively substantial amount of Mesolithic research compared to other regions of the British Isles (excepting that around Star Carr), notably on the islands: Arran (e.g. Affleck et al. 1988); Jura (Mercer e.g. 1968, 1970a, 1970b, 1971, 1972, 1974, 1980); Oronsay (Mellars 1987); Islay (McCullagh 1989); Mull (Bonsall et al. 1991, 1992); Risga (Pollard 2000; Pollard et al. 1996); and Rùm (Wickham-Jones 1990). Between 1988 and 1998, *The Southern Hebrides Mesolithic Project* (SHMP) examined Mesolithic settlement on Islay and Colonsay (Mithen 2000). Between 2004 and 2014, S.J. Mithen and K. Wicks undertook a survey and excavations of Mesolithic sites on Coll (Wicks & Mithen 2018), Tiree (Mithen et al. 2007) and northwest Mull (Mithen & Wicks 2018). In 2010, they began further work on Islay (Wicks et al. 2013; Mithen et al. 2015), which remains ongoing at the time of writing.

The Mesolithic record

Organic remains are extremely rare in western Scotland, primarily because of its acidic peaty soils. As such, the Mesolithic record is dominated by scatters of chipped and coarse stone artefacts. Flint beach pebbles provided the principle raw material, these being used to create flake and blade cores with a technology and range of artefact types referred to as the Scottish Narrow Blade Industry, which is equivalent to the British Later Mesolithic (Saville 2004). Other types of stone were used in smaller quantities, notably quartz, chalcedony, mudstone and pitchstone.

Geometric microliths, notably scalene triangles, crescents and backed bladelets, predominate within the tool assemblages, accompanied by scrapers, notches and points. Broad blade microliths, such as obliquely blunted points, as found in the British Early Mesolithic (Reynier 2005), are known as occasional finds and are prominent within (undated) assemblages from Glenbatrick and Lussa Bay on Jura (Saville 2004). Because such finds remain undated, it has not been possible to establish whether broad blade microliths constitute a chronologically early phase of the Mesolithic in western Scotland, as they do in England. The new evidence from Rubha Port an t-Seilich, as discussed below, suggests this might be the case, along with the presence of Late Glacial activity in light of the blade technology present (Mithen et al. 2015).

Narrow blade assemblages with geometric microliths have now been dated to c. 10 400 cal BP from Cramond, in eastern Scotland – the earliest in Britain (Lawson 2001; Waddington 2015; Waddington et al. 2017). Their earliest unambiguous appearance in western Scotland is in c. 9000 cal BP at sites such as Rubha Port an t-Seilich on Islay and Fiskary on Coll (Mithen et al. 2015; Wicks & Mithen 2018). At the other end of the Mesolithic time period, the Obanian culture was once proposed as a distinct Late Mesolithic cultural phase, distinguished by shell middens, bevel-ended artefacts and bipolar technology (Bonsall 1996). However, these elements are now recognized as being present throughout the Mesolithic period and interpreted as reflecting responses to resource and raw material availability (Pirie et al. 2006; Wicks et al. 2013).

The chronological pattern of human activity

Although there are a large number of Mesolithic artefact scatters in western Scotland, only a small fraction of sites have radiocarbon dates (Figure 7.1). Wicks and Mithen (2014) made a statistical analysis of those available in 2012 (137 dates from 32 sites, taken from a pool of 227 dates, with 90 dates being rejected as invalid, to create a summed calibrated probability distribution (SCPD) as a proxy for the population density of the Mesolithic period. This revealed a pattern of population growth after 9500 cal BP, followed by a marked population collapse, attributed to the 8200 cal BP abrupt climate event. Since 2012, a further 26 validated radiocarbon dates and 1 additional dated site (Temple Bay, Isle of Harris, Figure 7.1) have become available (Bishop et al. 2012; Mithen & Wicks 2018) enabling an update of the SCPD/population-proxy (Figure 7.2). The new dates have served to accentuate the inferred pattern of gradual growth in the Mesolithic in the early postglacial, followed by a collapse at 8200 cal BP.

Using activity events to establish a chronological pattern

Another way of interpreting chronological data is to use the distribution of activity events assembled within a temporal frequency histogram (Figure 7.3). When multiple dates are available at any one site, they are often temporally separated and fall into statistically consistent clusters, indicating repeated visits to the same location, which may be separated by lengthy periods of time. We refer to each visit as an 'activity event' (Wicks & Mithen 2014). Hence, rather than seeking to date a 'Mesolithic settlement', we focus on dating sequences of 'activity events' at Mesolithic sites within the region. This recognizes that conventional archaeological terms such as 'settlement' are inappropriate when dealing with highly mobile hunter-gatherers.

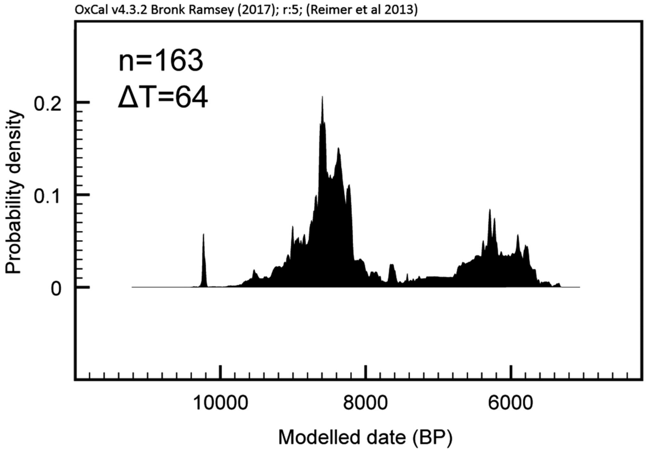

Figure 7.2 Population-size proxy for the Mesolithic of western Scotland (drawing on dates compiled in Bishop et al. [2012], Wicks and Mithen [2014] and Mithen and Wicks [2018]).

An activity event analysis of a Mesolithic site provides an estimate for the number of times the site was visited, otherwise known as the MNE – the minimum number of events. This is achieved by measuring the degree of statistical consistency among the radiocarbon determinations, the premise being that a tally of groups of statistically consistent dates plus individual statistically inconsistent dates provides a proxy for the MNE that would be necessary to account for the radiocarbon record. We used the Combine command from OxCal v. 4.2 radiocarbon plotting software (Bronk Ramsey 2009) to determine statistical consistency between radiocarbon dates coming from the same location, while the IntCal13 atmospheric and Marine13 curves (Reimer et al. 2013) were used for calibration in accordance with the material being dated. Full details of the radiocarbon analysis are provided in K. Wicks and S.J. Mithen (2014; Mithen & Wicks 2018).

The term 'event' is, of course, problematic because statistically consistent radiocarbon dates might still allow for a number of successive events occurring at any point in time bracketed within a calibrated date range, distributed either uniformly or randomly. While acknowledging this caveat, assessing the number of activity events is the radiocarbon equivalent of assessing the minimum number of individuals (MNI) required to account for an assemblage of animal bones at an archaeological site. Just as it is prudent to refer to the minimum number of individuals when cataloguing a faunal assemblage, it is equally prudent to refer to the MNE required to create the assemblage of radiocarbon dates – an event being either a single moment in time or a succession of moments that cannot be distinguished between by the radiocarbon dating evidence.

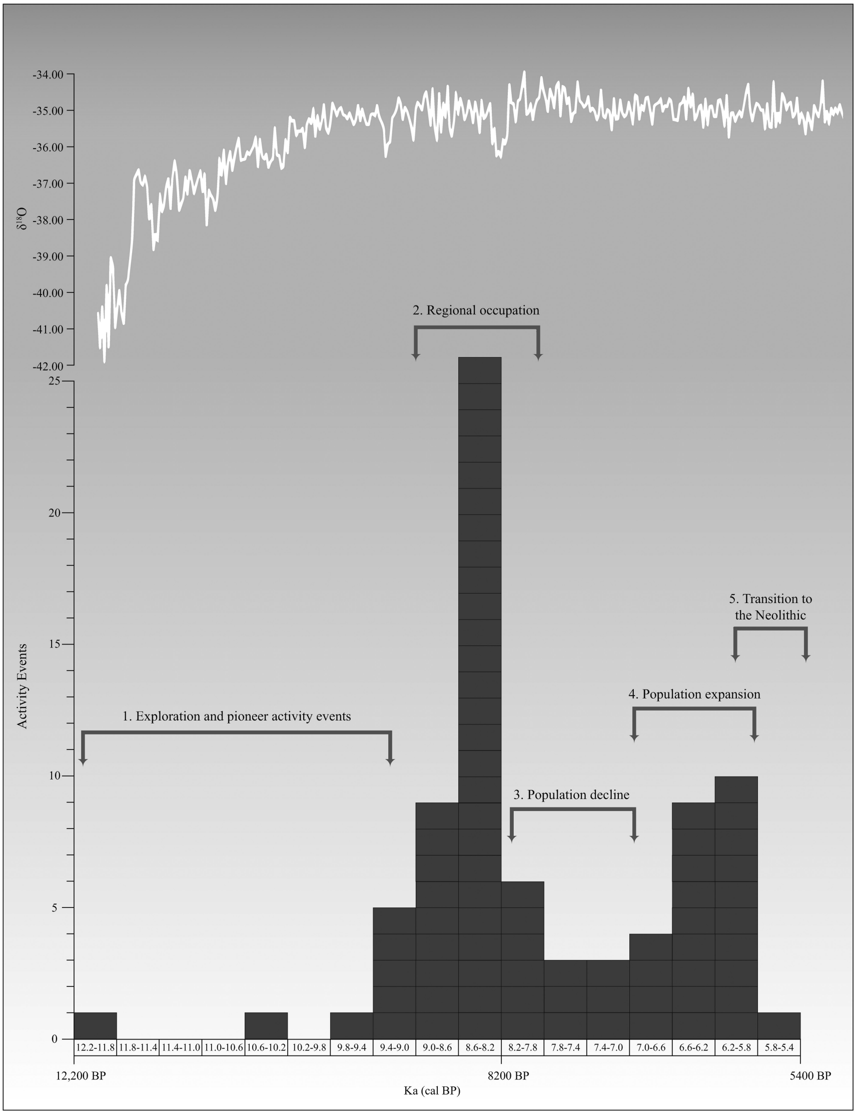

Figure 7.3 Histogram of dated Mesolithic activity events in western Scotland (drawing on Bishop et al. [2012], Wicks and Mithen [2014] and Mithen and Wicks [2018]).

As with calculating the MNI of a faunal assemblage, there might be a variety of reasons why an MNE underestimates the true number of activity events at an archaeological site: plateaus in the calibration curve might bias the distribution of dates; disparities between the actual duration of activity and the age of related dated material; the destruction of evidence of earlier events by later activity; excavation sampling strategies; human activities that fail to leave any archaeological traces containing material that can be radiocarbon dated.

When a site provides evidence for multiple activity events, this suggests the location was especially favoured by the Mesolithic hunter-gatherers. The reason for this is often intuitively evident: such sites tend to be sheltered locations, good for harbouring small boats, with access to fresh water, coastal foraging and terrestrial hunting. For the same reasons, such locations are often the scene of modern activity that can result in the accidental discovery of archaeological sites and hence potentially bias their distribution in the landscape. Similarly, such locations are often the most accessible for fieldwork, providing a further source of potential bias. Some control has been undertaken by test pitting in locations which are less amenable. On the Isle of Colonsay, for instance, the Mesolithic site of Staosnaig was discovered in a sheltered location on the east coast (Mithen et al. 2001). Test pitting was then undertaken at a similar topographic location on the more exposed west coast, failing to find any evidence of Mesolithic activity (Mithen 2000). While such absence might arise from the erosion of Mesolithic deposits at exposed localities, this was not the case on Colonsay where intact but culturally sterile sediments were found below thick deposits of peat.

Five phases of Mesolithic activity in western Scotland

Drawing on the activity event analysis undertaken by Wicks and Mithen (2014; Mithen & Wicks 2018) and the identification of a single event from the four new dates from Temple Bay (Bishop et al. 2012; df = 3, T = 1.791, 5% critical value = 7.815), Figure 7.3 plots the number of events occurring within defined time slices throughout the Mesolithic. This establishes the changing intensity of activity within western Scotland and shows how some sites were repeatedly visited. Five distinct phases of activity are apparent (Figure 7.3):

1. **Exploration and Pioneering Activity**. From at least 11 650 to 9500 cal BP, the earliest known activity event in the region comes from Rubha Port an t-Seilich, and is attributed to the Pleistocene/Holocene transition on the basis of tephra and artefact typology (Mithen et al. 2015). The earliest radiocarbon-dated activity event is at Criet Dubh, Isle of Mull, centred on 10 300 cal BP, represented by just two radiocarbon dates from a feature amid later Mesolithic activity; this is followed by activity at Kinloch on the Isle of Rùm, with an activity event centred on 9520 cal BP. Activity from 10 300 cal BP is attributed to the exploration of the region by people coming either from the south, perhaps moving north along the west coast of the British Isles, or from what is now the northeast coast of the British Isles, perhaps motivated by the inundation of the North Sea Basin (Waddington 2015). The latter is more likely in light of the earliest

dates for narrow blade technology coming from the northeast of Britain (Waddington et al. 2017).

2. **Regional Occupation**. After 9500 cal BP, there is a gradual and then a rapid increase in the number of dated Mesolithic activity events, appearing to reflect the establishment of regional occupation in the sense of a permanent presence of highly mobile hunter-gatherers within western Scotland. In this period, activity is found throughout the region, with favoured localities including Staosnaig (Isle of Colonsay), Criet Dubh (Isle of Mull), Fiskary (Isle of Coll) and Kinloch (Isle of Rùm). This is interpreted as population growth arising from the pioneer hunter-gatherers of the first phase of activity, and continuing migration into the region as the climate further ameliorated in the early postglacial.
3. **Population Decline**. After 8200 cal BP, there is a dramatic reduction in the extent of known activity within the region. Wicks and Mithen (2014) attributed this to the climatic and environmental impact of the 8200 cal BP event, reducing resource availability and increasing storminess and hence the risk of sea-borne travel. They suggest such environmental change caused increased mortality and decreased birth rates leading to a demographic decline, if not collapse, although people might have also abandoned the region. Some activity continued, notably on the Isle of Islay, at locations including Bolsay, Gleann Mor and Rubha Port an t-Seilich; also at Raschoillie Cave and MacArthur Cave on the mainland, and at Sand on the Isle of Rùm. Wicks and Mithen (2014) also discuss, and reject, the possibility that this decline in the number of known activity events might arise from post-depositional factors, such as an increase in the destruction or deep-burying of Mesolithic sites.
4. **Population Expansion**. After 7000 cal BP, the number of activity events increases again, suggesting demographic growth and/or recolonization. The emphasis now appears to be on the exploitation of coastal resources leading to the formation of shell middens, with notable activity on the tiny island of Oronsay, at the sites of Cnoc Coig, Caistael nan Gillean I and II, Priory Midden and Cnog Sligeach, at Ulva (Isle of Mull), An Corran (Isle of Skye) and Carding Mill Bay on the mainland.
5. **Mesolithic/Neolithic Transition**. After 5800 cal BP, sites with Mesolithic artefacts effectively disappear from the region. That approximately coincides with the appearance of the Neolithic, represented by burial monuments, sheep bones, ceramics, polished axes and leaf-shaped arrowheads. The relationship between the demise of the Mesolithic and the appearance of the Neolithic remains unclear: was there a population replacement with the extinction of the indigenous Mesolithic communities by exclusion from their resource base? Or was this a process of acculturation with the adoption of a new farming and herding lifestyle by the Mesolithic people from the spread of ideas? Or a mix of these processes? Recent publication of aDNA from Neolithic and Mesolithic remains in Britain indicates population replacement in the

Neolithic, with the only trace of possible inter-breeding coming from western Scotland (Brace 2019).

Favoured localities and activities

This record of activity events monitors the changing intensity of Mesolithic exploration of western Scotland across c. 5000 years between the Pleistocene/Holocene transition and the arrival of the Neolithic. It illustrates the impact of climate change in terms of early postglacial amelioration facilitating colonization and population growth, and then the negative impact of the 8200 cal BP abrupt climate event. Further insights into the Mesolithic lifestyle can be gained by considering the range of activities undertaken at specific locations. The following provides a summary of inferred activities from a selection of Mesolithic sites, ordered from north to south across the islands (Figure 7.1), with further details provided in the cited publications. With the exception of the Oronsay middens, these sites have been excavated by teams led by S.J. Mithen since 1987, with ongoing fieldwork at Rubha Port an t-Seilich, Isle of Islay. The same excavation, sampling methods and cataloguing were used by Mithen at all sites, notably bulk sieving through 3 mm meshes, and sieving selected samples through 4/2/1/0.5 mm meshes (as fully described in Mithen 2000). None of the sites has been excavated in their entirety and hence their spatial extent and the complete size and content of their cultural assemblages remain unknown. Although the radiocarbon dates and archaeological evidence indicate that each of these locations was visited on more than one occasion, the lack of substantial stratigraphy at all sites other than Rubha Port an t-Seilich means that it is not possible to identify the specific artefacts and other remains relating to each event. As such, it is not possible to identify how the activities at each location might have changed over time. Table 7.1 lists activity events from each of these locations, specifying the sets of statistically consistent dates and their median values.

Fiskary, Isle of Coll: a fishing camp

Fiskary Bay on the Isle of Coll has provided an ideal location in historic times for a fish trap: it has a narrow entrance across which there is a built wall and the bay becomes dry at low tide (Figure 7.4). Historical accounts of similar traps suggest the use of baskets to catch fish trapped on the landward side of the wall as the sea retreats. Although sea-level fluctuated during the Mesolithic period, the limit of these changes at the latitude of the Isle of Coll maintained this topography and the attraction of Fiskary as a locality for fishing. Mesolithic activity was identified in 2004 and explored via small-scale excavation in 2007 and 2008 (Wicks & Mithen 2018). This indicated a minimum of three visits to this locality, centred on 9070, 8520 and 8280 cal BP (Table 7.1, Figure 7.3), the first falling into the phase of 'Exploration and Pioneering Settlement' and the second and third in the phase of 'Regional Occupation' prior to the 8200 cal BP abrupt climate event.

Table 7.1 Activity events at locations discussed in this text, as defined by sets of statistically consistent radiocarbon dates. For the raw dates and individual calibrations see Wicks and Mithen (2014) and Mithen and Wicks (2018)

Site	*Activity event (cal BP)*	*Laboratory code*	*T*	*df*	*Critical value (5%)*
Fiskary Bay	8280	Beta-251111, Beta-251114	0.1	1	3.8
	8520	Beta-251109, Beta-251112	0.1	1	3.8
	9070	Beta-234855, Beta-251113	3.4	1	3.8
Criet Dubh	8580	Beta-221402, SUERC-58135, SUERC-58138, SUERC-58148, SUERC-58649, SUERC-58156, SUERC-58158, SUERC-58163, SUERC-58164, SUERC-58165	14.2	9	16.9
	8590	Beta-221402, SUERC-58134, SUERC-58135, SUERC-58138, SUERC-58147, SUERC-58148, SUERC-58156, SUERC-58158, SUERC-58159, SUERC-58163, SUERC-58164, SUERC-58165	14.4	11	19.7
	8710	Beta-288420, SUERC-58134, SUERC-58136, SUERC-58139, SUERC-58145, SUERC-58146, SUERC-58149, SUERC-58154, SUERC-58155, SUERC-58157	16.7	9	16.9
	8910	SUERC-58144, SUERC-58157	3.0	1	3.8
	9060	SUERC-58153			
	10 230	Beta-288421, SUERC-58137	0.0	1	3.8
Staosnaig	6230	AA-21629			
	7910	AA-21620			
	8270	AA-21626, AA-26227	0.5	1	3.8
	8500	AA-21619, AA-21621, AA-21622, AA-21623, AA-21625, Q-3278	5.0	5	11.1
	8590	AA-21619, AA-21621, AA-21624, AA-21625, Q-3278	7.3	4	9.5
	9060	AA-21627			
Cnoc Coig	6080	OxA-8014, OxA-8019	2.8	1	3.8
	6190	OxA-8004, OxA-8019	2.5	1	3.8
	6300	Q-1351, Q-1352, Q-1353, Q-1354, Q-3005, Q-3006	6.3	5	11.1
Coulererach	8340	OxA-4924			
Rubha Port an t-Seilich	7880	Beta-288425			

Table 7.1 Continued

Site	*Activity event (cal* BP*)*	*Laboratory code*	*T*	*df*	*Critical value (5%)*
	8370	Beta-288424	0.0	1	3.8
	8430	Beta-288428, Beta-363963, Beta-363965	1.0	2	6.0
	8490	Beta-288428, Beta-363964, Beta-363965	5.8	2	6.0
	8560	Beta-288423, Beta-363964, Beta-363965	5.8	2	6.0
	9200	Beta-288426, Beta-288427	0.0	1	3.8
Storakaig	5830	Beta-288430, Beta-307789, Beta-307790	5.5	2	6.0
	5810	Beta-288429, Beta-288431, Beta-307789, Beta-307790	1.8	3	7.8
	6080	Beta-264734, Beta-307788	2.4	1	3.8
	6320	Beta-307787			
Bolsay Farm	7650	AA-21633			
	8210	AA-21632, Q-3219	0.9	1	3.8

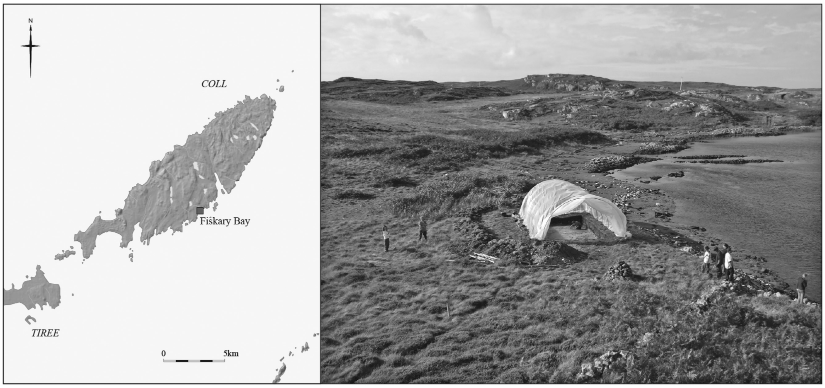

Figure 7.4 Location and excavation of Fiskary Bay, Isle of Coll, August 2007, showing the exposure of the beach deposit on which the Mesolithic fishing camp had been located, later sealed by a pebble beach deposited by the postglacial transgression at c. 6500 cal BP. Photograph: S.J. Mithen.

Although preservation was poor, the excavation recovered faunal remains from a diverse range of inshore fish including wrasse, whiting, saithe and pollock. There was no trace of other coastal resources such as shellfish and no faunal evidence from terrestrial mammals. While the former might reflect the limited extent of the excavation, it is unlikely that mammals such as deer and boar were ever present on Coll – the distance from the mainland being too far for them to swim. Other activities evident at Fiskary included the gathering and roasting of hazelnuts, along with the collection and burning of wood including birch, rowan, alder and aspen.

The chipped stone artefacts were almost entirely made from flint beach pebbles. These are rare on Coll today, and were most likely brought to the island as ready-prepared cores. This is supported by the low frequency of cortical flakes within the excavated assemblage and the small size to which cores were worked prior to discard. Other than the chipped stone artefacts, the only other tool recovered was the worked tip of an antler, probably from roe deer, which appears to have been used as an awl.

While the interpretation of Fiskary is constrained by the small area excavated, this locality appears to have been used as a fishing camp on multiple short-term visits to the island. Doing so would have required a sea crossing of several hours when using skin boats, which must have been a challenging and at times treacherous experience. Although the topography of Fiskary Bay was ideal for inshore fishing using traps, equivalent locations were readily available on the mainland coast. These also had the advantage of access to terrestrial game such as deer and wild boar. In this light, the repeated visits to the Isle of Coll cannot be explained on economic grounds alone: there must have been other motivations in the Mesolithic to make perilous sea crossings to small islands.

Criet Dubh, Isle of Mull: investing in a structure

Mesolithic huts and houses are rare in Britain. When found, they tend to be single structures on a site, although often with evidence of having been rebuilt or modified (Mithen & Wicks 2018). While several sites on the west coast of Scotland have postholes and pits, the only location where these are sufficiently numerous and patterned to suggest a Mesolithic hut is at Criet Dubh on the northwest coast of Mull (Figure 7.5). This site is located on the southwest side of an estuary known as Loch a'Chumhainn, in a particularly sheltered place

Figure 7.5 Location and excavation trench of Criet Dubh, Isle of Mull, July 2012, showing a series of truncated features likely representing a circular structure. Looking north towards the mouth of the Loch a'Chumhainn. Photograph: S.J. Mithen.

between two linear outcrops of bedrock. It was this natural shelter that led to the area being cultivated for potatoes in 2000 leading to the discovery of chipped stone.

Small-scale excavations were undertaken in 2006, 2010 and 2014. These exposed a cluster of more than 80 features primarily consisting of stake holes, postholes, pits and stone-lined fireplaces (Mithen & Wicks 2018). Because of recent cultivation, these features had been severely truncated, preventing their depth being measured, and hence the size of the posts they once held being estimated. Nevertheless, their patterning suggested a circular structure c. 6 m in diameter, with an entrance from the northeast, a palimpsest of overlapping hearths just within the interior and internal features, possibly racks (Figure 7.6).

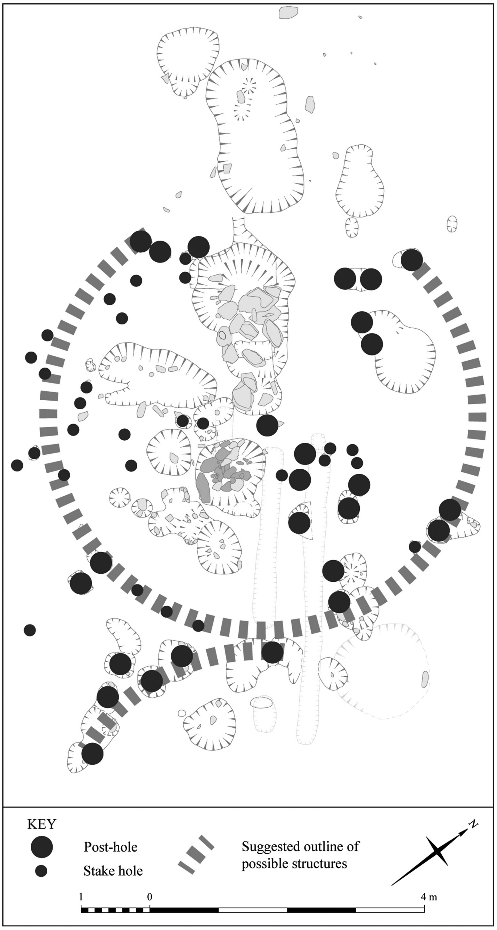

Figure 7.6 Plan of features and interpretation from Criet Dubh, Isle of Mull. *Source*: Prepared by S.J. Mithen and K. Wicks.

With regard to dating, this locality was visited on at least six occasions (Mithen & Wicks 2018; Table 7.1, Figure 7.3). The earliest activity event is centred on 10 230 cal BP within a 50-year period (at 95.4% confidence), falling in the phase of 'Exploration and Pioneering Activity'. This relates to two poorly preserved adjacent features. Hence, it is unknown whether a structure was constructed at this time. The site was repeatedly visited with events centred on 9060, 8910, 8710, 8590 and 8580 cal BP, all within the phase of 'Regional Occupation' prior to the 8200 cal BP event. Our interpretation is that the structure was renovated on each visit, leading to a palimpsest of features and inter-cutting hearths.We suspect the attraction of returning to this specific location might have been the fireplace and its associated social memories rather than the remnants if the structure itself that would have required renovation (Mithen 2019).

Preservation at Criet Dubh was poor, with no faunal remains. The site's estuarine location suggests fishing, access to terrestrial game and a diverse range of plant foods within the postglacial woodlands of Mull. In contrast to the majority of other Mesolithic sites in the region, coarse stone artefacts such as hammerstones and bevel-ended pebbles were entirely absent. The chipped stone assemblage indicates the use of beach pebble flint, with heavily reduced cores and limited signs of on-site knapping activity – flint pebbles are currently unknown on the beaches in the vicinity of Criet Dubh.

In summary, the Mesolithic activity at Criet Dubh remains difficult to interpret. Despite the location being naturally sheltered between rocky outcrops, a substantial structure was built. The locality was repeatedly visited, with the structure appearing to have been rebuilt and reused. Rather than providing shelter for people, the structure might have been a smokehouse for fish and meat, or perhaps a form of sweat lodge in light of the relatively narrow range of artefacts present (as fully discussed in Mithen & Wicks 2018).

Staosnaig, Isle of Colonsay: intensive harvesting of hazel woodland

Staosnaig on the Isle of Colonsay is similar to Fiskary by being located on a small island that would have required a lengthy sea crossing to reach by boat, navigating open and often stormy waters (Figure 7.7). Staosnaig is also similar to Fiskary in terms of being a coastal site within a sheltered bay, and by appearing to be a locality for one specific activity – in this case, the harvesting of hazel-dominated woodland for plant foods.

Traces of Mesolithic activity were first identified in 1989 (Mithen & Finlayson 1991), with excavation primarily undertaken in 1994 (Mithen et al. 2000a). Six features were located, the largest being a 4.5 m diameter circular shallow pit that contained more than 15 kg of charred hazelnut shell fragments, estimated to have come from between 30 000 and 40 000 hazelnuts (Mithen et al. 2001). This was interpreted as the remains of a small hut that was secondarily used for dumping waste. The surrounding features were smaller and of various shapes, some of which might have been ovens for roasting hazelnuts

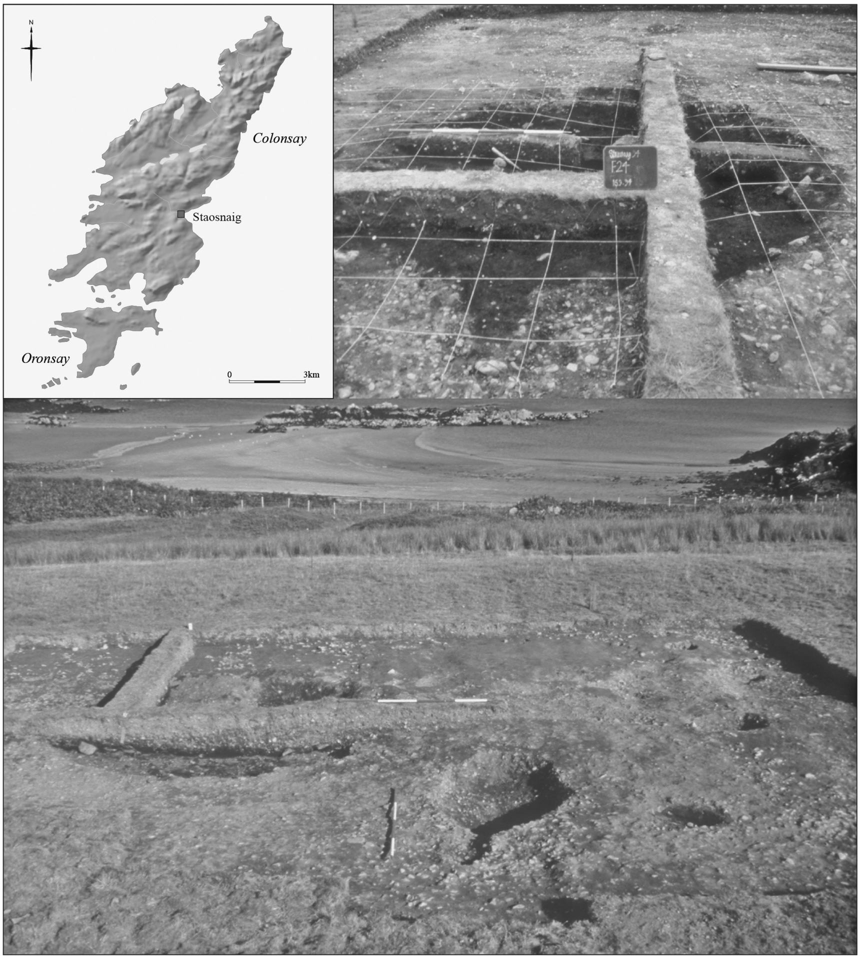

Figure 7.7 Location and photo excavation of Staosnaig, Isle of Colonsay, September 1994. Top shows the large shallow pit containing a dense mass of charred hazelnut shell fragments and other plant remains. Lower shows the suite of excavated features, looking east across the bay of Staosnaig. Photographs: S.J. Mithen.

and other plant foods. Experimental roasting indicates that between 12% and 25% of hazelnuts is routinely charred (Score & Mithen 2000). Had it just been charred waste discarded into the large pit, this would suggest that at least 300 000 hazelnuts had originally been roasted at Staosnaig. It seems more likely, however, that the shells from all roasted hazelnut – charred or otherwise – had been discarded into the large pit.

Why would this have been so? Why not just simply discard the hazelnut shells on the ground to be washed away into the sea or to be simply trampled into the ground? It seems unlikely that these hazel nuts/shells would have been required as a source of fuel because Colonsay would have been wooded through the Mesolithic, although wood charcoal was notably rare within the archaeological deposits. One possibility is that the hazelnut shells were burned to create a particular aroma for flavouring fish or game being smoked over the pit.

The remains of two other types of plant food were also recovered from the pit (Mithen et al. 2000a, 2001). The charred tubers and bulbils of Lesser Celandine (*Ranunculus ficaria*) were found at a much higher frequency than one would expect from accidental burning with hazelnut shells. Ethnographic accounts show that this plant has been used as both a food item and for medicinal purposes. Traces of crab apples (*Malus sylvestris*) were also recovered. Overall, it appears that hazelnuts, crab apples and potentially other plant foods that have left no trace, were systematically harvested from the Mesolithic woodlands surrounding Staosnaig.

The debris at Staosnaig had accumulated over the course of a millennium, although potentially in a small number of visits separated by long periods of absence. The radiocarbon dates indicate at least five visits to this locality, making use of the same pits for the discard of hazelnut shells, these possibly being deliberately burnt for the smoke, aroma and glowing embers they generate (Mithen 2019). These activity events were centred on 9060, 8590, 8500, 8270, 7910 and 6230 cal BP (Table 7.1, Figure 7.3), the first four within the phase of 'Regional Occupation', and the final two following the 8200 cal BP event, during the phases of 'Population Decline' and 'Population Expansion'. While the hazelnuts and crab apples suggest visits in the autumn, spring would have been the time to collect and process Lesser Celandine. It remains unclear whether there were additional types of activity at Staosnaig. Soil conditions prevented the preservation of faunal remains, should any have ever been deposited. Otters, seals and fish would have been available for exploitation from Staosniag, but there is no evidence that this occurred; it is unlikely that deer and wild boar were present on the island because of its distance from the mainland.

All features contained chipped stone artefacts primarily made from flint, while a range of coarse stone artefacts including hammerstones and elongated pebble tools were present. While the chipped stone assemblage was typical for the Scottish Mesolithic, backed blades dominated the microliths in contrast to scalene triangles as found elsewhere, notably at Bolsay (Mithen et al. 2000b). It is appealing to think that this might reflect different ranges of tools for different activities: those with backed blades for plant processing at Staosnaig, and those with scalene triangles for hunting weapons at Bolsay. As elsewhere, many of the cores had been heavily worked prior to discard. A cache of unworked pebbles placed within the large pit indicates the value placed on this raw material – perhaps they had been placed there for retrieval on a future visit. One further notable feature of Staosnaig is that while flint was dominant, there was also the presence of a wider range of raw materials than found at other sites, including quartz, rock crystal, siltstone, pitchstone and chalcedony. This might suggest people were travelling to Staosnaig from various locations for the woodland harvest, bringing some of their local raw materials.

Cnoc Coig and other shell middens, Isle of Oronsay: coastal foraging

The island of Oronsay is located at the southern tip of the island of Colonsay, to which it is connected at low tide. During the Mesolithic, it would have been no more than around 4 km^2 in area, with its size fluctuating as the sea level changed. Four Mesolithic shell middens were discovered and explored in the late 19th and early 20th centuries: Caisteal nan Gillean I & II, Cnoc Coig and Cnoc Sligeach (Figure 7.8). P. Mellars further sampled these in the 1970s, and undertook extensive excavation at Cnoc Coig. One further midden was discovered and sampled, named the Priory Midden (Mellars 1987). As a whole, these middens accumulated within the 7th millennium BP; any middens earlier than this date may have been destroyed by the postglacial marine transgression. The nature of the accumulation – whether from many

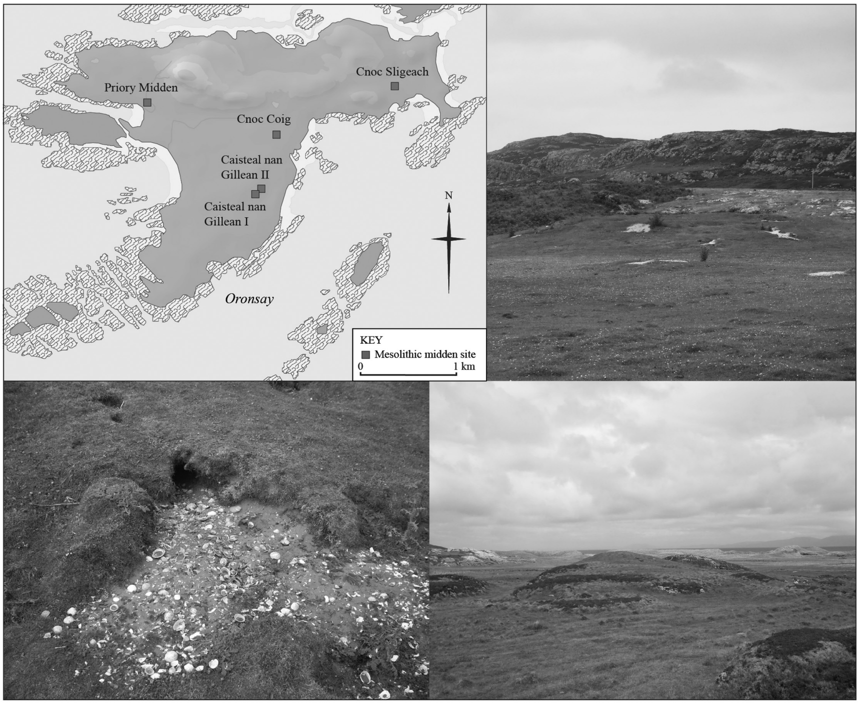

Figure 7.8 Location of the Oronsay middens. Top: the site of Cnoc Coig. Lower right: the midden of Cnoc Sligeach. Lower left: shells and other midden deposits eroding from a rabbit burrow dug into Cnoc Sligeach. Photographs: S.J. Mithen.

short-term periodic visits, regular seasonal or annual visits or from permanent settlement on Oronsay – remains debated (Mellars & Wilkinson 1980; Mellars 1987; Mithen & Finlayson 1991; Richards & Mellars 1998; Wicks et al. 2013).

The molluscan and faunal evidence indicates a diverse range of coastal foraging activities, notably fishing for saithe, hunting seals and otters, and collecting a wide range of shellfish and crustaceans (Mellars 2004). The remains of deer and wild boar are interpreted as deriving from either joints of meat or bone for raw material carried to Oronsay from the mainland or from the larger islands. This is because neither Oronsay nor Colonsay are likely to have supported their own populations of deer and boar. While described as middens, the evidence from Cnoc Coig suggests a substantial site with structures, fireplaces and floors – although such evidence remains unpublished. Radiocarbon evidence indicates activity events at 6300, 6190 and 6080 cal BP (Table 7.1, Figure 7.3), all during the period of 'Population Expansion' coming at the end of the Mesolithic period. It seems likely, however, that the evidence for earlier activity events has been destroyed by the postglacial rise in sea level across this very low-lying island. The chipped stone is very limited, primarily being small flint flakes coming from unprepared cores, with an entire absence of blades and microliths (Pirie et al. 2006). Bevel-ended pebble tools, bone points and antler harpoons were recovered.

P. Mellars and M.R. Wilkinson (1980; Mellars 1987) used seasonality inferences from fish otoliths to argue that all seasons of the year are represented within the middens: autumn at Cnoc Coig; mid-summer at Cnoc Sligeach; early summer at Caisteal nan Gillean II; winter at Priory Midden. They proposed that people were resident on the island all year round, moving between midden sites in different seasons. M.P. Richards and P. Mellars (1998) claimed support for this interpretation from isotopic evidence from human skeletal material that suggested an entirely marine diet. It has been challenged, however, on the basis of ecological unfeasibility and the presence of contemporary Mesolithic sites on Colonsay and Islay (Mithen & Finlayson 1991; Wicks et al. 2013).

While a gradual accumulation of midden deposits arising from many short-term visits to Oronsay is the most compelling interpretation, even this remains difficult to understand on entirely economic grounds. Island hopping from the mainland to Oronsay via Jura and Islay would still have involved crossing substantial stretches of open water with strong currents in (presumably) skin boats. It is difficult to find anything especially distinctive and valuable for Mesolithic coastal foragers on Oronsay that could not have been found at many other coastal locations in western Scotland that were easier and safer to access, including breeding seal colonies for which Oronsay is currently known.

Coulererach, Isle of Islay: raw material extraction

A key resource within the region was flint for the manufacture of stone artefacts. Although a variety of raw materials were used, including quartz, chalcedony, mudstone and pitchstone, flint was overwhelmingly the preferred raw material. It originated from cretaceous deposits, which are now below the Irish Sea, and was made available as beach pebbles. A survey of present-day beaches indicates restricted distribution to those on the west coast of the islands, with those on the Isle of Islay being especially rich. It is not surprising, therefore, that Mesolithic activity on the west coast of Islay at Coulererach indicates the collection and testing of flint pebbles, initial reduction and the removal of semi-prepared cores (Figure 7.9).

Activity at this location was identified in 1990 and examined by test pitting and trial trenching in 1993 (Mithen & Finlay 2000). The Mesolithic activity horizon was sealed below 2 m of peat and hence could only be sampled. This provided a distinctive flint assemblage with particularly large primary flakes and cores, contrasting strongly with the heavily reduced cores found at locations away from flint-rich beaches, such as at Rubha Port an t-Seilich, Criet Dubh and Fiskary. A further notable feature of the Coulererach assemblage is the presence of struck pebbles that were evidently flawed with inclusions, and some that display exceptionally poor knapping technique. This suggests the relative abundance of flint pebbles provided an opportunity for novice flint-knappers, perhaps children, to develop their skills by trial and error. The assemblage also had a relatively high frequency of finely manufactured blades indicating the presence of expert flint-knappers, suggesting the novices might have observed them at work if not received direct instruction (Mithen & Finlay 2000). Because of the restricted nature of the excavation, just one radiocarbon date was secured, which indicated an activity event centred on 8340 cal BP (Table 7.1, Figure 7.3), within the phase of 'Regional Occupation'. We strongly suspect, however, that Coulererach and other locations on the west

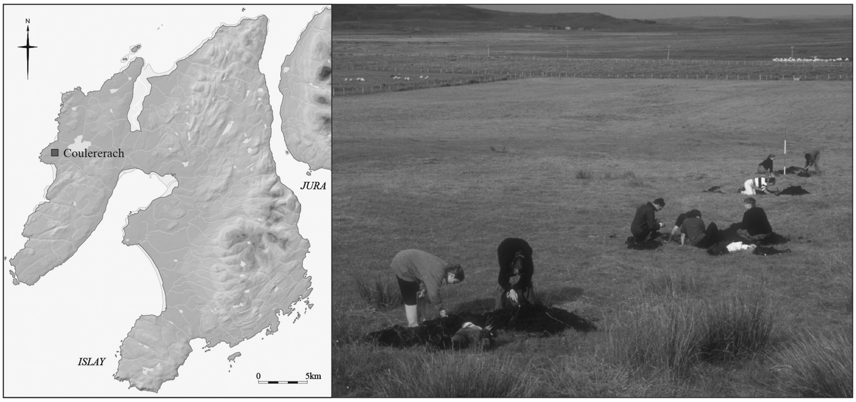

Figure 7.9 Location and survey of Coulererach, Isle of Islay, 1993, showing the excavating of test pits through deep peat deposits on the west coast of Islay, looking west. Photograph: S.J. Mithen.

coast of Islay were frequently visited to collect flint pebbles and undertake the initial stages of reduction.

Storakaig and Bolsay, Isle of Islay: terrestrial hunting

These are two inland locations on the Isle of Islay though neither is more than 5 km from the coast. They are both interpreted as hunting camps for the exploitation of terrestrial game, notably red and roe deer.

Bolsay is located at the base of a prominent summit in western Islay known (in Gaelic) as Beinn Tart a'Mhill, which translates as 'Stag Hill'. Excavations in 1990 and 1992 exposed a massive palimpsest of chipped stone artefacts (Figure 7.10) and the debitage from their manufacture, dominated by microliths and scattered pits and postholes, which lacked any patterning to suggest a past structure (Mithen et al. 2000b). This palimpsest of artefacts has been interpreted as arising from a multitude of repeated visits to a locality that has been favoured for hunting deer into the present day, most likely because of the particular topography. Radiocarbon dating is limited, but has indicated at least two activity events centred on 8210 and 7650 cal BP (Table 7.1, Figure 7.3) – although we are confident there would have been many more in light of the density of artefacts. During the Mesolithic, there was an extensive area of water and marshland close by, now known as Loch a'Bhogaidh (Edwards & Berridge 1995), which would have been suitable for fishing, fowling and hunting deer. Although faunal remains were not preserved at Bolsay, it is difficult to conceive of reasons other than hunting game for such repeat visits to a single inland location.

Storakaig is located in the east of Islay with extensive views along a wide valley where there is likely to have been movements of game (Figure 7.11).

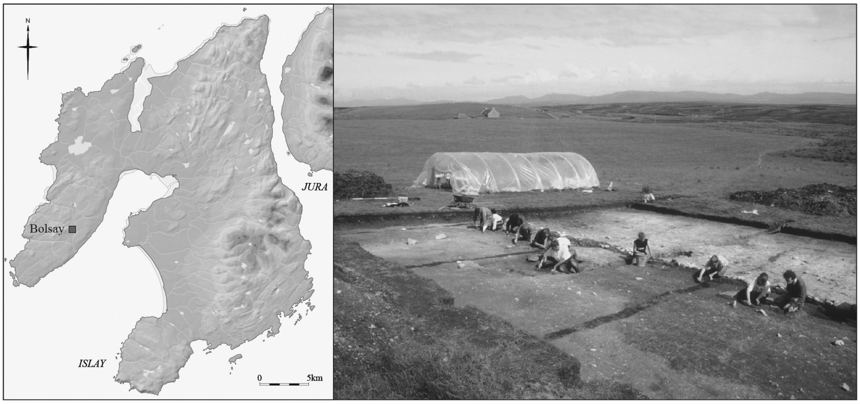

Figure 7.10 Location and photo excavation of Bolsay, Isle of Islay, August 1992, looking southwest. Photograph: S.J. Mithen.

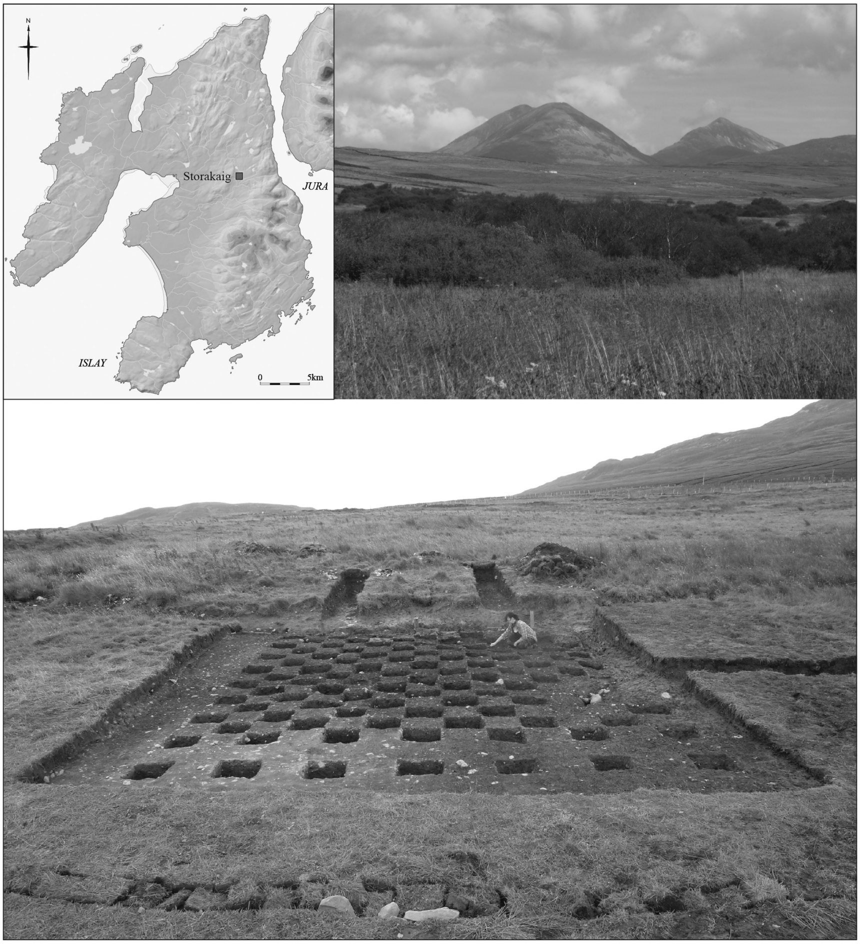

Figure 7.11 Location and excavation of Storakaig, Isle of Islay, 2010. Top: the location of Storakaig is marked by the white of the polytunnel, looking west with the Paps of the Isle of the Jura in the background. Lower: excavation of Mesolithic deposits. Photographs: S.J. Mithen.

Following discovery in 2009, excavations were undertaken in 2010 and 2011 (Wicks et al. 2013). This is a much smaller scatter of artefacts than at Bolsay, with no traces of features. It does, however, have faunal remains in the form of small bone fragments that had become calcined by being heated at high temperatures, within hearths. Analysis has identified the presence of red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), wild boar (*Sus scrofa*) and badger (*Meles meles*). Other species include a small dog (*Canis lupus familiaris*) or fox (*Vulpes vulpes*), a bird similar in size to shag (*Phalacrocorax carbo*) and small amphibians and/or a small mammal. Examination of the fine-sieving residues has identified limb bones from small rodents and fish teeth similar to the forms found on the pharyngeal plates of species such as Ballan wrasse (*Labrus bergylta*).

Eight radiocarbon dates from Storakaig indicate a minimum of four activity events centred on 6320, 6080, 5830 and 5810 cal BP (Table 7.1, Figure 7.3). These dates are some of the latest known for the Mesolithic, falling into the phases of 'Population Expansion' and 'Transition to the Neolithic'. Although the majority of the chipped stone from Storakaig is typical of the Scottish Mesolithic, some artefacts (less than 1%) have a Neolithic appearance. These are scattered within the otherwise Mesolithic assemblage and cannot be distinguished by their patination or condition.

Rubha Port an t-Seilich, Isle of Islay: a gateway site

Following the accidental discovery of Mesolithic artefacts by foraging pigs and the local gamekeeper in 2009, Rubha Port an t-Seilich (RPAS) was evaluated by test pitting in 2010 and a trial trench in 2013 (Mithen et al. 2015) (Figure 7.12). This initial work established RPAS as a particularly important Mesolithic site for western Scotland because of the diversity and abundance of its artefacts and a stratigraphic sequence indicating a significant change in chipped stone technology.

We currently understand the site to have two cultural horizons (Figure 7.13; Mithen et al. 2015). The upper horizon is attributed to the Mesolithic with radiocarbon dates identifying activity events centred on 9200, 8560, 8490, 8430, 8370 and 7880 cal BP, indicating an especially favoured location (Table 7.1, Figure 7.3). Tephra from immediately below the lower horizon has geochemical characteristics compatible with a Katla-type tephra, with the

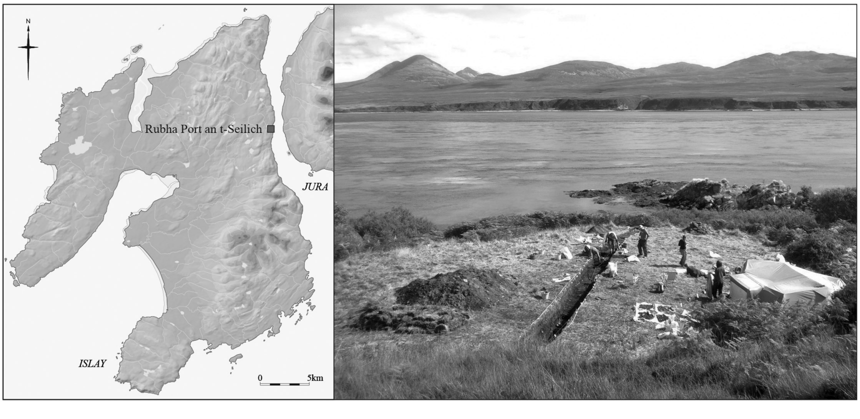

Figure 7.12 Location and excavation of test trench at Rubha Port an t-Seilich, Isle of Islay, August 2013. Looking east across the Straits of Islay towards the Isle of Jura. Photograph: S.J. Mithen.

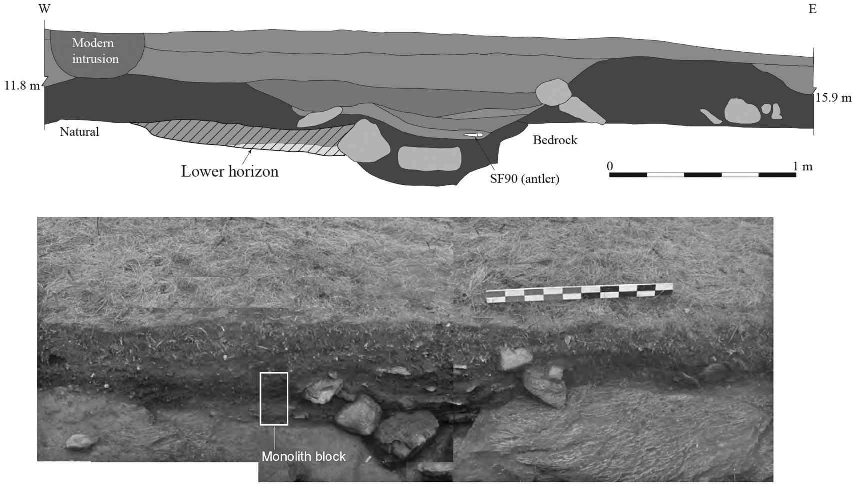

Figure 7.13 Stratigraphy of Rubha Port an t-Seilich, as exposed within the south-face of the trial trench, showing the upper horizon that contains the RPAS Concept 2 technology, and the lower horizon that contains the RPAS Concept 1 technology. A Mesolithic (upper horizon) fireplace is positioned between two boulders of bedrock, and the location is marked from which a sediment monolith was extracted for tephra analysis. *Source*: Prepared by S.J. Mithen, K. Wicks and S. Lambert-Gates.

possibility of it being either the AF555 tephra (11 580–11 340 cal BP), Vedde Ash (12 240–12 000 cal BP) or Dimna Ash (15 600–15 100 cal BP). We favour the Vedde Ash, placing those artefacts in the latter part or immediately after the Younger Dryas (Mithen et al. 2015). Although this remains provisional, the discovery of a tanged point that has the appearance of an Ahrensburgian point (Figure 7.14) within the base of a 2010 test pit adjacent to the 2013 trench, and assumed to come from the lower horizon, supports this time frame.

The start of a more extensive excavation in 2017 (Figure 7.15) has enabled the recovery of a larger sample of artefacts from both the upper and lower horizons, that from the latter having been eroded and redeposited. The technology present in the upper horizon has been designated as RPAS Concept 2 and is typical of the Scottish Narrow Blade Mesolithic. Its cores have short broad volumes and wide fronts with the knapping direction across the longitudinal direction of the core, exploiting the pebbles' short profiles and producing short irregular blades (Figures 7.16 and 7.17). Retouched artefacts include a range of microlith types and scrapers as typical for the Scottish Narrow Blade Mesolithic, similar to those from Fiskary, Bolsay and Coulererach as described above. This horizon also contains a range of coarse stone artefacts, including hammerstones and bevel-ended pebbles, abundant wood charcoal, charred hazelnut shells and fragmented faunal remains that include red deer, roe deer, wild boar, birds and fish.

Figure 7.14 Tanged point from Rubha Port an t-Seilich. Photograph: I.M. Berg-Hansen.

Figure 7.15 Excavation at Rubha Port an t-Seilich, April 2017. Photograph: S.J. Mithen.

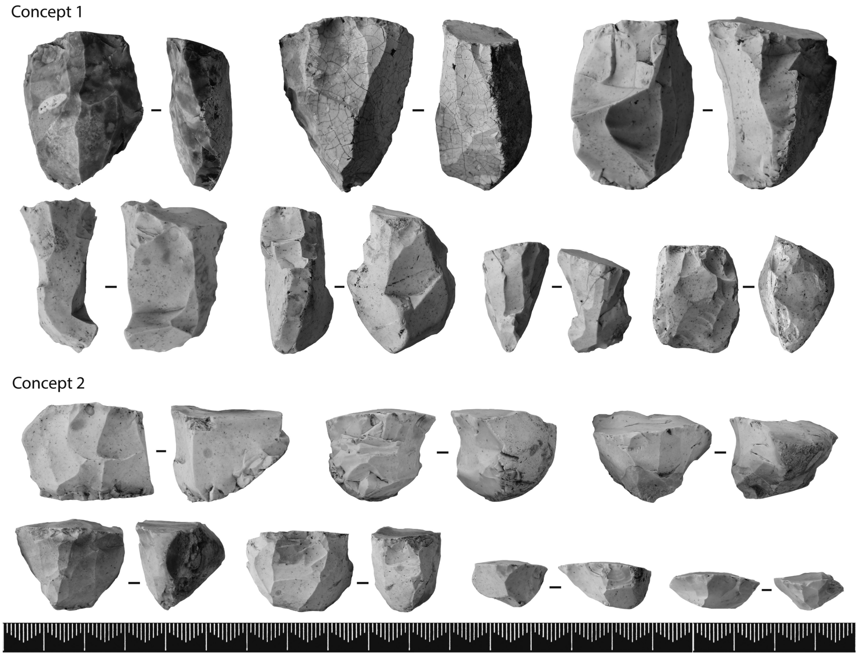

Figure 7.16 Comparison of RPAS Concept 1 and 2 cores. Photograph: I.M. Berg-Hansen.

Figure 7.17 Comparison of RPAS Concept 1 and 2 blades. Photograph: I.M. Berg-Hansen.

The technology from the lower horizon has been designated as RPAS Concept 1. Its cores are elongated, exploiting the longest profiles of the flint pebbles. They have narrow and curved fronts, facilitating the production of relatively long narrow blades. Their platforms are mainly angled, descending towards the back, and smooth or prepared by large facets. These cores were prepared to maintain their general shape and architecture throughout their use, generating irregular blades of medium length and width, with straight or an even longitudinal curvature (Figures 7.16 and 7.17). Retouched artefacts from the lower horizon include truncations and obliquely blunted points, while the tanged point was recovered from an equivalent horizon within a test pit (Figure 7.14). Material other than chipped stone has not yet been recovered from the lower horizon, which might simply reflect the limited extent of its exposure.

The RPAS Concept 1 core morphology and the percussion technique show similarities with the concepts for blade production found in the Final Palaeolithic (Ahrensburgian) and the Early Mesolithic in northwest Europe including Scandinavia (Berg-Hansen 2017, 2018, 2019; Perdaen et al. 2008; Sørensen 2006, 2008). This is consistent with the available tephra-chronology dating evidence from RPAS.

We are confident that RPAS is the first site in western Scotland to indicate exploration of the region prior to the 10th millennium BP, although whether that occurred within the Late Glacial or Early Holocene remains unclear. The tanged point from RPAS (Berg-Hansen et al. 2019) provides us with greater confidence that the claimed Ahrensburgian points from the Isle of Tiree and Shieldaig (Ballin & Saville 2003) might be authentic examples. The discovery of likely 14 500 cal BP Hamburgian-style artefacts at Howburn, in southern Scotland (Ballin et al. 2010), and possible Upper Palaeolithic artefacts at Kilmfort Cave (Saville & Ballin 2009) leaves open the possibility that pre-Ahrensburginan at RPAS might be discovered by further excavation.

With regard to an overall interpretation for RPAS, we should note that its locality is unlike those of Fiskary, Staosnaig and Criet Dubh. Those sites are found at sheltered bays and at an estuary where there were good opportunities for inshore fishing, probably using traps. While fishing would have been possible from RPAS, the Straits of Islay have strong currents with limited opportunities for shallow water, inshore fishing. The particular attraction of RPAS may have been its location on a main seaway from the mainland, providing access to the large islands of Islay and Jura, and to the smaller islands of Colonsay and Oronsay, then to Mull and the more distant islands of Tiree and Coll. As such, this appears to provide a 'gateway' location into the coastal landscapes of the region (Figure 7.18). We suspect this might be why RPAS was repeatedly used over a period of potentially 5000 years, from what is likely to have been the Pleistocene/Holocene transition (RPAS Concept 1) and then throughout the Mesolithic (RPAS Concept 2). Indeed, the Straits of Islay have provided such a route-way throughout historical times, with Port Askaig, located 1 km north of Rubha Port an t-Seilich, providing a busy ferry terminal for modern-day

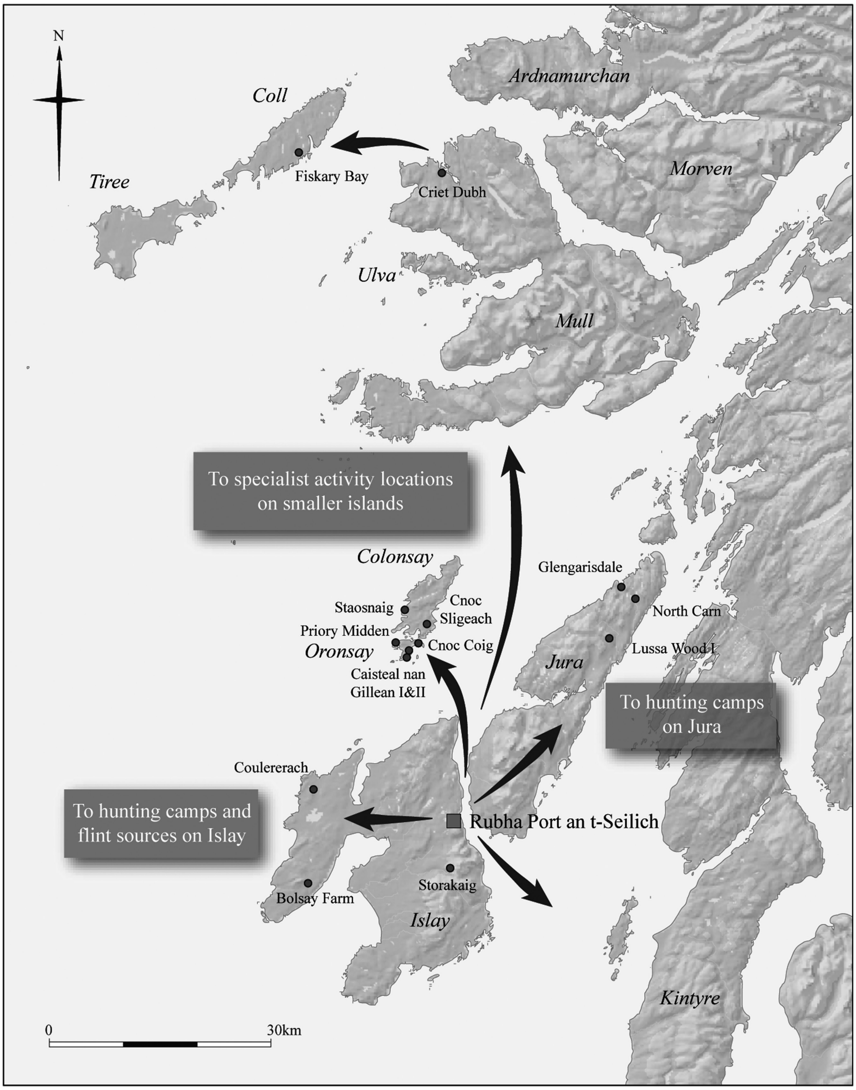

Figure 7.18 Rubha Port an t-Seilich, as a geographical gateway into western Scotland. *Source*: Prepared by E. Jamieson.

traffic. We also suspect that the re-use of a single fireplace at RPAS is significant with regards to the on-going re-enculturation of the landscape, as social memories and stories of previous visits to the site and island were recounted (Mithen 2019). In this regard RPAS was a favoured place for both the economic opportunities it provided and its role in connecting present occupants with those of past generations.

Conclusion

The gradual accumulation of evidence from western Scotland is enabling us to build an understanding of how this coastal landscape was used during the Mesolithic period. The relative intensity of activity varied during the c. 5000 years of the Mesolithic (Figure 7.3). This is attributed to the impacts of climate change and their influence on the environment: amelioration from the Pleistocene/Holocene transition up to c. 8200 cal BP resulting in population growth via reproduction of the pioneers and further immigration into the region, and then abrupt deterioration arising from the 8200 cal BP event, resulting in population collapse.

Throughout this period, hunter-gatherers were exploiting the marine, coastal and terrestrial resources. A number of especially favoured locations are evident, some of which were used for targeting specific resources: fishing at Fiskary; woodland harvesting at Staosnaig; hunting at Storakaig; and beach pebble collecting and processing at Coulererach. Other localities, such as Criet Dubh, appear to have provided access to a diverse range of resources, which might explain their greater number of activity events. This is especially the case for Rubha Port an t-Seilich that we describe as a 'gateway' into the landscapes and seascapes of western Scotland. In all cases, however, our interpretations must be cautious. The archaeological record is poorly preserved and fieldwork has merely sampled these sites rather than excavating any in its entirety.

A picture is emerging of people keen on exploring and exploiting the landscapes and seascapes for reasons that go beyond immediate economic imperatives, with a desire to visit the smaller islands that would have required challenging crossings of open water in skin boats. Rather than proposing a fixed settlement pattern, our interpretation is that the Mesolithic groups were highly flexible in their behaviour, having to respond to local conditions, which are likely to have varied significantly from year to year, and being able to do so by having extensive ecological knowledge about their region: they were 'Thoughtful Foragers' (Mithen 1990), able and willing to creatively respond to annual, seasonal and highly local variations in the natural world. To think and behave in this manner would have required a continual updating of their knowledge about their world of islands, estuaries, seashores and woodlands, much of this achieved via story-telling around fireplaces (Mithen 2019). Keeping up to date with their changing world might have been the motivation for making sea crossings to small and isolated islands.

This picture is still developing, with a substantial need for additional radiocarbon dating to refine the chronology of Mesolithic settlement and its relationship to climate change, and for further fieldwork. The discovery of stratified deposits at Rubha Port an t-Seilich has been of considerable value, not only for the evidence of Late Glacial/Early Holocene activity, but also for the character of the Mesolithic deposits with preserved faunal remains (despite being highly fragmented) and features that have yet to be fully excavated.

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8 Specialists facing climate change

The 8200 cal BP event and its impact on the coastal settlement in the inner Oslo fjord, southeast Norway

Guro Fossum

Introduction

Among the best-documented climatic events in the Early Holocene (c. 117 000–8000 cal BP) is the so-called 8200 cal BP event, which multiple palaeoclimate records describe as a significant but short-term fall in temperatures in the North Atlantic region. The cooling period is linked to the drainage of the proglacial Laurentide lakes in North America, which destabilized the thermohaline circulation in the North Atlantic Ocean. Ice core records from Greenland indicate that the 8200 cal BP event began around 8175 ± 30 cal BP and lasted for c. 150 years, with a maximum cooling of c. 3°C lasting c. 70 years (Alley et al. 1997; Barber et al. 1999; Clarke et al. 2004; Veski et al. 2004; Alley & Ágústsdóttir 2005; Nesje et al. 2005; Antonsson & Seppä 2007; Kobashi et al. 2007; Seppä et al. 2007, 2009; Thomas et al. 2007; Walker et al. 2012).

In northern Europe, this cooling period has been linked to cultural changes in several regions. M.A. Manninen (2014) detected changes in technological organization, settlement pattern, and land use in northernmost Fennoscandia. K. Wicks and S. Mithen (2014) inferred a population collapse from the radiocarbon record in western Scotland, and they argue that the collapse was due to a low-density population that lacked the capacity to adapt their technology and lifestyle to new environmental conditions in the course of the 8200 cal BP event. A similar pattern is detected by J. Apel et al. (2017) on the island of Gotland in the Baltic Sea where a gap in the summed calibrated radiocarbon date frequency distribution between 8200 and 8000 cal BP is interpreted as a drop in population. On the basis of Bayesian statistical modelling of archaeological sites in northwest Europe, S. Griffiths and E. Robinson (2018), on the other hand, cannot identify a decline in human activity in this period and they argue that the population in northwest Europe was resilient to the climatic changes.

Evidently, different regional case studies will provide different results depending on the methodological approaches (e.g. Griffiths & Robinson 2018). Moreover, as stressed by O.P. Nieuwenhuyse and P.F. Biehl (2016:4): ‘cultural adaptations to the same climate event should not a priori be expected

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to play out similarly across larger regions'. Firstly, the environmental effects of the 8200 cal BP event varied greatly from region to region. Secondly, as the cultural adaptations of hunter–gatherer groups differed in terms of subsistence strategies, mobility strategies, contact networks, environmental knowledge, and societal organization, it is reasonable to expect differential responses to environmental change. This provides a case study from the Oslo fjord area in southeast Norway and addresses hunter–gatherers in a coastal environment.

Several scholars argue that coastal environments have played an important role in human prehistory (Yesner 1980; Erlandson 2001; Bailey & Milner 2002; Bailey 2004; Bjerck 2007; Breivik 2014). Coastal zones tend to have a large number of ecological niches within a smaller area, and thus they exhibit a large species diversity (Yesner 1980:729). D.R. Yesner (1980:729) argues that marine resources are more stable than terrestrial resources, especially if stability is taken to mean the amplitude of resource variations. Further, coastal zones can ease transportation and communication as waterways allow people to move more easily, facilitating cultural contact and exchange with other groups (Bailey 2004:44). Boats allow dispersed resources to be harvested and brought to camp, and the use of boats can expand the foraging range and allow long logistical moves (Ames 2002). Still, the exploitation of coastal resources, and fishing in particular, has been viewed as a costly, technology-dependent, and highly specialized subsistence strategy (Binford 2001:444; Kelly 2013:127–128). The archaeological record from well-preserved coastal sites in southern Norway and western Sweden demonstrates the importance of fishing during the Early Holocene. Groups with specialized subsistence strategies, so-called specialists, may be vulnerable to climate-induced changes in resources as they will have fewer skills and a narrower experience from which to draw for adaptation strategies (Marshall et al. 2010:11). Assuming that the coastal hunter–gatherers living in the Oslo fjord area were so-called specialist, and therefore vulnerable to the environmental changes, we can expect changes in the archaeological record following the 8200 cal BP event.

This study uses shore-bound sites dated within the timespan 9000–7600 cal BP to investigate temporal and spatial changes in the site pattern in the course of the 8200 cal BP event. The locations of the sites are shown in Figure 8.1. The Oslo fjord area is well-suited for investigating prehistoric human–climate relations in coastal areas as the constant marine regression after the retreat of the Scandinavian ice sheet from c. 12 500 cal BP has caused shore-bound sites from all prehistoric periods to be located above present-day sea level. Recently, H. Breivik et al. (2018) used the temporal distribution of shoreline-dated sites to investigate if the 8200 cal BP event had an impact on coastal settlement on the western side of the outer Oslo fjord. No significant decline in the number of archaeological sites following the 8200 cal BP event was identified and it was suggested that coastal Mesolithic hunter–gatherers were resilient to climate changes. This is investigated further in this chapter, using additional data from the inner part of the Oslo fjord. A total of 138 shore-bound sites (123 surveyed and 15 excavated/partly excavated sites) dated within the timespan 9000–7600

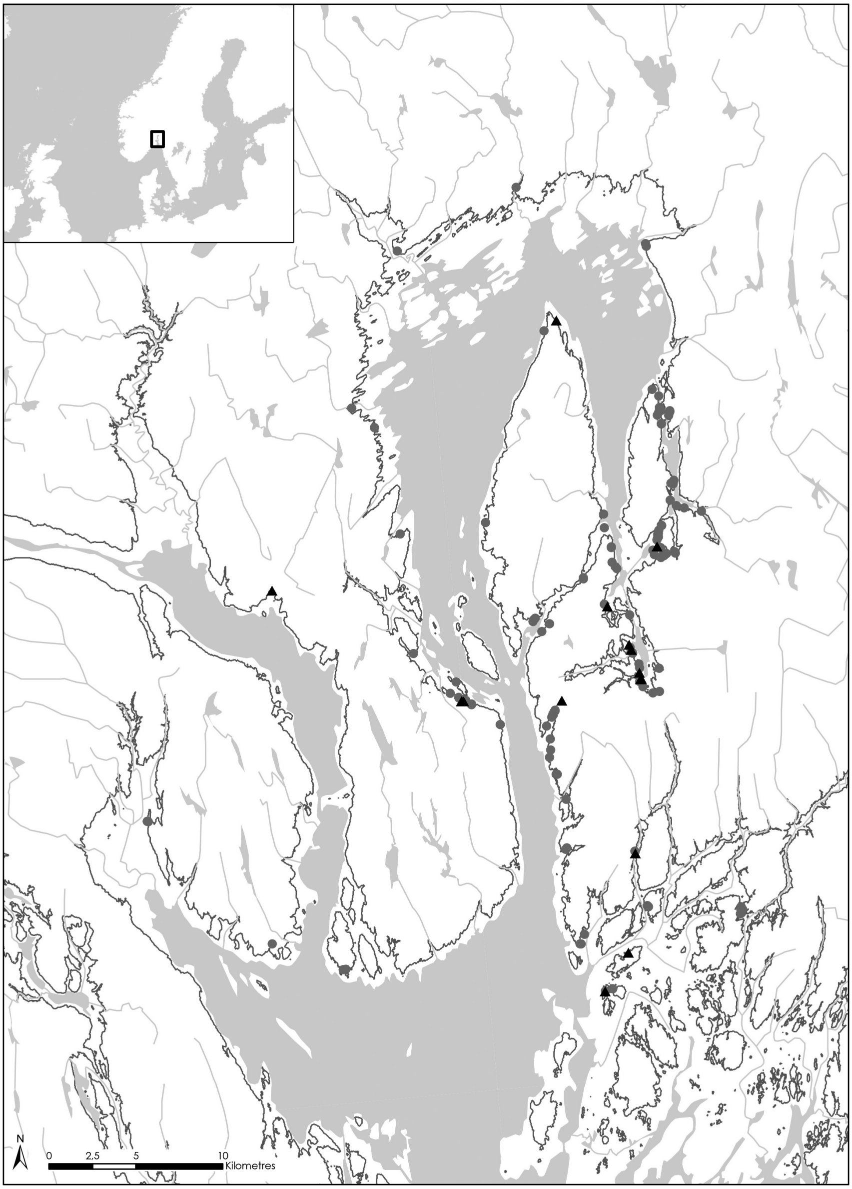

Figure 8.1 The Oslo fjord area. The black line marks the shoreline at 60 m above present sea level. The 123 surveyed sites in the study are marked with grey dots and the 15 excavated sites are marked with black triangles. Illustration: G. Fossum and J. Håland.

cal BP are mapped in order to investigate temporal and spatial changes in the site pattern following the 8200 cal BP event. The results provide a point of departure for discussing the resilience of the hunter–gatherers in the Oslo fjord area.

The Oslo fjord area, c. 9000–7600 cal BP: Geographical setting and subsistence strategies

The Oslo fjord is situated 58–59°N and lies in the northern part of the Skagerrak Strait that connects the Baltic Sea and North Sea areas. Skagerrak is among the most productive areas in the world, but has been detrimentally influenced by human activity in modern times (Gjøsæter 1992; Danielssen et al. 1997).

The Skagerrak and the case study region have undergone several palaeoceanic changes during the Holocene. An oceanic circulation pattern in Skagerrak similar to the present was likely established between 8500 and 8000 cal BP as a result of increased Atlantic inflow; the opening of the Danish Straits, Øresund, and the English Channel; and finally, the isolation of the Dogger Bank (Gyllencreutz 2005; Gyllencreutz et al. 2006; Erbs-Hansen et al. 2012). Few reconstructions on palaeoproductivity in the Skagerrak have been conducted. However, a recent article by I. Polovodova Asteman et al. (2017), covering the timespan from 4500 cal BP up to the present day, shows how productivity has varied through time and has been affected by climatic shifts. The primary production in the Skagerrak is influenced by several nutrient inputs, including the freshwater supply by the Baltic outflow, river runoff from the Swedish and Norwegian coast, and the inflow of the surface water from the North Sea and Atlantic Ocean (Polovodova Asteman et al. 2017).

Between 9000 and 7800 cal BP, the sea level in the case study region was 55–70 m above present sea level and the inner Oslo fjord was characterized by narrow fjords and straits whereas the outer part formed an archipelago. The water mass exchange between the ocean and the fjord would have been greater than the current situation and the topography would generate strong tidal currents (Jaksland 2001b). In this coastal landscape, Stone Age sites are numerous, clustering around narrow straits, inlets, and long, crooked fjord arms (Figure 8.1).

Our knowledge of the resource exploitation and seasonal movements of the coastal hunter–gatherer in this area is still limited. Due to poor preservation of organic material, it is difficult to assess the resource spectrum of hunter–gatherers based on direct sources, and much of our evidence of the subsistence economy is based on locational data of the sites. The proximity to prehistoric shorelines indicates the importance of marine resources and waterborne transportation. Despite the marine location of the sites, the available zooarchaeological remains are dominated by terrestrial species. The frequency of identified species, however, is likely heavily biased, as mammal bones are more resistant to taphonomic processes compared to small and fragile fish bones. Moreover, fish bones require special field recovery techniques in order to be recorded, and thus fish bones are likely under-represented in the archaeological record (Boethius & Ahlström 2018). Zooarchaeological remains from well-preserved sites dated to the Early Holocene located along the coast of southern Norway and western Sweden demonstrate the importance of fishing. Prestemoen 1 (c. 9700–9600 cal BP) is the oldest known site in the Oslo fjord area with preserved fish bones and these constitute c. 90% of the faunal remains. Different cod species, such as Atlantic cod (*Gadus morhua*), pollock (*Pollachius pollachius*), saithe (*Pollachius virens*), whiting (*Merlangius merlangus*), and common ling (*Molva molva*) are the most numerous (Persson 2014b; Mansrud & Persson 2018). Fish bones make up 73% of the zooarchaeological remains at the younger site Skoklefald (c. 8000–7600 cal BP), which is located in the inner Oslo fjord. Herring (*Clupea harengus*) is the dominant species (75%) followed by different cod species (Jaksland 2001a, 2001b). Sites along the Swedish west coast display a similar pattern. At Dammen (c. 9000–8600 cal BP), 93% of the bones were fish, dominated by herring and different cod species (Schaller Åhrberg 2007). Fishing appears to be an important subsistence strategy during all Mesolithic occupation phases at Huseby Klev, but especially during the two later occupation phases dated to 9600–8700 cal BP and 8000–7700 cal BP. Different cod species are the most common (Boethius 2018a).

The importance of fishing among Early Holocene hunter–gatherers in southern Scandinavia has recently been addressed by A. Boethius and T. Ahlström (2018). By combining previously published stable isotope data with new analyses of human and animal bone remains from southern Scandinavia, a Bayesian mixing model was used to reveal that fish, both marine and freshwater species, played a more significant role than previously thought. They also argue that the dependency on fishing increased from the early to the latter part of the Early Holocene and that fishery became more specialized over time. Several sites, such as Dammen, suggest targeted fishery and the use of specialized technology. The occurrence of herring implies the use of seines (Schaller Åhrberg 2007:50–52), and other species, such as ling and large cod, indicate deep-sea fishing with long line (Schaller Åhrberg 2007:51; Boethius 2018a:112–113); however, the evidence of offshore fishing during the Mesolithic is debated (see Pickard & Bonsall 2004).

Although the importance of marine resources, and especially fish, has been highlighted, scholars usually characterize the subsistence strategy of the Mesolithic hunter–gatherers in the Oslo fjord area as a broad spectrum economy (Glørstad 2010:73–86; Mansrud 2014:84–86). The zooarchaeological remains along with the seasonal and varied environment in which these sites are located can support the hypothesis that the Mesolithic groups were generalists as opposed to specialists. However, fishing can be regarded as a specialized subsistence strategy that involves complex and costly technologies and skills.

Within the framework of human behavioural ecology, fishing is considered a complex and costly subsistence strategy. Compared to terrestrial animals, fish are viewed as marginal resources because they provide a lower net energy return. In energy-based foraging models (e.g. optimal foraging theory), hunter–gatherers are not expected to harvest low-ranked items, unless post-encounter return rates of higher-ranked items decreased (Bicho & Haws 2008). In order to increase the return rates, technologies for mass harvesting can be applied, such as fishing nets and weirs, but these technologies are costly and complex and require large investments of time when first constructed. Once constructed, they require regular maintenance until they wear out. Mass harvesting of fish further implies technologies for processing and storage, such as drying, smoking, fermenting, etc. (Kelly 2013:127–128).

Several scholars have questioned the assumption that marine resources have played a marginal role in prehistoric hunter–gatherer societies and further argue that coastal hunter–gatherers have traditionally been viewed as exceptions in hunter–gatherer research. Further, the predictive models within the human behavioural ecological framework are based upon terrestrial, pedestrian hunter–gatherers, and these models may not be appropriate for hunter–gatherers living in coastal areas (Ames 2002; Bailey & Milner 2002; Bailey 2004; Bicho & Haws 2008; Arnold et al. 2016; Breivik et al. 2016). This discussion will not be further addressed here; however, it is important to stress that fishing, as a subsistence strategy, can be considered complex and costly in terms of technology, knowledge, and time investment. In spite of its cultural costs, this particular cultural adaptation appears to have been reproduced among the coastal hunter–gatherer in Scandinavia during the Early Holocene. In addition, the archaeological evidence suggests it became more specialized over time. Prior to the 8200 cal BP event, the Oslo fjord was inhabited by specialized hunter–gatherers, and according to N.A. Marshall et al. (2010), this particular specialization may have made them vulnerable to climate-induced changes in resources.

The 8200 cal BP event and its impact on the Oslo fjord area

The relatively low sampling resolution, chronological uncertainties, possible delays in ocean atmospheric coupling, and inconsistent responses of different proxy records make the different climate records difficult to compare and the total impact of the 8200 cal BP event difficult to address (Rohling & Pälike 2005; Ojala et al. 2008; Snowball et al. 2010; Randsalu-Wendrup et al. 2012). In addition, the chronological precision of the archaeological frameworks is often poor, making it difficult to compare the two data sets. This problem has recently been addressed by S. Griffiths and E. Robinson (2018) who argue that in order to understand human responses to the 8200 cal BP event, studies should encompass sites within a broad time envelope and high-resolution palaeoclimatic records.

Inferred Holocene temperature reconstructions from Lake Trehörningen on the Swedish western coast and Lake Flarken in Central Sweden show a temperature drop corresponding to the 8200 cal BP event (Seppä et al. 2005; Antonsson & Seppä 2007). At Lake Flarken, the inferred temperature drop is c. 1–1.5°C (Seppä et al. 2005:294). This drop reflects colder and shorter growing seasons, and the pollen records further demonstrate changes in forest vegetation in the course of the 8200 cal BP event. At Lake Flarken, there is a decline in the frost-sensitive hazel (*Corylus*) and also elm (*Ulmus*) and alder (*Alnus*) (Seppä et al. 2005:290). The same pattern is detected in the high-resolution pollen core from Lake Skogstjern, on the western side of the Oslo fjord (Wieckowska-Lüth et al. 2017). Between 8270 and 8110 cal BP, there is a decline in hazel as well as other deciduous trees such as elm, oak (*Quercus*), ash (*Fraxinus*), and linden (*Tilia*). At the same time, the low temperature–adapted pine (*Pinus*), birch (*Betula*), and juniper (*Juniperus*) increase (Wieckowska-Lüth et al. 2017:9).

D. Hammarlund et al. (2005:477) point out that the pattern of inferred changes in moisture conditions in association with the cold event is more complex than temperature reconstructions. M. Magny et al. (2003) have suggested that areas north of 50°N experienced drier conditions during the 8200 cal BP event, and several records from southern Norway and western Sweden do indicate that winter precipitation decreased during the event compared to earlier and later periods (Nesje & Dahl 1991; Dahl & Nesje 1994, 1996; Hammarlund et al. 2005; Seppä et al. 2005; Paus 2010; Paus & Haugland 2017).

The temperature drop around 8200 cal BP is also evident in marine proxy records and there is a decrease in the palaeosalinity estimates in Skagerrak (Risebrobakken et al. 2003; Erbs-Hansen et al. 2011, 2012). How these environmental changes affected marine primary productivity is still not clear. V.R. Krossa et al. (2017) argue that a reduction in ocean temperatures caused by an increase in the outflow of the cold Baltic Sea between 6300 and 5400 cal BP did have a negative impact on the natural ecosystems, particularly the marine realm. Polovodova Asteman et al. (2017), on the other hand, argue that climatic cooling could, in fact, improve marine primary productivity. Recalling that marine productivity in the Skagerrak is influenced by several nutrient inputs, such as the Baltic outflow, river runoff from the Swedish and Norwegian coast, and the inflow of the surface water from the North Sea and Atlantic Ocean (Polovodova Asteman et al. 2017), the documented decrease in salinity may suggest that the Atlantic inflow is weakened or less saline as a result of the freshwater pulse. Further, the reduction in winter precipitation following the cooling event indicates a decreased river runoff and spring flooding. Thus, the reduction in salinity and a reduced winter precipitation may have had a negative effect on primary productivity in Skagerrak, which may have affected the hunter–gatherers who were heavily dependent on marine resources.

Temporal and spatial distribution of shoreline-dated sites

Shoreline dating: Strengths and limitations

Recently, Breivik et al. (2018) and S. Solheim and P. Persson (2018) have demonstrated how the temporal distribution of shoreline-dated sites can be used as a population proxy. As the radiocarbon data set from the case study area within the timespan covered here is too small (n = 14, see Table 8.1) for conducting summed radiocarbon date frequency distributions, a site count of shoreline-dated sites is a more appropriate method for investigating short-lived population fluctuations. Since the introduction of pollen analysis and radiocarbon dating, shoreline displacement curves have been created independently of archaeological data (Persson 2014a:78). As shown below, there is only a small risk of circular reasoning as the extensive data shows coherent patterns that support the validity of shoreline dating as a method.

The glacio-isostatic rebound in the Oslo fjord provides us with a unique chronological sequence of shore-bound Stone Age sites. As the land rose, shorelines changed, and shore-bound sites lost their coastal location and were abandoned. Thus, based on the premise of a shore-bound location, by comparing a site's position above sea level with a local shore displacement curve, we can obtain relative dates of shore-bound Stone Age sites. This assumption has been corroborated by extensive archaeological fieldwork and studies combining radiocarbon dates and typological and technological traits of archaeological material from shore-bound sites, and local shore displacement curves (Glørstad 2004:78–80; Solheim 2013:255–258; Breivik et al. 2018; Solheim & Persson 2018). Further, the marked relief contributes to creating a consistent pattern for the shoreline dating of sites in this region. Sites are often located on small terraces in steep terrain, which were best accessible when the shoreline was near, and these locations limit long-term occupation or repeated occupation over long time spans (Jaksland 2014:37–38). Obviously, there are sites that stretch over large areas and height levels that may have been used on many occasions over a long time span. The radiocarbon record also demonstrates that sites have several occupation phases (Table 8.1). Further, there are, of course, sites that were not shore bound and demonstrate that activities were carried out in the surrounding hinterland and not at the shore. These sites are, however, not abundant (Solheim & Persson 2018:336).

The shoreline displacement in the Oslo fjord region varies through time and from area to area. During the first part of the Holocene, the land rise was initially rapid, gradually slowing down. The land uplift was stronger in the inner and northern part of the fjord than in the outer, southern part, but the difference was most prominent at the beginning of the Early Holocene (Sørensen 1979; Sørensen et al. 2014a). The direction and gradient of the shoreline displacement have implications for the dating of the sites. Places with the same land upheaval can be connected by isobases which are perpendicular to the direction of the land uplift (Påsse 2003:48). Sites situated along the same isobase can be dated by the same shore displacement curve.

Table 8.1 Key information on the 15 excavated sites in this study

Sites	*m a.s.l.*	*Number of finds*	*Excavation method*	*Excavated area (m^2)*	*Features*	*Fauna (number of fragments and species)*	*Shoreline date (cal BP)*	*Date (BP)*	*Lab number*	*Sample*	*Reference*
Trolldalen	74–75	1448	¼ m^2 units, 10 cm spits, sieving	55	1 hearth, 1 layer	N/A	9200–8900	7977 ± 44 7876 ± 53	Ua-49212 Ua-49212	*Betula* *Corylus* (nutshell)	Solberg (2014)
Kongsdelene 61	70	1020	¼ m^2 units, 10 cm spits, sieving	40	N/A	N/A	8800–8700	N/A	N/A	N/A	Ballin (1998)
Bleivik Nordre	64	2181	¼ m^2 units, 10 cm spits, sieving	27	1 hearth/ cooking pit	N/A	8400–8300	N/A	N/A	N/A	Åstveit (2008)
Kongsdelene R71/72	67	3117	¼ m^2 units, 10 cm spits, sieving	53	N/A	N/A	8500–8400	N/A	N/A	N/A	Ballin (1998)
Trosterud 1	69–70	5380	¼ m^2 units, 10 cm spits, sieving	141	3 hearths	N/A	8600–8400	7745 ± 75 7435 ± 75	TUa-1549 TUa-1548	*Betula/ Corylus/ Salix* *Betula/ Corylus/ Salix*	Berg (1997)
Rød Nedre 72	63	1593	¼ m^2 units, 5 cm spits, sieving	48	N/A	N/A	8200–8100	N/A	N/A	N/A	Berg (1995)
Kongsdelene R62	64	11 107	¼ m^2 units, 10 cm spits, sieving	63	N/A	N/A	8300–8100	N/A	N/A	N/A	Ballin (1998)
Kvestad lok. 3	66–67	8782	¼ m^2 units, 10 cm spits, sieving	117	N/A	65 (mammalia indet.)	8400–8200	7435 ± 70 7040 ± 45*	TUa-1547 LuS-13500	*Corylus* (nutshell) Calcined bone (mammalia indet.)	Berg (1997)

(*Continued*)

Table 8.1 Continued

Sites	*m a.s.l.*	*Number of finds*	*Excavation method*	*Excavated area (m^2)*	*Features*	*Fauna (number of fragments and species)*	*Shoreline date (cal BP)*	*Date (BP)*	*Lab number*	*Sample*	*Reference*
Hyggen vest 2	65–70	8	Mechanical removal of topsoil	c. 2500	2 cooking pits, 1 pit	N/A	8600–8200	7540 ± 45 7670 ± 45 7825 ± 50	TUa-5896 TUa-5897 TUa-5900	*Betula* *Betula/Pinus* *Betula/Pinus*	Kjos (2006)
Bråtan 4	65	772	¼ m^2 units, 10/5 cm spits, sieving	65	N/A	N/A	8200–8100	N/A	N/A	N/A	Ballin (1998)
Horgen 4	59–61	357	¼ m^2 units, 10 cm spits, sieving	29	N/A	N/A	7800–7600	N/A	N/A	N/A	Berg (1997)
Kvestad lok. 2	60–61	1112	¼ m^2 units, 10 cm spits, sieving	70	N/A	3 (mammalia indet.)	7900–7700	7055 ± 45*	LuS-13499	Calcined bone (mammalia indet.)	Berg (1997)
Skoklefald	62	257	1 m units, 5–10 cm spits, sieving	8	1 hearth, layer	473 (*Clupea harengus*, *Gadus morhua*, *Ostrea edulis* + +)	7800–7600	7050 ± 110 7090 ± 80 6860 ± 70 6820 ± 80	T-15058 TUa-2894 TUa-2895 TUa-3094	*Pinus* *Salix caprea/Salix/Populus* *Corylus* (nutshell) *Corylus* (nutshell)	Jaksland (2001)
Nøstvet	56–60	5882	1 m units, 10 cm spits, sieving	60	N/A	48 (mammalia, *Aves*, *Pisces*)	8200–6800	6565 ± 45	TUa-4602	Calcined bone (mammalia indet.)	Jaksland (2005)
Knapstad R113	56	2937	¼ m^2 units, 5 cm spits, sieving	60	N/A	N/A	8700–8600	N/A	N/A	N/A	Berg (1995)

* First presented in this publication.

Compared to the western side of the fjord, the marine regression in the inner Oslo fjord was constant throughout the Early and mid-Holocene (Sørensen, 1979; Sørensen et al. 2014a, 2014b) and the relative dating of shore-bound sites can therefore be made with greater precision. That being said, shoreline dating is a relative dating method that allows us to work at the century scale at best.

Gathering the data

A total of 138 sites are included in the analysis, 15 of which are excavated or partly excavated (see Table 8.1) and the remaining 123 are surveyed sites. Information on surveyed sites was gathered from the Directorate for Cultural Heritage's online database 'Askeladden'. Sites were primarily mapped to gain spatial information (m a.s.l., location on a micro and macro scale), thus sites with uncertain spatial reference, typically sites surveyed a long time ago, sites stretching over large areas and height levels, and sites defined by the occurrence of stray finds, were excluded from the analysis. As the analysis is based on data generated by development-led archaeological excavations and surveys, there is a risk that some height levels are over- or underrepresented. However, the case study area has been thoroughly surveyed in response to infrastructure projects, and these surveys cover most of the heights included in this analysis.

T. Påsse's (2003) shore displacement curve for Lake Vaglarna in Bohuslän, Sweden, was used to shoreline date the sites. Although Lake Vaglarna is located up to 70 km south of the sites in this study (Figure 8.2), Påsse's curve is built on an empirical model (Påsse 2001) that allows the curve to be transformed and moved, making it convenient for this particular study. Corrections were made according to the distance between the sites and the reference isobase line for Lake Vaglarna. According to Påsse (2003:48), the isobases are oriented N 30°O (see Figure 8.2). Thus, it is possible to transform and apply the curve for Lake Vaglarna to places further north along the Oslo fjord and provide tentative curves for the entire area. In order to test the reliability of the new curves, the two radiocarbon dates from R. Sørensen's 'Ski curve' (1979), dating the transition levels between marine and lacustrine sediments (isolation basins), were compared to the new curves and they correspond well. Further, the radiocarbon dates from the excavated sites were also used to test the reliability of the curves and, as can be seen from Figure 8.3, they correspond quite well to the adjusted curves. In this fashion, sites were given a shoreline date based on their height above sea level and spatial coordinates in relation to the new curves. To determine the shoreline date of a site, the contemporary shoreline was set to 2 m below the lowest height of the site area.

To avoid claiming a false level of precision, the sites were distributed into 200-year time slices. Griffiths and Robinson (2018:2) have recently argued that a 200-year precision is too coarse to identify human responses to short-lived climatic changes at the level of individual sites as it is 'significantly

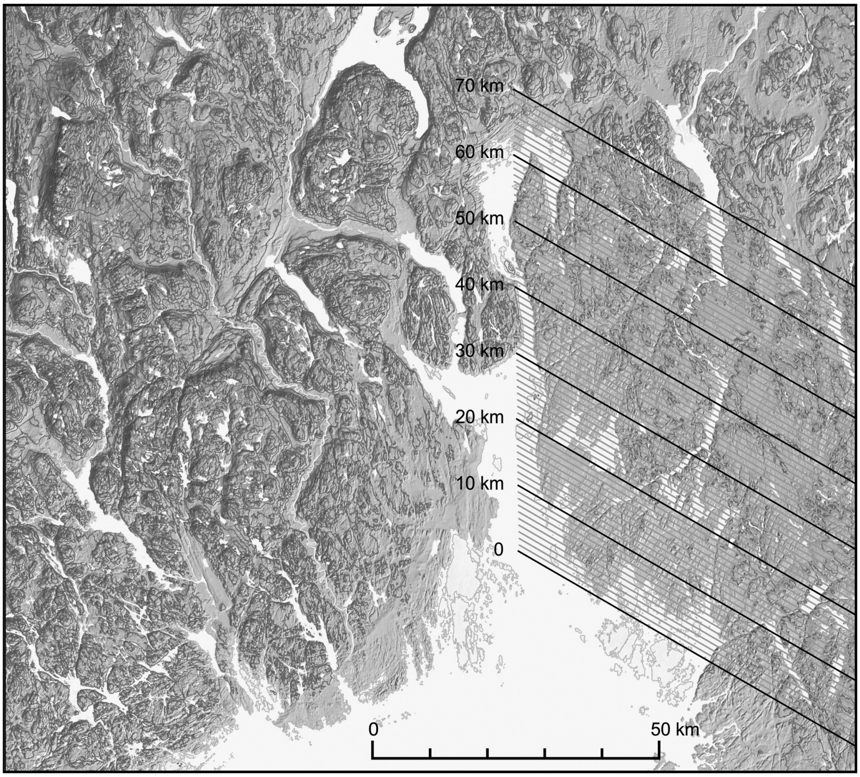

Figure 8.2 The distance from the reference isobase line (0) and the study area varied between 30 and 70 km. The isobases are positioned N30°O. Illustration: P. Persson, MCH, UiO.

beyond the duration of individuals' lives and generations'. This is, of course, true, and the resolution provided by the method applied here might not be sufficient to discover human responses to climate change at individual site levels, but rather allows us to detect trends in the coastal site pattern within a broad time envelope. Yet, even if the 8200 cal BP event is portrayed as a short-term climate change, it is perhaps best described as a long-term change on a human scale.

What do the sites represent?

The sites in the analysis clearly represent different activities, meanings, and temporalities. Some sites may be the lithic traces of a single episode while others may be the result of many different activities conducted by different people over several occasions within the same week, season, year, decade, or perhaps even century. The majority of the sites in the analysis are surveyed sites, and we

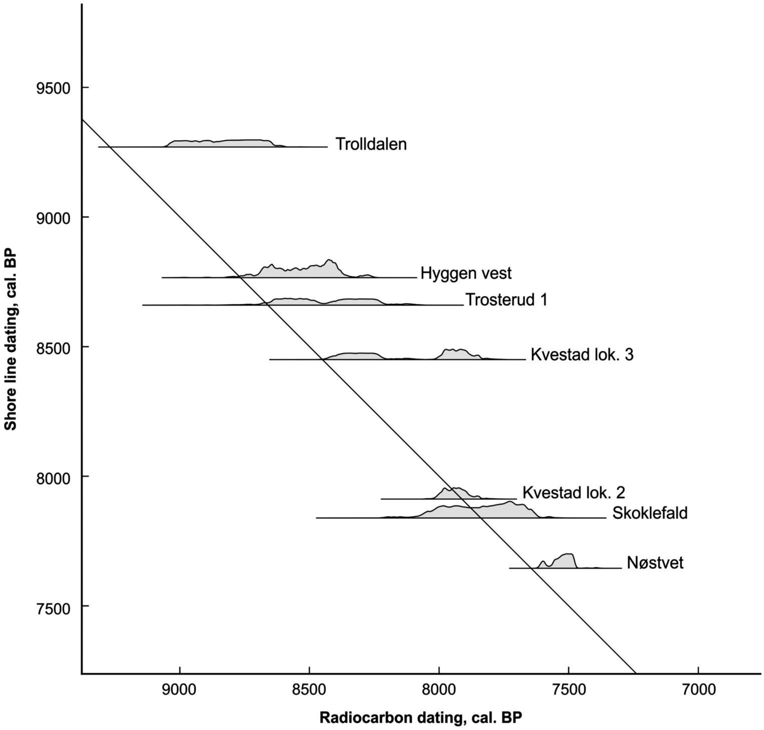

Figure 8.3 The correlation between the shoreline dates and the radiocarbon dates from the study area. Radiocarbon dates are listed in Table 8.1. Illustration: P. Persson, MCH, UiO.

have partly limited knowledge of the representativeness and character of these sites, in terms of size, features, the amount of lithic waste, and the composition of lithic remains. As can be seen from Table 8.1, the excavated sites vary in size, location, duration of occupation, features, number, and character of the lithic remains and zooarchaeological remains, thereby reflecting a complex site and mobility pattern during the period covered here. However, the character of the sites will not be addressed further here, as the purpose of the analysis is to use shoreline-dated sites as a proxy for human activity through time.

Results and discussion

Temporal and spatial changes in the site pattern, c. 9000–7600 cal BP

By dividing the sites into 200 year-long time slices, it is possible to obtain a general impression of the site pattern from 9000 to 7600 cal BP. As can be seen from Figure 8.4, there is an increase in the number of sites from 9000 cal

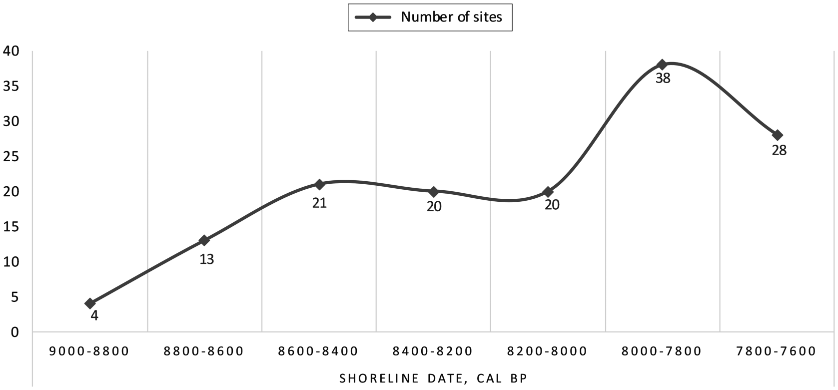

Figure 8.4 Graph showing the temporal distribution of shoreline dates from 9000 to 7600 cal BP. Illustration: G. Fossum.

BP to c. 8500 cal BP. From c. 8500 cal BP, the number of sites appears to stabilize and slowly decrease towards 8000 cal BP. From c. 8000 cal BP there is a marked increase in site frequency followed by a decrease after 7800 cal BP (Figure 8.4).

According to L.R. Binford (2001:444), changes in subsistence will produce dramatically different settlement patterns. This is clearly not the case here, as the spatial distribution of sites indicates no substantial changes in site location between 9000 and 7600 cal BP. Sites show a preference for the mainland (81%) rather than islands (17%) throughout the entire period (Figure 8.5). Further, sites are preferably located in the sheltered, inner part of the fjord. The only noticeable change concerns the site location on a micro level, especially sites' proximity to narrow straits (Figure 8.6). Between 9000 and 8200 cal BP,

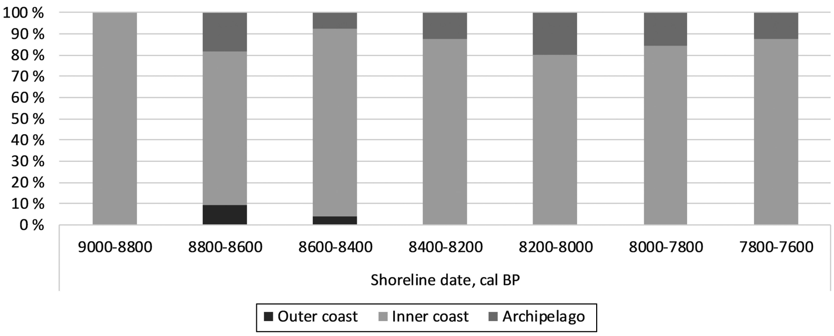

Figure 8.5 The location of the sites at a macro level. Illustration: G. Fossum.

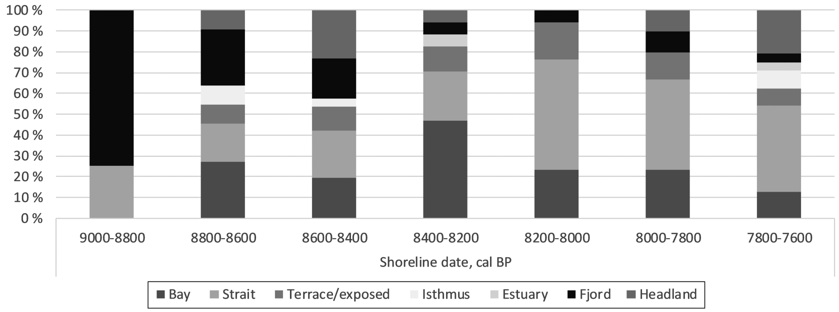

Figure 8.6 The location of the sites at a micro level. Illustration: G. Fossum.

one-fifth (18–23%) of all sites were located by narrow straits compared to nearly half of all sites (41–52%) within the timespan 8200–7600 cal BP.

The temporal distribution of shoreline-dated sites from the inner Oslo fjord shows fluctuations in the frequency of sites during the timespan 9000–7600 cal BP. As mentioned earlier, the chronological uncertainties with timing the 8200 cal BP event and the relatively coarse resolution of the archaeological record make it difficult to compare these two data sets. A recent study by Kelly et al. (2013) complicates the matter even further. Their study suggests up to 300 year lags in human responses to Holocene climate change events caused by either that the population or the ecological carrying capacity responds slowly to changes in climate. Thus, it is likely that the slight decrease in the frequency of shoreline-dated sites beginning around 8500 cal BP cannot be attributed to the 8200 cal BP event. However, the increase in the number of sites from c. 8000 cal BP can perhaps be caused by a delayed human response to the 8200 cal BP event indicating increased activity in the coastal area following the climate change.

Resilient or plain luck?

Although characterized as potentially vulnerable for climate-induced changes in resources, the results provided by the spatial and temporal distribution of shore-bound sites suggest that the hunter–gatherers in the Oslo fjord region were not affected by the climatic cooling 8200 years ago. The results are further supported by zooarchaeological material from sites such as Skoklefald and Huseby Klev, which demonstrates that the specialized subsistence strategy of the hunter–gatherers in the Oslo fjord area persisted after the cooling period. The fact that the knowledge, technology, and skills associated with this particular subsistence strategy were reproduced and transmitted to future generations implies that the dependency on marine resources, and fishing in particular, was a successful adaptation and that the hunter-gatherer population was resilient to the environmental changes that were brought about by the 8200 cal BP event. Moreover, the increase in frequency of shore-bound sites from c. 8000 cal BP indicates an even larger dependency on marine resources after the climatic cooling. Further, the percentage of shore-bound sites situated near straits increased during the latter part of the period covered by this study. Straits are associated with strong tidal currents with rich and predictable marine resources. Along the Norwegian coast, especially along the western coast, an abundance of Stone Age sites have been found in connection to these straits, signifying the importance of marine resources, especially fish (Bakka 1993; Bergsvik 2001). Thus, there appears to be an increasing preference for this particular location from 8200 cal BP onwards which may support the earlier-mentioned assumption that fishing gradually became more important and specialized in the latter part of the Early Holocene.

But, how was the adaptation successful and what made the hunter–gatherers resilient in spite of being characterized as potentially vulnerable? Clearly, its success can, of course, be a result of the fact that the ecological niche of the hunter–gatherers was not negatively affected by the environmental changes. Nevertheless, part of the success of the hunter–gatherers can perhaps also be linked to different strategies for coping with changes and variability in resources.

Although fishing may be considered a costly, technology-dependent, and specialized subsistence strategy, there is a difference between groups who target a particular type of fish and those who target a range of different species using different techniques – the latter group being less vulnerable to climate-induced changes in resources (Marshall et al. 2010:11). The zooarchaeological material indicates that the hunter–gatherers in the Oslo fjord area practised different types of fishing techniques and targeted different types of fish species – likely due to seasonal variations in resources. Unfortunately, the available zooarchaeological material from the case study region is too fragmented and limited to reveal potential short-term adjustments in their behavioural strategies, such as intensification or diversification of marine resources, during the climatic cooling. Another risk-reducing strategy was food storage. Food caching was an important strategy to store food for future use, and ethnographic data shows that this was particularly common among hunter–gatherer groups living in cold environments with resource variability (Kelly 2013:103), such as the case study region. Apart from a possible fermentation pit from the Sunnansund site in southern Sweden, there is little direct evidence of food storage in Scandinavia during the Early Holocene. The assumption that the hunter–gatherers stored food is largely based on indirect evidence, such as traps and weirs as well as the zooarchaeological material (Boethius 2018b:327–328). Mobility was another important strategy for dealing with resource variability, and hunter–gatherers adjusted their mobility if the environmental conditions changed (Halstead & O'Shea 1989; Kelly 2013:ch. 4).

The results of the present analysis demonstrate that the specialized subsistence strategy of the coastal hunter–gatherers in the case study region was successful and persisted over time. The results do, however, raise several issues that need to be explored further, initially by additional palaeoenvironmental reconstructions of past climate changes' effect on different ecosystems, and by more detailed studies of the lithic material from the prehistoric sites. The scale of the present analysis provides a certain pattern that may have several explanations; therefore, additional investigations into the character of the sites are needed. For example, why did the site frequency between 8500 and 8000 cal BP stabilize and then slightly decrease? Is it linked to changes in the mobility pattern where the hunter–gatherers decreased their mobility and occupied fewer sites? Likewise, is the marked increase in sites after c. 8000 cal BP a result of increased mobility or actual population growth? If the latter is the case, can the growth be attributed to an actual increase in the coastal population due to more favourable conditions or movement of groups from areas where the environmental impact of the climatic cooling was more severe? More detailed studies of the character of the sites will hopefully provide us with more insight into what made the specialized hunter–gatherers resilient to climate change.

Conclusion

Initially, it was suggested that the hunter–gatherers in the Oslo fjord in the southeast Norway area had a specialized subsistence strategy and were potentially vulnerable to climate changes. Yet, the results from the present study suggest that the coastal hunter–gatherers in the Oslo fjord area were not affected by the environmental changes following the 8200 cal BP event. The results may further indicate an even larger dependency on marine resources. However, these results need further and more detailed investigations in order to explore the resilience of the hunter–gatherers. Also, palaeoenvironmental reconstructions of past climate changes' effect on different ecosystems are crucial for further studies.

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9 Mesolithic networks of Atlantic France

The two faces of Brittany (7th and 6th millennia cal BC)

Grégor Marchand

The last groups of hunter-gatherers in Atlantic Europe from a historical perspective

The drastic metamorphosis of the French Atlantic shores during the Holocene was driven by the rise in sea level, while isostatic adjustments did not have any tangible influence (Pirazzoli 1991; García-Artola et al. 2018). Consequently, the archaeological traces of maritime societies from the Upper Palaeolithic until the beginning of the Mesolithic were submerged or destroyed during the marine transgression. In the middle of the 7th millennium cal BC, the level of the oceans tended to stabilize at about 15 m below the current level (Pirazzoli 1991; Stéphan & Goslin 2014; Goslin et al. 2015) and these fishing settlements began to appear but only on rocky coastlines. The long sandy shorelines between the Armorican Massif in the north and the Pyrenees in the south are much more exposed to erosion and do not provide any such records. They are thus excluded from this overview. The neolithization of Atlantic France at the end of the 6th millennium cal BC marks the end of the Mesolithic communities. Therefore, these last maritime societies can only be viewed through a narrow window, in time and in space, that is, in the south of the Brittany region between the 7th and 6th millennia cal BC. This corresponds entirely to what archaeologists call the Teviecian, on the basis of the technical and stylistic characteristics of the tools (Figure 9.1).

The theoretical question of the special status of these maritime populations arose at the end of the 1970s and was widely debated in the social anthropology sphere during the 1980s, followed by a rapid transfer of the issues to the field of Prehistory. After the general reinstatement of hunter-gatherer lifestyles (Lee & DeVore 1968; Sahlins 1974), it became clear that many societies based on hunting and gathering practices did not fit the mould, particularly those on North Pacific shores, in America or Asia. In particular, their highly hierarchical social organization, specialized economy or sedentary settlements contrasted sharply with the other hunter-gatherer practices. Most of them revolved around the widespread use of aquatic resources, and were thus placed in a separate category, that of 'maritime hunter-gatherers' (Yesner 1980; Erlandson 1988). These human communities set up specialized economies which sometimes

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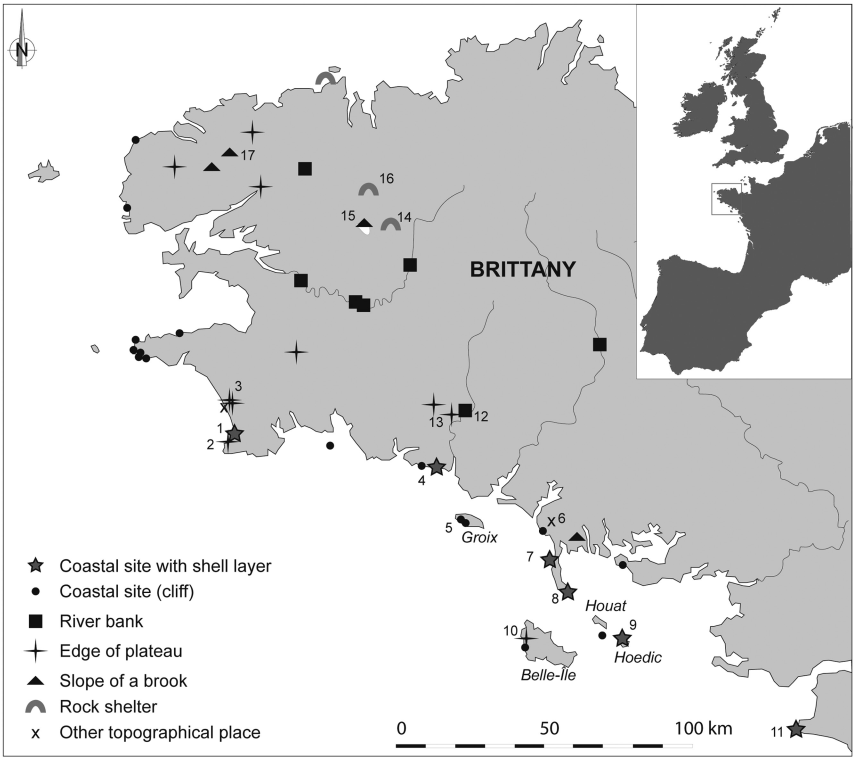

Figure 9.1 Map of the main Late Mesolithic sites in Brittany, according to the type of dwelling. Island names are in italics. Location of the sites mentioned in the text or tables. 1: Beg-an-Dorchenn (Plomeur, Finistère); 2: Porz-Carn (Penmarc'h); 3: Ty-Nancien (Plovan); 4: Pors-Bali (Moëlan-sur-Mer); 5: Roc'h Gored (Groix); 6: Lannec-er-Gadouer (Erdeven); 7: Téviec (Saint-Pierre-Quiberon); 8: Beg-er-Vil (Quiberon, Morbihan); 9: Port-Neuf (Hoedic); 10: Bordelann (Sauzon); 11: Saint-Gildas (Préfailles); 12: La Villeneuve (Locunolé); 13: Loc-Ivy (Tréméven); 14: Kerbizien (Huelgoat); 15: La Presqu'île (Brennilis); 16: Pont-Glas (Plounéour-Ménez); 17: Kerliézoc (Plouvien). Illustration: G. Marchand.

generated surpluses, with an extremely elaborate technical system and high population densities (Binford 2001; Sassaman 2004; Kelly 2007). By contrasting immediate-return systems versus delayed-return systems, J. Woodburn (1982) opened the field for other ecological systems, while highlighting a specific economic aspect with major social implications. In particular, the control of the labour force to build up reserves by certain groups of individuals – sometimes through slavery – could give rise to political systems referred to as 'complex' (Arnold 1993, 1996). In Northern Europe, this was immediately applied to the world of archaeology to study the last Mesolithic groups. The search for traces of social complexity was either centred in an evolutionary perspective on the pathway towards the Neolithic (Price & Brown 1985; Zvelebil 1986), or as one of the possible socio-economic solutions for societies (Rowley-Conwy 2001). In France, A. Testart (1982:26) focused more specifically on the notion of storing abundant food resources on a seasonal basis. According to this latter author, the practice of wide-scale food storage represented a more important cut-off point in history than the invention of agriculture. In more recent works asserting evolutionism, he also suggests that the management of riches determines the forms of social organization, while the organization of the political systems at the end of the Mesolithic and the beginning of the Neolithic is described as minimal (Testart 2012:468).

This theoretical substratum was disparately applied by archaeologists but eventually permeated all the studies carried out in Atlantic France on the Mesolithic and neolithization, and in particular, the essential question of religious and funerary megalithism. The development of funerary monumentality around 4600 cal BC (Middle Neolithic 1) was associated with an elite's control of the circulation of axes, bracelets or beads in exotic rocks with a high social value (jadeite, serpentine, variscite), which are clear markers of strong social hierarchies (Pétrequin et al. 2013). Where and how did these emerge? Megalithism developed here from the beginning of the 5th millennium cal BC at the tip of the two main neolithization currents affecting Atlantic Europe, derived, respectively, from Central Europe (Linearbandkeramik – LBK) and the Mediterranean Basin (Impressed Ware including Impressa and Cardial), in zones where groups of maritime hunter-gatherers flourished during the whole of the previous millennium, from Portugal to Denmark (Marchand 2014). In the 1930s, links were established in the south of Brittany between the Mesolithic graves of Téviec and the funerary vaults from the beginning of the Neolithic, based on formal analogies or technical similarities (Le Rouzic 1931:44–45; Boujot & Cassen 1993; Large 2013).

Do these general setups justify all sorts of hasty and hazardous analogies? Each Late Mesolithic site in Atlantic coastal areas has been analyzed in terms of 'complexity', 'sedentariness' and 'storage', but ultimately these high-flown ideas only tend to limit or obstruct reflection. Everything happens as if the mere presence of the actors on the stage of the theatre defines the text, whereas they only partly condition it. Our current work is precisely to reflect on these possible interactions between actors (and we have not even identified them all!) and the chronology of events, to compose one or more narratives. Our analyses based on archaeological remains from the end of the Mesolithic and the beginning of the Neolithic cannot back away from this rather teleological evolutionary point of view, as we have to account for the possible participation of native communities in the local development of agro-pastoral societies. However, our work focuses more on the analysis of the social, cultural and economic networks from the end of the Mesolithic, which represent the backbone of our conception of the 'Mesolithic landscape'. We focus primarily on the function of settlements and the mobility practices of these populations, in other words, on the hubs of these networks and their connectivity. What types of networks involving human and non-human populations emerged in highly contrasting maritime, estuarine and continental ecosystems? And how can an archaeological or technological approach transcribe these interactions?

Presentation of the archaeological corpus

The legacy of previous researchers

In the West of France, the excavations of M. and S.-J. Péquart between 1928 and 1934 established key milestones for understanding the Late Mesolithic. These are still indispensable today, in spite of major stratigraphic problems and of the partial conservation of the unearthed archaeological finds. Their work initially focused on the island of Téviec (Saint-Pierre-Quiberon) between 1928 and 1930 (Péquart et al. 1937), then Port-Neuf on Hoedic Island between 1931 and 1934 (Péquart & Péquart 1954). In both cases, a cemetery was immersed in a layer less than a metre thick, containing bones, sandy sediments, ashes, charcoal, chipped flint and shells. The dissolution of the shells and the covering of the sites by dunes counteracted the natural acidity of the Armorican Massif soils. These exceptional taphonomic conditions led to the recovery of 23 individuals in ten tombs in Téviec and 14 individuals in eight graves in Hoedic (Figure 9.2). Distinctions between styles were then made on the basis of the grave goods (Taborin 1974),

Figure 9.2 The necropolis of the island of Hoedic in 1933. The individual or collective tombs installed in the shell levels were clustered in a zone of about 30 m^2 and did not overlap. Photo: Marthe and Saint-Just Péquart/Fonds Melvan. Reprinted with permission.

or the degree of wealth based on age (Schulting 1996). In addition, systematic isotopic analyses demonstrated the dependence of these populations on marine food (Schulting & Richards 2001). Less importance was accorded to domestic structures than to graves. There is also a scarcity of stratigraphic analyses: although the Péquarts described the contemporaneity between the shell deposit and the tombs immersed inside it, we cannot rule out the hypothesis of temporal discontinuity, with burials occurring well after the abandonment of the settlement. The question remains open ended. During the 1980s, excavations by O. Kayser in the shell midden of Beg-an-Dorchenn (Plomeur, Finistère) and Beg-er-Vil (Quiberon, Morbihan) resulted in improved knowledge of the technical traditions and paleoenvironments (Kayser 1992; Tresset 2000, 2005; Dupont et al. 2009; Marchand 2014; Dupont 2016), although no new cemeteries were discovered. These four shell middens yielded very diverse archaeological findings, and form the basis of this chapter.

The continuous prospections conducted in ploughed fields from the 1970s onwards represent another important research impetus in the west of France (Gouletquer et al. 1996). These prospections are a veritable application of participative science (before this term became part of the new European research language), and rally dozens of amateur archaeologists alongside students and professional researchers for long-term monitoring of the landscape. As a result, about 1400 sites have been discovered just in the west of Brittany (Finistère department) and 10 open-air sites have been excavated since 2000 (Marchand 2009). After that, the focus shifted to small, episodically occupied rock shelters in this geographic zone (Marchand et al. 2011). At the present time, 28 Late Mesolithic sites have been excavated in the west (Normandy, Brittany, Pays-de-la-Loire), and hundreds of surface sites have been recorded. On account of soil acidity, bone remains are never conserved, and the analysis carried out on non-coastal zones is focused on not only the original economy of raw materials (Yven 2003; Marchand & Tsobgou Ahoupe 2009), but also typological and technological markers (tools, debitage techniques and methods).

The Late Mesolithic (or Teviecian) thus presents two faces in Brittany, one on the coast, the other inland. It is linked to different research methods, but this alone does not explain the differences observed in terms of dwelling organization. Does this reflect differences in mobility? How do these two faces – landscape and seascape – fit together?

Beg-er-Vil: a new insight into domestic life on the coastline

The excavations undertaken by our team at the site of Beg-er-Vil in Quiberon (Figure 9.3) in 2012, and still in progress in 2018, aimed to explore other aspects of coastal landscapes from the end of the Mesolithic; on the one hand, the dwelling structures around the shell midden, and on the other hand, a more detailed analysis of links with the natural environment (Marchand & Dupont 2014; Marchand et al. 2016, 2017). The first excavations focused on the shell midden over a surface of 57 m^2, the latter on the sandy surroundings over

Figure 9.3 Aerial view of Beg-er-Vil at Quiberon. The site with the shell midden is in front of and under the car park, in the centre of the image. Photo: H. Paitier. Printed with permission.

more than 300 m^2. The work concerns a single, very organic archaeological level, lying on natural formations of either the dismembered Pleistocene beach or the rock, and protected by a dune. The two excavated zones lie on slopes with different gradients: the shells were spread over a slight slope whereas the sandy level is almost horizontal. The geoarchaeological data show that the shell midden is both a waste zone and an intensely trampled activity area (M.-L. Onfray analysis in Marchand et al. 2016). Ten pits have been identified in both areas, the largest of which reaches a diameter of 1.5 m and a depth of 0.6 m (Figure 9.4). Several types of hearths (circular areas paved with rubified stones, depressions surrounded by slabs, hearth with surrounding horizontal slabs, pits with thermal alterations of the walls) indicate the importance of combustion activities in daily life. They may point to different uses still to be defined.

Four meters to the east of this shell dump, small stone blocks were placed vertically in the ground and marking postholes, spaced by about 20 cm. The whole layout clearly marks out a circular dwelling structure with a diameter of 3.5 m. It contained a pit in the middle filled with charcoal and burnt bones, delimited by carefully organized, intensely rubified slabs (Figure 9.4). This dwelling structure is implanted in a flat zone, bordering the zone of waste spread out towards the sea. The spatial analysis of the dispersal of remains, but also micromorphological and geochemical analyses may help us in the future to decipher whether this is a

Figure 9.4 Hollow hearth surrounded by sloping slabs (Structure L) installed in the middle of a circle of post wedges interpreted as a circular hut, at the site of Beg-er-Vil at Quiberon (2017 excavation). Photo: G. Marchand.

dwelling, a fish or meat drying structure or even a sweat lodge. In any case, these recent excavations normalize the somewhat mysterious notion of a shell midden, in order to describe a coastal dwelling in all its complexity. Judging by the descriptions and photographs of M. and S.-J. Péquart at Téviec and Hoedic, the same applies to these sites, although these domestic aspects were largely eclipsed in their records by the description of the tombs.

Chronology

About 40 radiocarbon dates are available for the Late Mesolithic in Brittany and Pays-de-la-Loire, but these measurements are not exempt from criticism, in particular because of the oceanic reservoir effect, which is difficult to assess in human bones. As a consequence, the dates ranging between 6200 and 6000 cal BC for Beg-er-Vil and 5700 and 5500 cal BC for Beg-an-Dorchenn appear to be the most reliable markers for this coastal Mesolithic. There are dates at around 5400 cal BC at Téviec on human bones, while a roe deer in a tomb has been dated to about 6000 cal BC: what result should we believe? New test pits are thus required to shed light on this question. In the continental sphere, the Pont-Glas rock shelter (Plounéour-Ménez, Finistère) and the open-air site of Kerliézoc (Plouvien, Finistère) have yielded dates in the 5400–5300 cal BC interval for the Teviecian, but in more controversial sedimentary contexts. To sum up, the Teviecian extends in Brittany between 6200 and 5400 cal BC, with extremely minor changes (appearance of asymmetric trapezes among the geometric arrowheads after 6000 cal BC).

For clarity of discourse, the chronology of the regional Neolithic requires a prior presentation of its roots, since it is fundamentally a process of diffusion. In Mediterranean France, the Impressed Ware groups developed during the 6th millennium cal BC, after transferring from Italy and subsequently expanding into eastern Spain. It includes two successive cultural entities quite distinct in their stylistic manifestations: the Impressa facies is dated to the 5850–5650 cal BC interval; then, after a hiatus, groups that use Cardial pottery develop from 5400 to 5250 cal BC (Perrin et al. 2017). The modalities of the transfer of the Cardial (the Impressa is only a coastal group) from the Mediterranean coast to the Atlantic coast – 370 km across south-west France – remain very poorly known. However, one thing is certain following the typological and technological analyses of the lithic and ceramic industries: there was no colonization by circumventing the Iberian Peninsula, as supposed in the 1980s, but a probable transfer across the continent and especially along the Garonne River, the most direct way (Marchand & Manen 2006).

The first occurrences of groups affiliated to an evolved Cardial pottery appear by the Atlantic shores at the end of the 6th millennium cal BC, but in very disturbed archaeological contexts on the beaches. They correspond to ancient marshlands or a coastal lagoon invaded by the sea. The most notable of these coastal sites are la Lède-du-Gurp (Grayan-et-L'Hôpital, Gironde; Roussot-Larroque & Villes 1988) and le Grouin du Cou (La Tranche-sur-Mer, Vendée; Joussaume 1986). But it is the advanced phase of the Early Neolithic, in the 4700–4500 cal BC interval, which is particularly well recorded between the Loire River and the Pyrénées mountains (south-west of France).

The area north of the Loire, where the chronology can be connected to the Central European chronological system, based on the development of the LBK, is not affected by the same challenges. The sites are relatively frequent as a result of rescue archaeology operations and dating is not impeded by the reservoir effect, as only seeds and charcoal are used for isotopic counts. The numerous archaeological remains show a process of diffusion, which is relatively easy to identify due to the standardization of settlements as well as technical and stylistic standards from the last century of the 6th millennium until about 4700 cal BC.

This brief chronological panorama highlights a development of the Late Mesolithic of Brittany until 5400 cal BC, with a hiatus of around at least four centuries until the early Neolithic at around 5000 cal BC. The process of neolithization of this peninsula is the latest in France.

Economic network of coastal societies during the Mesolithic

Presumed functions of certain coastal sites

Four types of Mesolithic sites can be described along a several hundred-metre-wide coastal strip (Table 9.1 and Figure 9.5). In addition to the shell middens with necropolises (Téviec type) and without necropolises (Beg-er-Vil

Table 9.1 Classification of the Late Mesolithic dwellings in Brittany (6th and 7th millennia cal BC)

Geographic context	*Type of site*	*Example (townland in brackets)*	*Implantation*	*Position of the site in the water cycle*	*Archaeological structure*	*Tool production*
Coastal zone	Shell layer with necropolis	Téviec (Saint-Pierre-Quiberon)	Coastline – small cliff	Ocean	Stone-lined hearths, tombs, cenotaph, paved area	Diversified
	Shell layer without necropolis	Beg-er-Vil (Quiberon), Beg-an-Dorchenn (Plomeur)	Coastline – small cliff	Ocean	Paved area, pits, hearths	Diversified
	Cliff top	Pors-Bali (Moëlan-sur-mer), Porz-Carn (Penmarc'h)	Coastline – cliff	Ocean	Unknown	Production of bladelets – armatures
	Inland open air	Ty-Nancien (Plovan)		Stream	Unknown	
Island	Shell layer with necropolis	Port-Neuf (Hoedic)	Coastline – small cliff	Ocean	Hearths, tombs, cenotaph, paved area	Diversified
	Open air	Bordelann (Sauzon)	Edge of plateau, above a steep valley and a stream	Source – near a permanent stream and the ocean	Unknown	Diversified
	Open air	Roc'h Gored (Groix)	Coastline – cliff	Ocean		Diversified
Hill	Open air	La Presqu'île (Brennilis)	Side of valley	Near a permanent stream	Unknown	Diversified
	Rock shelter	Pont-Glas (Plounéour-Ménez)	Rocky chaos – side of plateau		None	Armatures brisées

Peneplain	Quarry sites	Loc-Ivy (Tréméven)	Side of plateau and slope	Stream	Pit?	Waste
	Necropolis (?)	Lannec-er-Gadouer (Erdeven)	Middle of plateau	Badly drained	Pits	Armatures and knives
River mouth	Shell layer	Saint-Gildas 1b (Préfailles)	Coastline – cliff	Estuary	None	Diversified
	Cliff top	La Gilardière (Pornic)	Coastline – cliff	Estuary	Ocean	Production of bladelets – armatures
	Coastal open air	Saint-Gildas 1c (Préfailles)	Coastline – cliff	Estuary	None	Diversified
Low navigable river terrace	Open air	La Villeneuve (Locunolé)	Low terraces	River side	Unknown	Diversified

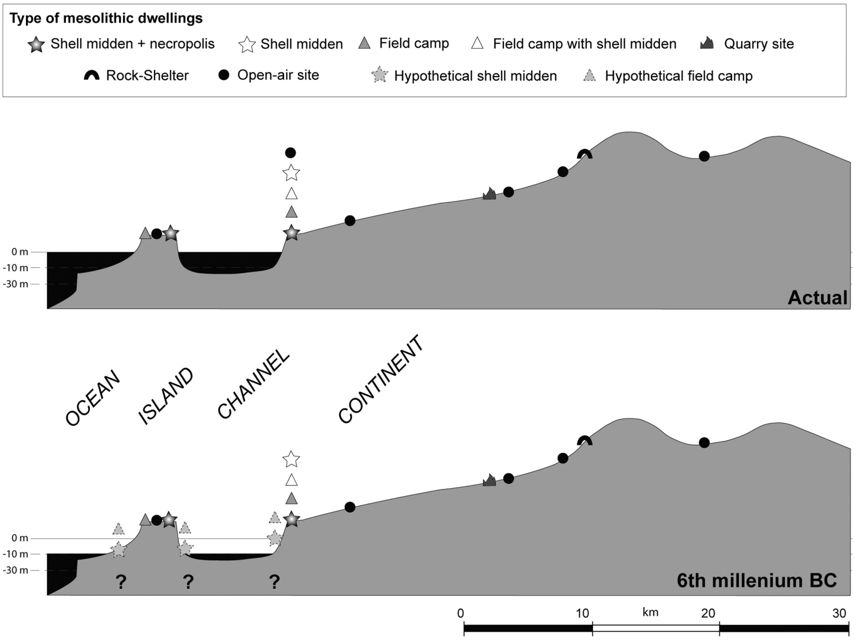

Figure 9.5 Schematic north–south sections of Southern Brittany with indications of the different types of Mesolithic sites on the islands, the coast and the mainland. Top: current situation; bottom: situation during the 6th millennium cal BC, with indications of the submerged sites. Illustration: G. Marchand.

type) described above, we can point to the existence of vast open-air sites identified by a layer of knapped flint extending over several hundred square metres, where limited test pits have not revealed any stratigraphy or structure (Ty-Nancian type). Present-day cliff tops also contain sites spread over a diameter of several dozens of square metres (Pors-Bali type). The same applies to the islands, apart from shell levels with no necropolises. To understand the economic networks initially involves identifying the activities carried out at the different dwelling sites. The investigation of these is based on the types of identified structures, the production sequences and the tool types represented at the site. Functional analyses of the toolkits are only just beginning (Guéret et al. 2014). The types of faunal remains are clearly essential for this investigation, but they only concern the four shell levels and not the other sites where the sediments are too acidic for the conservation of bone remains.

The funerary function of Téviec and Hoedic gives these sites a specific status in the coastal Mesolithic landscape. The important characteristics of these cemeteries are the (1) immersion of the pit tombs in a shell midden containing abundant daily life waste (bones, charcoal, knapped flint, rubified stones);

(2) concentration of the tombs in a specific area over a low surface of the site (40–50 m^2 at Téviec for an excavated surface of 320 m^2, about 30 m^2 at Hoedic for an excavated surface of 200 m^2); (3) absence of overlap between the tombs, which are marked on the surface by little 'cairns' or a few boulders (Téviec); (4) single graves, but also the grouping of several deceased in a tomb (2–6), deposited at the same time or successively (Péquart et al. 1937; Péquart & Péquart 1954). It is certain that the graves are dug in the shell layers and filled with its sediments. It cannot be decided whether the occupations were contemporary with the burials (the dead are buried in the rubbish heap in the middle of the village) or whether the burials took place in a deserted village (the dead are deposited in the village of the Ancients) because of the lack of observations in the 1930s excavations. While waiting for future complementary excavations, we can only insist on the exceptional role of these shell middens in the Mesolithic seascape. The cemetery was a pivot in the social space of these maritime hunter-gatherers, a place they came back to regularly and which acted as a symbolic interface between the dead and the living.

What about the domestic activities on these sites? They are represented by abundant bone remains, tools and debitage waste. There is a greater variety of objects than on small sites and there is no obvious specialization in the tools or early uses that traceological analyses reveal. In coastal dwellings, other pits clearly served as hearths, such as at Téviec and Beg-er-Vil. At the most, they measure 1.50 m in diameter, more often a metre, with depths ranging between 0.3 and 0.6 m, and they were filled with waste from daily life. At Beg-er-Vil, there are also pits with unknown primary functions, one of which was interpreted as a storage space (Kayser & Bernier 1988). It is difficult to support this hypothesis without any evidence as its morphology corresponds to the other combustion pits. The Beg-er-Vil 'hut' or 'wigwam' described above can, of course, be added to the dwelling structures. In Beg-an-Dorchenn and Hoedic, three circular areas were paved with large-sized beach pebbles (Marchand 2014). The one at Beg-an-Dorchenn was excavated in 1986–1987; it had a diameter of 2.5 m and a fireplace in the middle. The function of these last structures is unknown but the reasonable hypothesis of dwelling houses can be made (more massive than at Beg-er-Vil).

Compared to these four sites with shell deposits, the archaeological remains of the other Mesolithic settlement on the coast seem rather insignificant. This may be partly due to the fact that limited surfaces have, as of yet, been explored, and always by test pits only.

Fishing and hunting economies in a coastal ecotone situation

At the crossroads of the maritime and continental environments, obviously very contrasted, the coastal strip forms a very particular ecotone, which is rather narrow at these latitudes (less than 1 km wide), the occupation of which would have offered a very diverse range of resources in prehistory. They are expressed in multiple cycles, the seasons and the tides being the most notable.

How did humans exploit it and fit in? This is ultimately the question behind the understanding of mobility modalities. In terms of weight, land mammals (red deer, wild boar, roe deer and more rarely aurochs) dominate the faunal remains, followed by marine animals (seal). This diet is also supplemented by the capture of prey accessible on the seafront, made up of molluscs, fish and birds (Dupont et al. 2009, 2010; Tresset 2000, 2005; Marchand et al. 2016). The dates of capture are spread throughout the year, which is another characteristic of these hunting-gathering economies (Table 9.2; Dupont et al. 2009), along with the diversity of prey, which may be linked to the status of the site or occupation duration (Dupont 2016).

Estimating hunting seasons is a developing topic in western France and the data remain preliminary (Marchand 2014:264–290). Only 'massive' hunting and fishing will be considered here, as most animals are present year-round but scattered in space. The best harvesting season for shellfish is in the early warm season, but the first sclerochronological studies conducted by C. Dupont on clams show collections both in this season and in the fall (Dupont et al. 2009). And the millions of shells present on Beg-er-Vil could also testify to other periods, not represented by the small sample analyzed. Fish such as sea bream or the old bream are present mainly in summer. For grey seals, the period of aggregation on land is in winter, and for reproduction on land in October–November (most frequent period at present; however, no data from archaeological records are available). In contrast to these seasons of predation, southern Morbihan is a wintering area for many birds, such as ducks and woodcocks.

Hunting large mammals sometimes benefits from the grouping of animals during rutting periods: deer in summer and autumn and wild boar in early winter. The two species are particularly concentrated in winter. There are hunting and fishing opportunities all year round on the coastal settlement of Beg-er-Vil, but with a reliable chronology extending over less than two centuries, we should not speak of sedentary lifestyles, as multiple stays at the site are also possible.

Fish traps and specialization?

The massive collection of marine molluscs is visually striking, as the shells cover the levels with thicknesses from 0.30 (in Hoedic) to 1 m (in Téviec), as well as crab remains. The same does not apply to fish (sea bass, wrasse, ray, tope shark), as their remains are less visible. However, the question of fisheries or fish traps must nonetheless be raised, as they are known in similar Mesolithic ecosystems in Ireland (McQuade & O'Donnell 2007) and Denmark (Pedersen 1995). More than 600 fisheries have also been recorded in Brittany during historic periods (Langouët & Daire 2009). This demonstrates that these are economic practices that are profitable and not marginal in Atlantic France. These structures are of considerable importance for all these economic systems, on account of their implications in terms of predation

Table 9.2 Data on the potential current seasons of resource exploitation (dark grey: period when the resource is most accessible; light grey: period when the resource is commonly accessible; white: period when the resource is not accessible; from Dupont et al. 2009)

Site	*Origin of remains*	*Species*	*Season of availability*															
			Winter				*Spring*				*Summer*				*Autumn*			
Beg-an-Dorchenn	Birds	Great auk (*Alca impennis*)							▓	▓	░	░						
	Molluscs	All molluscs	░	░	░	░	░	░	░	░	░	░	░	░	░	░	░	░
		Carpet shell (*Tapes decussatus*)	░	░	▓	▓	▓	▓	▓	▓	░	░	░	░	░	░	░	░
	Fishes	All fishes	░	░	░	░	░	░	░	░	░	░	░	░	░	░	░	░
		Tope (*Galeorhinus galeus*)									▓	▓	▓	▓				
		Gilthead sea-bream (*Sparus auratus*)									▓	▓	▓	▓				
	Fruits	Hazelnut (*Corylus avellane*)													▓	▓	▓	▓
Beg-er-Vil	Birds	Razorbill *Alca torda*)			░	░	░	░	▓	▓	░	░						
		Great auk (*Alca impennis*							▓	▓	░	░						
		Guillemot (*Uria aalge*)	░	░	░	░	▓	▓	▓	▓	▓	▓	░		░	░	░	░
		Woodcock (*Scolopax rusticola*)	▓	▓	▓	▓	░ ?	░	░	░	░ ?	░	░	░	▓	▓	▓	▓
		Duck (*Anas platyrhyncos*)	▓	▓	▓	▓	░	░	░	░	░	░	░	░	░	░	░	░
	Molluscs	All molluscs	░	░	░	░	░	░	░	░	░	░	░	░	░	░	░	░
		Carpet shell (*Tapes decussatus*)	░	░	░	░	▓	▓	░	░	░	░	░	░	▓	▓	░	░
	Fishes	All fishes	░	░	░	░	░	░	░	░	░	░	░	░	░	░	░	░
		Tope (*Galeorhinus galeus*)									▓	▓	▓	▓				
		Gilthead sea-bream (*Sparus auratus*)									▓	▓	▓	▓				
	Fruits	Wild pear (*Pyrus cordata*)													▓	▓	▓	▓

(*Continued*)

Table 9.2 Continued

Site	*Origin of remains*	*Species*	*Season of availability*			
			Winter	*Spring*	*Summer*	*Autumn*
Téviec	Birds	Razorbill (*Alca torda*)	·░	░▓	░···	·
		Great auk (*Alca impennis*)	··	·▓	░···	·
		Guillemot (*Uria aalge*)	░░	▓▓	▓▓░·	░
		Atlantic puffin (*Fratercula arctica*)	·▓	▓▓	▓▓░·	·
		Woodcock (*Scolopax rusticola*)	▓▓	░░	░░░░	▓
		Duck (*Anas platyrhyncos*, *A. penelope*, *A. acuta*, *A. crecca*)	▓▓	░░	░░░░	░
	Molluscs	All molluscs	░░	░░	░░░░	░
		Cuttlefish (*Sepia* sp.)	··	▓▓	▓▓▓▓	·
	Fishes	All fishes	░░	░░	░░░░	░
		Tope (*Galeorhinus galeus*)	··	··	▓▓▓▓	·
	Fruits	Wild pear (*Pyrus cordata*)	··	··	····	▓
		Hazelnut (*Corylus avellane*)	··	··	····	▓

profitability, population stability, territorial control, the mobilization of collective energies, excellent knowledge of the maritime domain, construction techniques and storage techniques. In the west of France, these structures consist of stone or wooden walls, also referred to as dams or weirs, 100–200 m long, installed in the mid-foreshore to benefit from the two daily tides. When the sea retreats, fish and crabs are trapped and can be gathered without much danger, in a sluice or directly with a net. Salt can also be collected. Direct dating of the stone works is generally impossible and the wooden installations are recent. However, specialists propose using sea levels as an approximation: since the weirs must be located in the middle of the intertidal zone to function optimally, a construction date can be proposed using the sea-level curve (Langouët & Daire 2009). Several dozens of these structures only seem to have operated with sea levels ranging between 7.6 and 4.7 m below the present sea level. These levels were reached at the end of the Mesolithic and the beginning of the Neolithic (Stéphan & Gosselin 2014): it is not enough to strictly demonstrate the existence of these fish traps in the Mesolithic, but it encourages us to redouble our work to test this hypothesis. Side-scan sonar and sub-bottom profiler prospecting was conducted in April 2013 in a zone of about 1.2 km^2 in the whole bay in front of Beg-er-Vil, but no walls were detected. Other sub-marine investigations are needed.

In the Mesolithic in the west of France, no evidence of intensive fishing has been identified on the basis of fish bones and there are no signs of specific mollusc gathering. A single pebble with two opposite notches – generally interpreted as a fishnet weight – is identifiable at Téviec, but none has been detected at Hoedic according to the Péquarts, and none at Beg-er-Vil, in spite of the fact that we examined thousands of pebbles. There are no significant proportions of fish remains in these dwellings, and even the presence of fish bones is rather limited. The abundance of burnt stones at Beg-er-Vil could be linked to drying or smoking fish or molluscs, but this is, at most, a marker, and does not provide proof of such activities. The possibility of the massive trapping of fish in foreshore fish traps remains open. This, however, would impose fish processing outside the actually known dwellings and a possible storage of fish fillets in open-air structures; it involves too much conjecture in relation to the available data.

To summarize, the wide spectrum of these ecotone economies does not show any traces of specialization focusing on one species, nor any means of mass capture, storage for later consumption or preparation for exportation to other dwellings. All the fish caught are accessible from the coast and the presence of cetacean vertebrae at Hoedic and Téviec does not point to offshore fishing, but rather to opportunities linked to stranding. In the same vein, all the animal species of the intertidal zone were exploited, not just the low tide zone, which is the richest (C. Dupont, personal communication): this means that humans were clearly adapted to these foreshores all year long and that they did not practice occasional passages on the occasion of very large tides.

The islands and maritime mobility

Taking into account the most recent curves of marine upwellings for the region (Stéphan & Goslin 2014) and bathymetric records (Meunier 2003), truly insular occupations during the Mesolithic are known on Hoedic, Belle-Île and Groix, but not for Téviec, which was connected to the continent during the 6th millennium. What role do the islands play in this littoral system? Living on an island not only forced human populations to adapt by confronting them with isolation and limited terrestrial resources, but it also forced them to navigate frequently in order to have sufficient resources. The choice to establish dwellings there may have been based on symbolic considerations or on an expansionist tropism of our species. Here, we can only elucidate certain economic and technical parameters. How can we explain the presence of numerous Mesolithic sites on islands with such a fragile ecological equilibrium? If we consider the ways of life of red deer, roe deer and wild boar, Belle-Ile (currently 8500 ha), Groix (1480 ha) and Houat/Hoedic (2200 ha during the 6th millennium) may have comprised several hundred animals, with however, possible difficulties for wild boar and especially for male red deer, which need a lot of space. This may have resulted in aggressive behaviour or modified reproduction cycles. It is clear that the survival of these large mammals in closed environments depended on the strict management of prey by human populations, with no resilience, unlike in continental zones. Moreover, today, these large mammals no longer exist on the islands and no date has yet been advanced for their extinction. We can also very legitimately hypothesize the importation of mammalian carcasses (whole or cut) on these islands with too few large mammal resources. This is obvious from the aurochs bones found in Hoedic, but this can also be questioned for all other mammalian remains such as red deer. The disappearance of the bones remains after the excavation prevents further study on this subject.

In any event, there is no economic reason to set up an extensive predation economy based on terrestrial game on these islands. Only the marine resources are conducive to establishing long-term settlement. Furthermore, the abundance of sites and the number of flints show that the occupation was regular and the organic remains conserved at Hoedic reveal that oceanic resources were preponderant in the diet. Seal hunting is also another possibility to keep in mind, although it cannot be proven, as no bones of this animal were conserved on the islands and none was reported in the Mesolithic shell midden of Hoedic.

By a curious geological fluke, these French Atlantic islands contain very few rock resources suitable for knapping. Throughout the region, flint comes mainly from coastal pebbles, but they are relatively rare on island beaches. This shortage of materials was partially compensated by the use of quartz pebbles, but with no specific *chaînes opératoires*. Current research shows no differences in technical traditions between the islands and the continent, which implies that contacts with the mainland were very frequent. These exchanges would likely only have covered the demand for specific needs, which means that it is probably more fitting to view these as a result of cycles of collective mobility rather than interaction between separate groups. All these observations point to the hypothesis of regular movements on both sides of the straits. The type of boats used is another problem: the use of dugout canoes in the Atlantic Ocean has yet to be proven. In addition, no large lithic tools suitable for carving out tree trunks have been found in these coastal dwellings, such as axes, adzes, or even choppers or massive end scrapers. In tombs F, H, J and K at Hoedic, there are picks in red deer antler, but the use-wear we observed at the Carnac Museum points more to a use as a pickaxe, with traces of abrasion on a mineral material (personal observation). We must thus presume that other types of boats were used, such as hides stretched on wooden frames. Another possibility is the existence of 'Mesolithic shipyards' outside the dwelling zones, with massive lithic tools which might not yet have been detected. The marine mobility of these populations is thus archaeologically obvious, but the aims and means of this mobility remain obscure.

Interaction with continental societies

Two economic systems for the same cultural entity

No particular lithic tool distinguishes coastal dwellings from inland sites, which are also referred to as Teviecian. Can we imagine complementarities between coastal and continental zones? Mammals gather together at the end of the summer and at the beginning of the cold season. The great salmon is a richness of the Breton rivers and they probably offered exceptional opportunities for massive fishing, especially during the spring and during the autumn runs of large salmon. Unfortunately, no bones are preserved. We can therefore see that the coastal ecosystem is more attractive in the warm season and the continental zone at the beginning of the cold season. This might suggest a pendulum between the two, but the other archaeological data presented below do not support this hypothesis.

Two opposing economic systems appear to have existed during this period for the region of Brittany; one based on the exploitation of the coastal strip, the other on the predation of land resources towards the interior of the peninsula. This hypothesis is based on three foundations: (1) the analysis of the type of rocks used for the toolkit, (2) the isotopic analyses of human bones from coastal necropolises and (3) the predation seasonality based on faunal remains (only on the coast of course).

For sites located 15–20 km inland, the widespread use of local rocks (sandstones, microquartzites, ultramylonites, cataclasites, phtanites) has a considerable effect on the debitage methods and even the style of tools. They are indeed materials of less good quality, for the most part neglected after the

Mesolithic, and their production was very often interrupted by cleavage planes or material faults. The provisioning networks show a large investment in all siliceous rock resources on the peninsula, even though flint pebbles gathered from the coast still represent at least 50% of the raw materials (Marchand & Tsobgou Ahoupe 2009). Continental rocks, however, are never found on the main coastal sites. What does it mean for our understanding of human mobility and exchanges? If the human groups had a 'pendulum' rhythm defined as 'summer on the coast and inland in the winter', ultramylonite or phthanite tools made during the previous season would be found in the shell middens. At least one among the tens of thousands of pieces should be expected to be of these materials, but this is never the case. It would thus seem that flint pebbles circulate through exchanges between these zones rather than through periodic migrations of the same group. It also seems to testify to two different populations.

The second element is the high ratio of marine proteins in the skeletons from the cemeteries of Téviec and Hoedic (respectively, 50% and 80%; Schulting & Richards 2001). This obviously indicates the stability of coastal occupations. The third element is the complete economy we can see in the shell midden of the coast (Table 9.2), mixing continental and maritime preys. The analysis of seasonality based on the growth rings of clams and the dates of capture of the other animal species leaves open the possibility of a prolonged occupation of the shell middens (Dupont 2016; Marchand et al. 2016).

The distinguishing feature of this territorial organization is that it is confined to a small region, Brittany (about 20 000 km^2), with no particular topographic constraint. This dichotomy is directly connected to the ecological and geographic factors, in particular the type of captured prey and the lithic materials.

Another ecosystem, another type of mobility?

Three types of sites coexist in the mainland zone: (1) layers of flint spread over several thousand square metres, in valleys, on low river terraces or on plateau edges (Table 9.1); (2) quarry sites, dwellings on or immediately beside raw material sources (Yven 2003); (3) small rock shelters, such as the Pont-Glas shelter at Plounéour-Ménez (Finistère) in a granitic chaos (Marchand et al. 2011). At the two rock shelters (Pont-Glas and Kerbizien) over 20–30 m^2 was excavated in order to identify possible structures at the sites (whereas the open-air sites were only explored by test pits). In their acidic sediments, charcoal and hazelnut shells are the only organic remains.

Although we have no information on the rhythm of collective mobility, we can perceive the overall territorial extension, which seems to be reduced to about 50 km. There is a contrast between the vast open-air sites and the logistic rock shelter sites, where only some of the debitage was carried out and where armatures are predominant. In both cases, no structures have been detected, which could indicate more frequent mobility practices.

Table 9.3 Summary of the points opposing simple and complex hunter-gatherers (Kelly 2007:294), excluding several unreadable parameters for archaeology, and the analysis of these parameters in several societies from the Atlantic Mesolithic. White boxes: criteria for hunter-gatherer societies; pale grey boxes: criteria for 'complex' societies; dark grey boxes: impossible observations due to the lack of data are marked. The right-hand column proposes a comparison with the Late Mesolithic in Portugal, which is the other great reference for the cemeteries on Europe's Atlantic coast

Parameters	*Hunter-gatherer societies*	*'Complex' hunter-gatherer societies*	*Coastal Brittany (Teviecian)*	*Mainland Brittany (Teviecian)*	*Late Mesolithic in the estuaries in Portugal*
Environment	Unpredictable or variable	Highly predictable or less variable	Predictable and rich	Unpredictable or variable	Predictable and abundant
Food resource	Terrestrial game	Marine diet or terrestrial plants	Mixed terrestrial and marine game	Terrestrial game	Mixed terrestrial and marine game
Dimension of the camps	Small	Large	Small and large	Small and large	Very large
Residential mobility	Medium to high	Low to null	Low	High	Low
Demography	Low population density	High population density	High in Morbihan	Average	High
Food storage	Slight to null	Medium to high dependence	Absent	Absent	Probable, in pits
Social organization	No distinct groups	Lineages	Lineages	?	No lineage, vast cemetery of individual graves
Political organization	Egalitarian	Hierarchical, based on wealth or lineage	Relatively egalitarian	?	?
Specialization	Only for old people	Common	Null or slight	Null or slight	Null or slight
War	Rare	Common	Possible (murders of Téviec)	?	Absent
Competition ethics	Not tolerated	Encouraged	Null	Null	Null
Exchange	General reciprocity	Object of value, competitive festivity	Only functional	Only functional	Only functional

Conclusion

In a relatively flat region, and in the same cultural complex, two opposing economic networks appear to exist, based on very contrasting ecosystems. The extent of their interactions can only be gauged by the transfer of lithic materials, which is clearly very restrictive. The typology of the dwellings is also rudimentary, as complementarities between small sites and more permanent sites are possible in each zone. The estimation of mobility rhythms was developed on coastal material, based on analyses of the captured fauna. Such analyses are still impossible elsewhere due to the lack of excavated material.

Our aim here was to characterize these groups employing a range of parameters. The question of social complexity defined by social anthropology was raised at the beginning of this chapter and some aspects can be concluded here. The comparison with Portuguese shell middens dated to the 6th millennium is appropriate for this time, because they also combine settlement and cemetery (Table 9.3; Marchand, 2015). The common points do indeed exist, even if these Portuguese settlements are at the bottom of estuaries while the Breton sites are at the top of marine cliffs. The comparisons between these two areas are most relevant, at least from a processual or prehistoric ecological perspective. Whether in Portugal or France, there is a lack of clear evidence of specialized activities or storage. Indications of strong social hierarchy or competition between households are totally absent from the Atlantic Mesolithic. Even if the notion of lineage is present in the graves of Brittany, the coastal Mesolithic in Atlantic France does not correspond to the generally defined parameters, contrary to many previous assertions. For the moment, we cannot detect any leaning towards practices of intensified predation or delayed consumption, nor any marked social inequalities in grave goods or grave organization. This only accentuates the drastic rupture with the first stages of the Neolithic in these regions.

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Part III

The resources of the sea and beyond

10 Mesolithic fishing landscapes in western Norway

Knut Andreas Bergsvik and Kenneth Ritchie

Introduction

In many areas of southern and western Europe, Late Palaeolithic and Early Mesolithic marine landscapes are not easily accessible for archaeologists because of heavy flooding during the Early Holocene. The situation is different in parts of northern Europe, because in these areas the early postglacial land rise was faster than rising sea levels (Bjerck 2008). Along the coast of Norway this has resulted in old and well-preserved marine environments and sites on dry land. These sites and environments offer a rare opportunity to study the long-term development of coastal Mesolithic adaptations.

After the retreat of the ice sheet, Norway was populated around 9500 cal BC. The first immigrants encountered rich marine landscapes. Sea mammals and fish were available resources, although data from these earliest colonizers has not yet included faunal material or bone tools. This type of data is, however, present at sites dated to around 8000 cal BC. It appears that fishing was a well-established part of the subsistence base then and continued to play an important role throughout the Mesolithic along the entire Norwegian coast.

In this contribution, we will focus on a well-researched region: western Norway (Figure 10.1). Along the Norwegian Sea coast and the fjords of western Norway there are many similarities in terms of topography and marine resources, and there are common trends in cultural developments throughout the region.

The main problem orientation of this chapter is to characterize marine fishing during the Mesolithic in western Norway and evaluate its importance using direct and indirect evidence. The direct evidence is fish bones and fishing gear from seven excavated sites. Indirect evidence is data on site locations and their relationship to fishing. In our discussions on chronology, we mainly apply 500-year chronozones in the format EM (Early Mesolithic), MM (Middle Mesolithic) and LM (Late Mesolithic), subdivided by numbers (Table 10.1; Bjerck 2008), although we use more precise dates when relevant.

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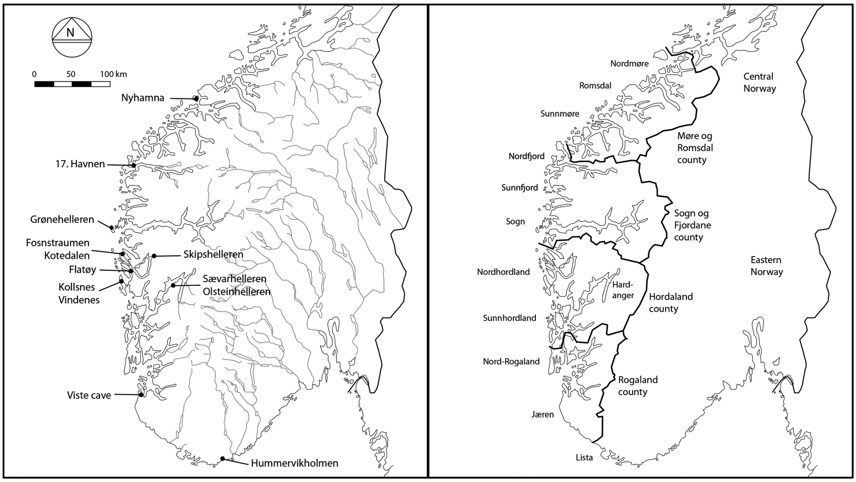

Figure 10.1 Southern and central Norway. Map to the right: Counties in western Norway (names to the right) and districts (names to the left) referred to in the text. Map to the left: Archaeological sites referred to in the text. Illustration: K.A. Bergsvik.

Climate, topography and fish resources

During the Preboreal (c. 9700–8200 cal BC), major changes in topography and climate influenced mobility patterns and site availability, as well as fish resources along the coast of western Norway. In the early Preboreal, the polar front was situated further south than presently (Bjerck 2008:66). According to H.B. Bjerck, the marine biotopes would have been similar to modern Svalbard with fishes characteristic of polar environments, which in turn means that most of the fish species found along the coast today would not have been present. However, as pointed out by L.I. Åstveit (2017), colonization did not start until around the end of the early Preboreal/early mid-Preboreal. From the mid-Preboreal, the Atlantic Current had largely reached its present form, and one would expect a large variety of fish species to be present (Breivik 2014). From this time onwards, the Norwegian Sea had more or less the same temperatures as today (Bang-Andersen 2012; Åstveit 2017 with references). This suggests that the diversity and abundances of fish species observable today (see below) were in place relatively soon after the first immigrants had arrived in western Norway. Accompanying the transition to the Boreal (c. 8200–6950 cal BC) was a major rise in air temperatures, which only increased during the Atlantic period (c. 6950–3800 cal BC), when the mean summer temperature was up to 2°C warmer than today (Bjune et al. 2005). However, it is difficult to say whether these temperature changes had any effect on the fish fauna.

The deglaciation of Scandinavia during the Late Glacial and early Postglacial resulted in not only marked sea-level rise, but also isostatic uplift in western

Table 10.1 Mesolithic chronozones, based on (Bjerck 2008:74)

Chronozones		*Date range cal* BC		*Duration (cal years)*		*Date range uncal* BP		*Duration (uncal years)*
Early Mesolithic	EM1	9500	9000	500		10 020	9590	430
	EM2	9000	8500	500	1500	9590	9270	320
	EM3	8500	8000	500		9270	8900	370
Middle Mesolithic	MM1	8000	7500	500		8900	8400	500
	MM2	7500	7000	500	1500	8400	7970	430
	MM3	7000	6500	500		7970	7690	280
Late Mesolithic	LM1	6500	6000	500		7690	7110	580
	LM2	6000	5500	500		7110	6560	550
	LM3	5500	5000	500	2500	6560	6090	470
	LM4	5000	4500	500		6090	5680	410
	LM5	4500	4000	500		5680	5230	450

Norway. Until around 8000 cal BC, the uplift was stronger than the rising sea levels, and the rate of rebound increased from west to east, from peripheral towards central parts of the previously glaciated region. For Hordaland county in western Norway this means that the marine limit was 30–40 m a.s.l. at the outer coast of Hordaland, and around 110 m a.s.l. in the inner part of the Hardanger fjord (Mangerud et al. 2013). Around 8000 cal BC, the rapid melting of the remaining ice cover in North America led to the Tapes transgression, which flooded coastal areas by as much as 6–7 m, causing massive destruction of coastal sites established during the periods EM3–MM2. In parts of the coastal zone (Jæren and Sogn-Sunnmøre), almost all sites dated to before c. 6000 cal BC were flooded or are situated below today's sea level (Bjerck 2007:10). With increasing distance eastwards, the transgression had less effect because of stronger uplift.

The topographer O. Puschmann (2005) subdivides western Norway into several physiographical zones. To the north of Boknafjorden (between Nord-Rogaland and Jæren), the *outer coast* is characterized by strandflats below sea level as well as above sea level on the rim of islands and headlands exposed to the North Sea and more protected low-lying islands of varying sizes. Generally in this zone, the water is relatively shallow, with depths of no more than 50–100 m b.s.l. Further east, the *outer fjord basins* consist of short fjords and the mouths of longer ones. There are also large islands and fjord basins. Compared to the strandflats in the west, there are hills and mountains of significant height. Also, the waters of the fjords are deeper than those at the coast. The *middle* and *inner fjord* zones have water depths up to 1302 m b.s.l. (Sognefjorden), and steep mountainsides up to more than 1500 m a.s.l. Throughout the area, side valleys drain into the main fjord. To the south of Boknafjorden, however, Jæren consists of relatively low-lying terrain behind an exposed coastline with few islands and almost no fjords and inlets. Thus, navigating along the coast of Jæren would have been much more challenging than moving along the coast north of Boknafjorden, where the rim of islands and skerry seascapes mostly allowed protected navigation by boat.

Despite its northerly location, the climate of western Norway today is relatively mild due to the Atlantic Current bringing temperate water northwards along the coast, mixing with the local tidal currents. During summer, temperatures are around 15°C and in winter usually above 0°C. Precipitation is high throughout the year. Ice is rare in coastal areas and in the fjords.

The present topographic and climatic situation creates a productive marine environment along the coast as well as in the fjords (Bjerck 2007) and may be analogous to the Mesolithic situation. It has resulted in a moderate diversity of fish, with the number of individuals for some fish species being very high. The most numerous species are cod, saithe and herring (see Table 10.2 for Latin names). Coastal cod can be caught throughout the year at the outer coast as well as in the fjords, but concentrate at the outer coast in the period between autumn and early spring. Arctic cod is only present in the northern part of western Norway between February and April when it approaches the coast

Table 10.2 Tables with fish identified at the Sævarhelleren, Olsteinhelleren and Kotedalen sites, based on A.K. Hufthammer (1992:21–44) and K.A. Bergsvik et al. (2016:41). All three sites were sieved (for data from unsieved sites, see text). The faunal material from Kotedalen was burned and material from the other two sites was unburned

English name	*Latin name*	*Sævarhelleren MM1-LM1*	*Olsteinhelleren LM2-4*	*Kotedalen Phase 2-5 LM1-2*
Cod	*Gadus morhua*	794	404	145
Haddock	*Melanogrammus aeglefinus*	1	1	61
Whiting	*Merlangius merlangus*	1	1	
Pollock	*Pollachius pollachius*	43	225	214
Saithe	*Pollachius virens*	458	2334	763
Pollachius genus	*Pollachius* sp.			736
Tadpole fisk	*Raniceps raninus*	2	1	
Poor cod/Norway pout	*Trisopterus* sp.	1	7	
Unspecified gadid	Gadidae	2546	19 072	1555
Ling	*Molva molva*	3	38	1
Tusk	*Brosme brosme*	2	8	
Unspecified lotid	Lotidae		5	
Ballan wrasse	*Labrus bergylta*	151	8	45
Cuckoo wrasse	*Labrus mixtus*	490	14	3
Unspecified labrid	Labridae	788	744	4
Salmon	*Salmo salar*			2
Sea trout	*Salmo trutta*	24	30	
Unspecified salmonid	Salmonidae	76	354	7
Golden redfish	*Sebastes norvegicus*	3	5	1
Norway redfish	*Sebastes viviparus*	1	81	
Unspecified sebastid	Sebastidae	6	14	

(*Continued*)

Table 10.2 Continued

English name	*Latin name*	*Sævarhelleren MM1-LM1*	*Olsteinhelleren LM2-4*	*Kotedalen Phase 2-5 LM1-2*
Sharks/rays	Chondrichthyes		23	
Mackerel	*Scomber scombrus*	108	20	
Flatfish	Pleuronectidae		9	4
Eel	*Anguilla anguilla*		5	
Herring	*Clupea harengus*	11	2	2
Sturgeon	*Acipenser* sp.		1	
Three-spined stickleback	*Gasterosteus aculeatus*		1	

to spawn. Frequent at the outer coast as well as in the fjords are 2- to 4-year-old saithe and pollock. These age groups of saithe move in schools in shallow waters and concentrate on banks where they feed on smaller fish. They are available throughout the year, but are most common in the spring. When they are around four years old, saithe move out to deeper banks in the North Sea. Herring approach the coast in huge quantities during early spring to spawn and occur in large schools at the coast as well as in the fjords during summer. In addition to these species, salmon is a common fish in western Norway. They arrive in early summer and pass in shallow waters along the shorelines at the coast to spawn upstream in rivers. Likewise, sea trout are common at river mouths during summer and autumn. Similarly, mackerel is frequent in summer, when schools move in the uppermost layers of water everywhere at the coast and in the outer fjords where there is sufficient salinity. The more stationary and infrequent labrids and flatfish move in shallow waters during summer close to the shoreline all over the coast and in the fjords. Finally, the deepwater species ling and tusk spawn in the relevant area in the spring and are commonly caught at the outer coast and in the fjords (Rasmussen et al. 1988; Pethon 1989; Warren 1994; Bakketeig et al. 2017).

Overall, the warm season of the year is clearly the most productive for most fish species. Due to the relatively shallow waters along the coast and strong water movements (which lead to concentrations of primary producers and consumers), marine productivity is generally higher at the coast than in the fjords. However, there are also local differences in productivity. For example, fish (and consequently marine birds and sea mammals) concentrate in tidal current channels between islands at the coast/outer fjord basins (Aksnes 1988).

Site locations and fishing

The above overview of the landscape and resources shows that there were geographical and seasonal differences in marine productivity. By studying the relationship between Stone Age site locations and areas with different levels of productivity, one may get some indications of the subsistence base of the prehistoric populations. In the following, we will first discuss locations on the macro level. Thereafter, we will discuss how the sites relate to local topographical features in the context of fishing on a micro level.

Macro-level site distributions

Data at the *macro level* considers distributions of sites with regard to the major topographical zones described above. It consists of two data sets presented together on a map: sites excavated by the University Museum of Bergen during 1980–2017, and sites surveyed by county archaeologists retrieved from the national database ‘Askeladden’. The distribution of these Stone Age sites shows marked concentrations at the outer coast and partly in the outer fjord basins, strongly indicating that these zones were more attractive than the fjords for settlement (Figure 10.2).

Some source-critical comments should, however, be made about the databases and the map. One problem is that sites in both data sets are only generally dated to the Stone Age, also including Neolithic sites. This might be problematic if Neolithic sites were mainly related to agricultural activities, which would obviously influence site distributions. However, in this region, agriculture commenced as late as the Late Neolithic (Hjelle et al. 2006). This means that a large majority of the Neolithic sites were used by hunter-fisher-gatherer populations. Their subsistence-settlement patterns are largely supposed to be a continuation of Mesolithic ones (e.g. Olsen 1992; Hjelle et al. 2006). A more pressing problem is that excavations and surveys have mainly been carried out as part of cultural resource management (CRM), meaning that the site distributions are the results of modern development, not of research-driven surveys. Since development in western Norway occurs to a large degree at the

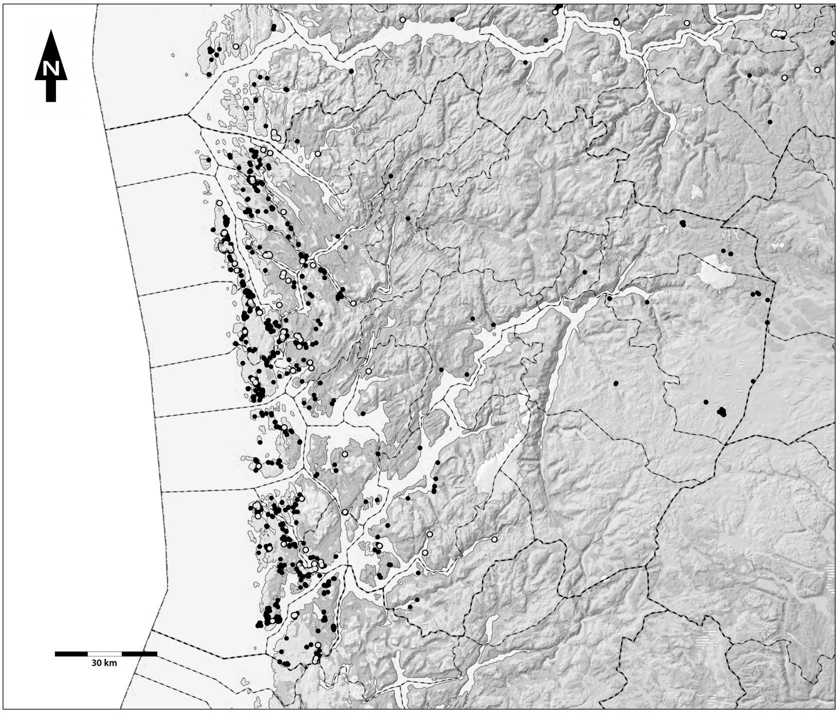

Figure 10.2 Distribution of Stone Age sites in Hordaland County. White dots: Sites from the project database at the University Museum in Bergen. Black dots: Sites retrieved from advanced search by the entries 'Stone Age' and 'dwelling and activity area' in the database of protected heritage monuments in Norway 'Askeladden.' Map: C. Zinsli and R. Børsheim, University Museum, Bergen.

outer coast and in the outer fjord basins, this leads to many more sites being surveyed and/or excavated in these areas than along the middle and inner fjords. Therefore, the concentration of sites at the outer coast might not be representative of the real distribution. However, the distribution of Mesolithic stray finds (adzes), mainly found by local farmers and delivered to the university museums according to the law of antiquities, can be considered unbiased compared to the distribution of Middle and Late Mesolithic adzes in coastal as well as fjord zones in the southern and inner parts of Hordaland. Only a few adzes have been found in fjord zones, whereas the number of adzes is very high at the outer coast (Figure 10.3). This clearly supports the hypothesis that residential sites concentrate at the coast.

Micro-level site distributions

When observing the *macro-level* site/artefact distributions in Figures 10.2 and 10.3, the impression is that all local areas at the outer coast and outer fjord basins were equally attractive for occupation. But this was not the case; there

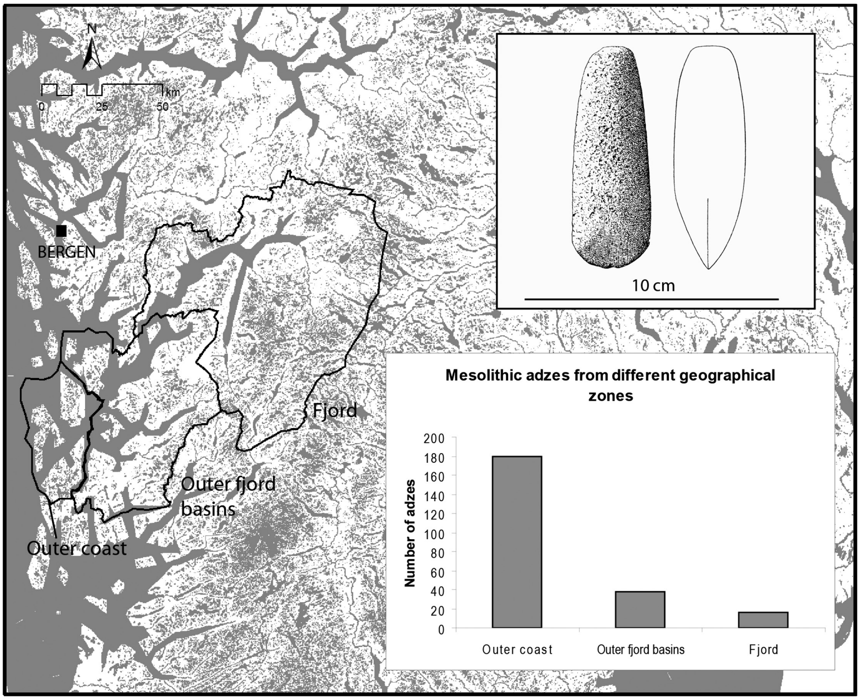

Figure 10.3 Distribution of Mesolithic adzes at the *outer coast*, *outer fjord basins* and *fjords* in the southern part of Hordaland. Illustration: S. Solheim, M.K. Ødegaard and K.A. Bergsvik. Inserted adze reproduced from A.W. Brøgger (1907:47). Printed with permission.

are major differences at the *micro level* within these zones, which relate to variability in the local physiography and marine productivity. Recently, a number of site location analyses were performed in this area by mapping such differences.

The *shoreline* has been considered an important site location factor for Mesolithic populations because of boat access and sea overlook; birds, fish shoals and marine mammals would be more easily spotted from shore sites than further inland (Shetelig 1922; Gjessing 1945; Bjørgo 1981; Bjerck 1986). The traditional assumption that Mesolithic sites are mainly shore bound has strongly influenced CRM-related surveys in western Norway, and it is probably fair to say that areas above the ancient shorelines have not been intensively searched for Stone Age sites (see critique by Berg-Hansen 2009). A hypothesis, therefore, might be that the apparent Mesolithic affinity for the shore is mainly a result of biased survey methods. A few tests of this hypothesis have been performed in Hordaland County. The test pit surveys were partly research driven and partly related to the development of the areas Vindenes, Kollsnes and Fosnstraumen. In all cases, terrain close to the Stone Age shorelines was extensively test pitted, and levels up to 20 m above these shorelines were thoroughly surveyed (Ågotnes 1981; Nærøy 1994; Bergsvik 1995). The results show that very few sites were found higher than 5–6 m above the shorelines at the time of occupation (Bergsvik 2009). In the same area, the elevations of stray finds of Mesolithic adzes were recorded; 70% of the axes were found along the Mesolithic shores, and only 13% in the interior, a pattern indicating that although the interior was used, activities mainly took place at the water's edge. Since these adzes have mainly been found by modern farmers and farming land is found at all altitudes above sea level in the lowland, this can be considered a representative sample.

At the shore-bound sites, several other 'micro-level' factors have also been studied. It appears that safe harbour conditions were of vital importance for Mesolithic coastal populations, particularly on exposed islands (e.g. Bjerck 1989; Bergsvik 1994; Nyland 2012). Factors such as easy access to fresh water, level ground, view over the sea and drainage were also important (Bergsvik 1994, 1995; Kristoffersen 1995; Kristoffersen & Warren 2001; Berg-Hansen 2009).

Another important site location factor is concentrations of marine resources. As noted above, the coastal landscape of western Norway is characterized by large numbers of *tidal current channels*, where currents with speeds of up to several knots shift water four times a day through narrow inlets to fjords or 'bottlenecks' between islands. These are particularly attractive to marine life, because their productivity is higher than in other coastal waters. For this reason, local fishers today tend to gravitate towards the channels, and archaeologists in this region have traditionally acknowledged their significance for Stone Age populations (Brinkmann & Shetelig 1920; Bøe 1934; Bakka 1964). Data from many CRM-related surveys during the last 40 years confirm that this was the case. These channels were Mesolithic 'hot spots' (e.g. Nilsson et al. 2018); residential sites concentrate along them, and they have spatially more extensive and thicker

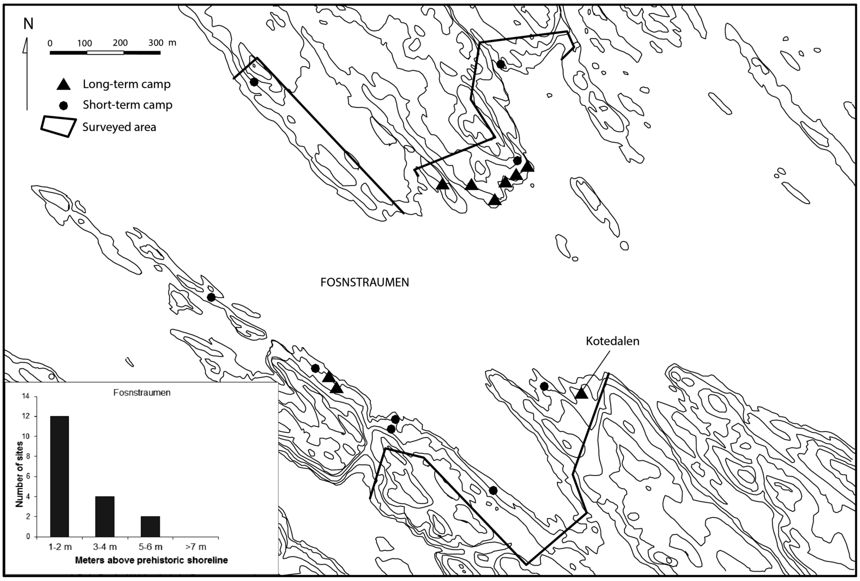

Figure 10.4 Surveyed and excavated sites around the tidal current channel Fosnstraumen. Shoreline drawn 10 m above present sea level. As seen in the inserted graph, Mesolithic sites along this channel were extremely shore bound. Illustration: K.A. Bergsvik.

cultural layers than areas at the coast without strong tidal currents (Bergsvik 2001). Examples of thoroughly studied tidal current channels with Mesolithic site concentrations are Fosnstraumen (Figure 10.4; Olsen 1992; Bergsvik 1995, 2001), Skatestraumen (Bergsvik 2002) and Vatlestraumen (Kristoffersen 1995).

These results are important for understanding the fisheries. Concerning the *macro level*, there is clearly a concentration of sites at the coast and along the outer fjord basins, and this coincides with the fact that marine productivity is higher here. This supports the assumption that coastal marine resources constituted a major attraction for the placement of residential sites during the Mesolithic. This is also the case at the *micro level*. At the coast, residential sites tend to be found in good harbours along the Mesolithic shorelines, and there are major site concentrations close to tidal current channels where fishing was most favourable and predictable. In sum, the abundance of fish seems to have significantly influenced where Mesolithic populations settled.

Early Mesolithic (EM 9500–8000 cal BC)

Some of the sites in Figure 10.2 date to the Early Mesolithic. They already indicate a marked marine orientation. Recent discussions about the subsistence strategies of EM populations stress the importance of marine mammals – seals in particular. Seals provided meat, skins for clothes/boats and oil. The locations of EM sites on exposed coastal islands only accessible by boat and close to the most important seal biotopes support this hypothesis (e.g. Bjerck 2008; Breivik 2014). In addition, terrestrial mammals have also played a role (Fuglestvedt 2012). Fish are not considered important this early, but it is an open question whether fishing should be seen as insignificant in the subsistence base of the EM groups. It is true that direct evidence for fishing is lacking; due to acidic soils, no fish remains have been retrieved from any of the EM sites and no artefacts can be incontrovertibly connected to fisheries. However, direct evidence for sea mammal hunting is also lacking from Norway. As discussed above, rich and varied fish resources were available already during the mid-Preboreal, around 9200 cal BC. Second, as pointed out by Åstveit (2014, 2017), the locations of the coastal EM sites are not necessarily indicative of a focus on marine mammal hunting. The spatial distribution of these sites is not markedly different from that of Middle or Late Mesolithic sites in this region; all these sites were situated close to contemporary shorelines, in protected harbours, and close to important fishing grounds (Bergsvik 1994, 1995; Nyland 2012). The general agreement that site locations of MM and LM sites support the hypothesis of fishing being important in these periods should also be valid for the Early Mesolithic (Åstveit 2014:90).

An argument against this could be that fishing was incompatible with the mobile lifeways of EM populations. Fishing characterizes people who are sedentary, because it demands a familiarity with the landscape and knowledge of the best fishing grounds. However, given the naval experience and knowledge of seascape and resources that must have been present among the EM groups, and considering that they would have been both eclectic and opportunistic (e.g. Erlandson 2001), we find it likely that they would have been able to quickly identify some of the favourable fishing grounds near the sites that they occupied.

Another argument could be that fishing would not pay off for highly mobile people considering the labour investment in fishing gear. However, fishing is not necessarily labour intensive; for example, spears and hooks are low-investment gear; easy to make from bones of large ungulates, they are lightweight and flexible. Such tools are likely to have been used from boats and would therefore fit well into a residentially mobile lifestyle where boats played a crucial role (e.g. Bjerck 2017). There are several examples of fishing gear contemporaneous with – or older than – the first immigration to Norway. Bone or ivory fishhooks are directly dated to the Late Palaeolithic in eastern Germany (Gramsch et al. 2013), and barbed points are commonly found at sites from this period in northern Europe (e.g. Clark 1975; Verhart 1990), although these may also have been used on mammals. In any case, there are good reasons to believe that technologies for catching fish were known among the Late Palaeolithic Ahrensburgian groups. Moreover, in the Baltic region, Gotland seems to have been colonized by people who were accomplished fishers (Boethius et al. 2017). It appears that fishing took place in adjacent areas during the Preboreal to Early Atlantic periods, albeit in freshwater contexts: osteological data shows that freshwater fishing for pike (*Esox lucius*), chub and perch (*Perca fluviatilis*) took place at Final Palaeolithic sites in central Europe (Cziesla 2006). Fish bones of pike, perch, cyprinids and wels catfish (*Siluris glanis*) have also been found at Maglemosian sites in Denmark such as the eponymous Maglemose complex, Holmegård, Lundby, Ulkestrup Lyng and Sværdborg (Rosenlund 1976 and references therein). In Sweden, pike, perch, salmon and cyprinids are known from Almeö close to Lake Hornborgsjön (dated to around 8700 cal BC) (Nordquist 2000). Given the pre-existing knowledge of fishing, when colonizing groups headed for the productive coasts of Norway it is very unlikely that they left this particular part of their cultural repertoire behind, and we expect that some sort of fishing was practiced during the EM of western Norway.

Middle and Late Mesolithic (MM/LM 8000–4000 cal BC)

Many of the Middle Mesolithic sites in western Norway were destroyed by the Tapes transgression, but some sites are preserved, and Late Mesolithic sites are abundant (e.g. Bjerck 2008). Fortunately, from these two periods a few sites have good preservation conditions for organic material. These are primarily caves and rockshelters (see overviews in Bjerck 2007; Bergsvik & Storvik 2012), but there are also some open-air sites with faunal data preserved. A few Mesolithic sites on the mountain plateaux in the southern Norwegian inland have bones of trout preserved; however, these will not be dealt with here (but see Indrelid 1994; Mjærum 2016). In the following, five cave/rockshelter sites and two open-air sites will be presented, followed by a description of fishing equipment mainly from these sites (Figure 10.1, Table 10.3). It is important to note that although preservation conditions were good for faunal remains and bone tools in the rockshelter sites, the methods for collection were very different. Sieving strongly influences the kinds of bones retrieved (Olsen 1976:131; Wheeler & Jones 1989). Of the following sites presented, only 17. Havnen, Kotedalen, Sævarhelleren and Olsteinhelleren were sieved. These taphonomic differences must be considered when comparing the different assemblages.

Sites with faunal data on fishing

The open-air site 17. Havnen lies in a protected bay at the outer coast along the tidal current channel Skatestraumen in Nordfjord (Figure 10.5). It was excavated (total 89 m^2) during 1992–1995 (Bergsvik 2002). Soils were water sieved with 4 and 2 mm meshes. The site's Late Mesolithic phases 2a and 2c with faunal data are radiocarbon dated to c. 5400–4850 cal BC (LM3 and LM4). From these phases, in total 4310 burnt bones of fish were retrieved. Determination of family and species was, however, low; 28 bones were identified as gadids, and there were a few bones of cod (2), saithe (2) and pollock/

Table 10.3 Chronological distribution of the Mesolithic sites and fishing equipment of bone and stone in western Norway

	EM1	*EM2*	*EM3*	*MM1*	*MM2*	*MM3*	*LM1*	*LM2*	*LM3*	*LM4*	*LM5*
Sites											
17. Havnen									▨	▨	
Grønehelleren								▨	▨	▨	▨
Kotedalen							▨	▨			
Skipshelleren									▨	▨	▨
Sævarhelleren						▨	▨				
Olsteinhelleren								▨	▨	▨	
Viste Cave						▨	▨				
Fishing equipment											
Viste-type fishhooks						▨	▨				
Skipshelleren-type fishhooks								▨	▨	▨	▨
Flutters						▨	▨				
Gorges						▨	▨	▨	▨	▨	▨
Barbed points						▨	▨	▨	▨	▨	▨
Bone points						▨	▨	▨	▨	▨	▨
Scaling knife						▨	▨				
Netting needles								▨	▨	▨	▨
Soapstone sinkers								▨	▨	▨	▨
Large stone sinkers						▨	▨	▨	▨	▨	▨

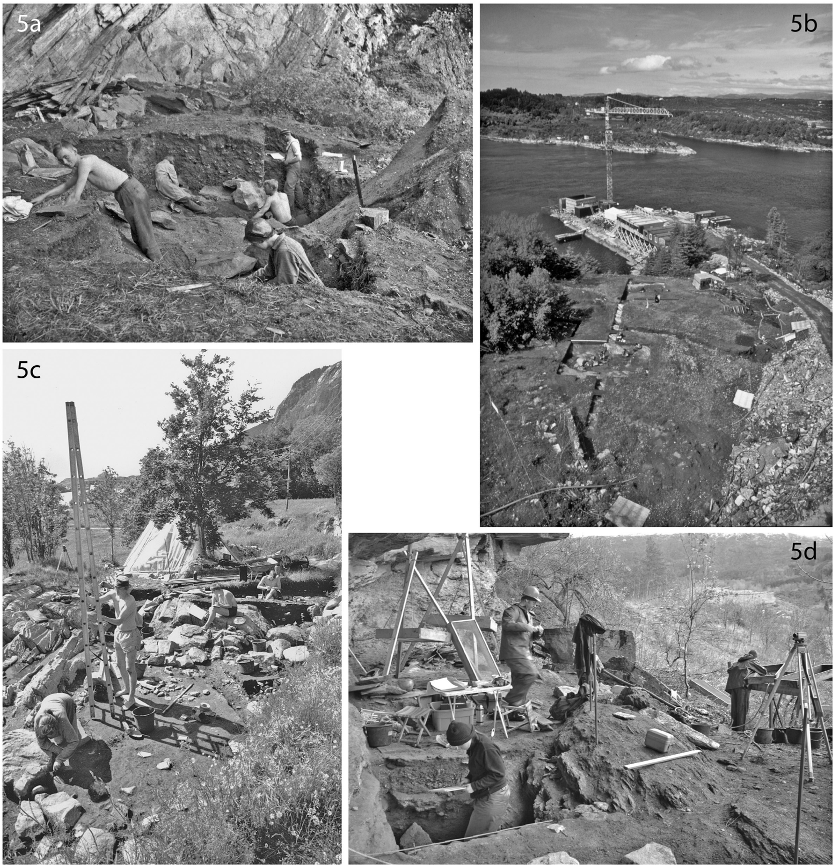

Figure 10.5 Excavations at some of the Mesolithic sites in western Norway referred to in the text. 5a: Skipshelleren; 5b: Kotedalen; 5c: 17. Havnen; 5d: Sævarhelleren. Photos: Skipshelleren: Johannes Bøe 1931 Copyright University Museum of Bergen; Kotedalen: D.N. Simpson; 17. Havnen, Sævarhelleren: K.A. Bergsvik. Printed with permission.

saithe (3). No shellfish were identified. Bird and mammal bones were present, but few have been determined to species (Senneset & Hufthammer 2002:328).

The rockshelter Grønehelleren lies at the outer coast on the exposed island of Ytre Sula in Solund, just north of the mouth of Sognefjorden. It is situated close to the shoreline in a protected bay. The site was excavated (total 40 m^2 – c. 20 m^2 within the dripline) in 1964 and 1965 (Jansen 1972; Indrelid 1978; Bjerck 2007). The Mesolithic layers (phase I) at the site can be dated generally to about 6000–4000 cal BC (LM2–5) based on the lithic industry and the presence of line sinkers. The soils were not sieved (K. Jansen, personal communication, 10 November 2017). The faunal material is not very large, consisting of 231 fragments, determined by H. Olsen. Bones from the following species were identified: cod (20), saithe (45), pollock (8), ling (1), tusk (1) and ballan wrasse (1). In addition, Jansen reports that mussels (*Mytilus edulis*), common periwinkle (*Littorina littorea*), common limpet (*Patella vulgata*) and oysters (Ostreidae) were observed during excavation of the Mesolithic layers. Several mammals and marine birds were also identified (Jansen 1972:64).

The open-air site Kotedalen lies at the outer coast close to the shore of the tidal current channel Fosnstraumen, one of the narrow inlets of Lygrefjorden (Figure 10.5). It was excavated in 1986 and 1987 (Olsen 1992; Hjelle et al. 1992; Warren 1994; Bergsvik 2001). The site was occupied during LM1–5, but only the site's earliest Late Mesolithic layers were subject to substantial excavations (44 m^2). The relevant layers were radiocarbon dated to c. 6500–5500 cal BC (LM1–2; Olsen 1992:36). The bone fragments were burnt and generally in poor condition. They were collected mainly from water sieving with 4 mm mesh. The faunal data is dominated by gadids with a relatively large variety of species present (Hufthammer 1992; see Table 10.2). There are also significant amounts of mammal and bird bones. Shellfish was not preserved at the site.

The rockshelter Skipshelleren is situated close to the shoreline in Vaksdal, Hordaland, in the middle/inner fjord at the end of the watercourse leading down from the Voss valley (Figure 10.5). The site was excavated (94 m^2) in 1930 and 1931 (Bøe 1934; Olsen 1976). The radiocarbon-dated Mesolithic occupational layers 6 and 7 span 5300–4000 cal BC (period LM3–5; Indrelid 1978; Bjerck 2007; Rosvold et al. 2013). The soils were not sieved. A large amount of faunal material, mainly unburned, was collected and analyzed by H. Olsen in an unpublished thesis (1976). In total, 10 633 fish bones were collected. Unfortunately, in Olsen's thesis, only the gadids are specifically related to the different phases/layers. The following were determined for the Mesolithic layers: cod (1223), saithe (519), pollock (367), haddock (131) and ling (128; Olsen 1976:113). According to Olsen, the fish bones were of relatively small specimens. Altogether, 296 bones of salmonids were identified (stemming from all phases). This low number is puzzling, considering that the Voss River is one of the best rivers for salmon fishing in Norway today. J. Bøe reported large numbers of shells in the Mesolithic layers, particularly blue mussels, and also common periwinkle. Some common limpets and a few oyster shells (*Ostrea edulis*) were found (Bøe 1934:13–19). Analyses of cod otoliths from the site only show summer occupation (Hufthammer et al. 2010).

The rockshelters Sævarhelleren and Olsteinhelleren are situated close to the village of Herand in the middle/inner Hardanger fjord (Figure 10.5). They were located relatively close to the contemporary shoreline. In 2005 and 2006, excavations of the Mesolithic layers at the two sites covered 9 and 2 m^2, respectively (Bergsvik et al. 2014, 2016; Ritchie et al. 2016). The radiocarbon dates from the Mesolithic layers at Sævarhelleren span 7000–5800 cal BC (MM3–LM1), and at Olsteinhelleren 5600–4800 cal BC (LM2–4). The soils were water sieved with 4 and 2 mm meshes. The faunal material was mainly unburned and in good condition. The identified fish assemblages are also clearly dominated by gadids (see Table 10.2). Bird and mammal bones were present. The cultural layers were largely shell layers composed of blue mussels and common periwinkle. In addition, a few scallop shells (Pectinidae) and ocean quahog (*Arctica islandica*) were present at both sites.

Finally, the shallow cave Svartehålå (Viste Cave) is situated at the outer coast in Randaberg, Rogaland. It was excavated (125 m^2) in 1907 (Brøgger 1908; Winge 1908) and in 1939–1941 (Degerbøl 1951; Lund 1951). The Mesolithic layers (stratum I and II) in the cave span 7000–6000 cal BC (MM3–LM1; Mikkelsen 1971, 1978; Indrelid 1978; Bjerck 2007; Bergsvik & David 2015). The soils were not sieved. The faunal material is unburned and is mainly from the Mesolithic phases of the site (Lund 1951:9). However, it cannot be related precisely to these phases, and the fishbone fragments were not counted. According to H. Winge (1908:8–9) and M. Degerbøl (1951:55), the following fish are present at the site: ling, cod, haddock, saithe, pollock, tusk, hake (*Merluccius merluccius*), conger eel (*Conger conger*), wolffish (*Anarhichas lupus*), ballan wrasse and cuckoo wrasse. Gadids, particularly cod, dominate the assemblages. Degerbøl (1951:82–83) points out that several of the bones of ling stem from very large specimens. Shells were not present in stratum I; however, stratum II was a veritable shell layer in which periwinkle, limpets and other species were present.

Mainly based on an evaluation of site sizes, artefact frequencies and faunal data, the two open-air sites in this analysis, 17. Havnen and Kotedalen, have been interpreted as sedentary residential camps (Olsen 1992; Warren 1994; Bergsvik 2001, 2002). This is also the case with the cave/rockshelters Grønehelleren and Viste Cave (Indrelid 1978; Mikkelsen 1978). These sites are situated at the outer coast. The remaining rockshelters, Skipshelleren, Sævarhelleren and Olsteinhelleren, are fjord sites and have been interpreted as short-term seasonal camps used by task groups from the outer coast (Bjørgo 1981; Bjerck 2007; Bergsvik et al. 2016).

Fishing equipment

The sites presented above also have good preservation conditions for bone artefacts, including fishing tools such as fishhooks, flutters, gorges, needles and barbed points (e.g. Matland 1990; Olsen 1992). In addition, stone line sinkers are found at many sites, and there are also stone tools that were used during the production of fishing equipment (Table 10.3). As was the case with the faunal material, bone tools from open-air sites are burned and tools from caves and rockshelters are mainly unburned.

Bone fishhooks are present at all sites except 17. Havnen. Mesolithic fishhooks have also been retrieved at other sites in western Norway (e.g. Gjessing 1920:19; Clark 1948; Myhre 1967:18; Åstveit, 2008a:135, 402). Traditionally, two main types of barbless fishhooks are distinguished, which belong to different time periods: the Viste type and the Skipshelleren type (Figure 10.6). Both have pointed stems and tips, and the stems often have ground notches (1–8) along the external side, most likely for attaching the line, perhaps also

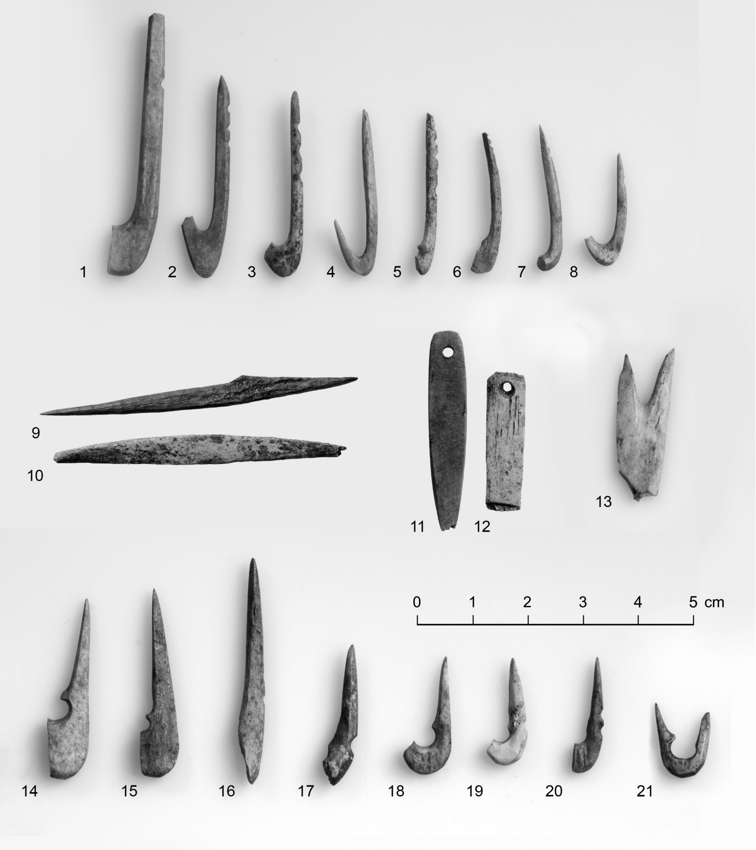

Figure 10.6 Fishing equipment of bone. 1–8: fishhooks of the Viste type from Sævarhelleren; 9, 10: gorges from Sævarhelleren; 11, 12: flutters from Sævarhelleren; 13: possible netting needle from Olsteinhelleren; 14–21: fishhook of the Skipshelleren type, Olsteinhelleren. Photos: S. Skare, University Museum, Bergen.

as ornaments. The most important difference between the two hook types is that the Skipshelleren type has traces of a drilled hole at the bottom of the gap (these traces were removed by grinding in the Viste type), and a shorter shank than the Viste type compared to the length of the tip. The chronological distribution of both types is MM3–LM1 and LM2–5, respectively (Table 10.3). Both hook types are relatively small and have similar length ranges measured between the point of the stem and the bottom of the bow: Viste type: generally, 2.1–4.8 cm; Skipshelleren type: 1.1–4.2 cm (Bergsvik et al. 2016). Some individual specimens of the Viste type are 6–7 cm long (Lund 1951:27). Most of the hooks found at the sites are broken. This may have happened during use or production (or result from burning). Recently, the production process of the Viste-type hooks has been studied based on the hooks themselves and the bone refuse material at Viste and Sævarhelleren. The reconstructed *chaîne opératoire* indicates that bone was first split by means of a 'shaft-wedge-splitter' method, followed by drilling, sawing, scraping and grinding with stone tools. The surfaces of all hooks were finished by abrasion. All sequences in this operation seem to have taken place at sites interpreted as residential sites or field camps, indicating that the craft was mastered by all makers (Bergsvik & David 2015). Preliminary studies show that the operational sequence documented for the Viste types is also relevant for the hooks of the Skipshelleren type.

Bone flutters are another tool type related to fishing (Figure 10.6). These blade-like artefacts, measuring 2.5–5.9 cm in length, have a transversely drilled perforation and ground surfaces. While these artefacts are often interpreted as pendants (e.g. Lund 1951; Mikkelsen 1978), Degerbøl (1951:140) has convincingly argued that they were attached to a line along with hooks and used as flutters (similar to spoon baits) for attracting fish. Until now, flutters have only been found in Viste Cave and at Sævarhelleren. This indicates a timeframe of MM3–LM1, similar to that of Viste-type fishhooks.

Gorges of bone were also Mesolithic fishing gear (Figure 10.6). They are 5.3–5.9 cm long and have pointed ends and ground surfaces. They were probably baited and attached to a line. Found both in Skipshelleren and Sævarhelleren, they indicate a relatively broad range of dates: MM3–LM5.

Barbed bone points are present at several of the sites. Two main types can be distinguished: spearheads and harpoon-heads (e.g. Clark 1975:129). They are broadly dated to the Middle and Late Mesolithic in this region. At the above sites, harpoon-heads dominate. Single finds of bilaterally barbed harpoons with opposite patterns have been made at Kotedalen (fragmented) and Viste. The Viste specimen was 9.4 cm long. Unilaterally barbed harpoons are somewhat more numerous and are present at Viste, Kotedalen, Skipshelleren and Olsteinhelleren. Most of them are broken. Two almost complete specimens from Skipshelleren and Olsteinhelleren measure 16.5 and 11.5 cm, respectively (Figure 10.7). The only possible spearhead securely dated to the Mesolithic is from Viste Cave and measures 8.4 cm. Barbed points are mainly related to seal hunting, but they are also sometimes associated with fishing (Clark 1975:134; Verhart 2000).

Some bone artefacts are less securely related to fishing. Bone points with circular cross sections are found at Sævarhelleren, Olsteinhelleren and Skipshelleren. They are 0.3–0.4 cm thick, 3–6 cm long, straight with one pointed end and the other broken. They may have served multiple functions; however, one option is that they were barbs in composite fishhooks. During the excavation of Sævarhelleren, a possible scaling knife was found (Bergsvik & David 2015:14), It was 10.5 cm long and made from a splintered longbone of a large ungulate and had use-wear on the sides, possibly from the processing of fish. Finally, possible *netting needles* are present at Olsteinhelleren and Skipshelleren, thus dated to LM2–5. They are 1.5–4.5 cm long and the ends of the needles have a ground cleft with depths varying between 0.3 and 1 cm,

Figure 10.7 Harpoon-heads from Olsteinhelleren and Skipshelleren. Photos: S. Skare, University Museum, Bergen.

indicating the crafting of nets (alternatively they were just used for coiling up fish lines, see Figure 10.6). The opposite ends are broken on all specimen. As pointed out by Bøe, the sizes of these needles imply that they may have been used to make nets with small mesh sizes. They would – if indeed they were used as netting needles – originally also have had clefts in the broken ends (Müller 1888:191; Bøe 1934:39).

The only stone tool clearly associated with fishing is the soapstone sinker (e.g. Bergsvik 2017; see Figure 10.8). Soapstone sinkers are commonly found at Late Mesolithic sites in the region and were used during LM2–5. Three size/weight groups are distinguished here: small/light (1–10 g), medium (10–50 g) and large/heavy (>50 g). Small-sized sinkers clearly dominate. At the two open-air sites in this analysis, sinker distributions are 17. Havnen (n = 43): 37/2/4 and Kotedalen (n = 36): 34/4/0. A few large sinkers of other raw materials (some weighing more than 1 kg) are present at the Nyhamna sites in the northern part of western Norway and are dated to MM3 and LM2–5 (Åstveit 2008a). It is argued in this chapter that sinkers of all sizes were primarily line sinkers; however, particularly large sinkers could also have been used as weights for nets or fish traps (Åstveit 2008a:107, 416). Other stone tools such

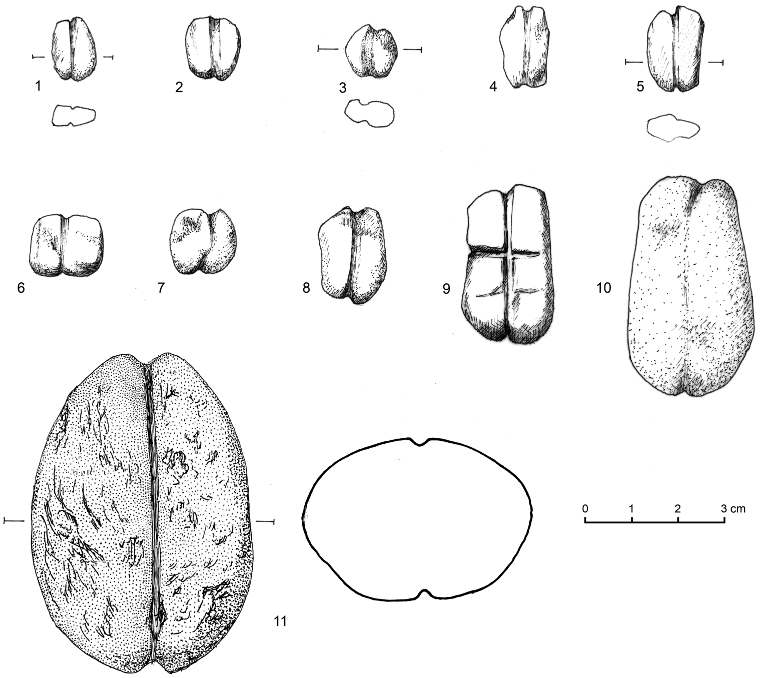

Figure 10.8 Line sinkers of soapstone. 1–8: small sinkers (<10 g); 9–10: middle-sized sinkers (10–50 g); 11: large sinker (>50 g). Drawings: L. Gustafson and E. Hoff, University Museum, Bergen.

as grinding stones and drill-heads, which were used during the production of fishing equipment, are commonly found in rockshelters as well as open-air sites (Bergsvik & David 2015).

In summary, in terms of the faunal data, only the open-air site Kotedalen and the rockshelters Sævarhelleren and Olsteinhelleren provide faunal assemblages that are large enough for comparative purposes (Table 10.2). It appears that the faunal record is diverse, with a relatively large number of species. However, gadids dominate at all three sites. The remaining sites may provide only supplementary information due to problematic conditions of preservation (17. Havnen) and lack of sieving (Grønehelleren, Skipshelleren and Viste Cave), However, even with such factors in mind, the data from these sites largely confirms these patterns. Concerning fishing equipment, taphonomical problems are also relevant, but not as problematic as for the faunal data, since recovery of the (generally larger) artefacts is not to the same degree dependent upon sieving. The survey shows that fishhooks and stone line sinkers are clearly the most common tools for fishing in Mesolithic western Norway. In the following, we will discuss how these patterns reflect different fishing methods, the relationship between fishing and hunting, and geographical and chronological differences in fishing practices.

Discussion

Methods of fishing

With the diverse faunal record and the extensive array of fishing equipment that has been recovered, it is logical to try to describe the Middle and Late Mesolithic fisheries of western Norway in more detail. There are, however, several reasons why this is a challenging endeavour. They include: many fish species can be caught by multiple methods; items of fishing equipment are generally effective in catching many different species; fish species' vulnerability to different methods of capture depends on age, season, weather, etc.; and (perhaps most importantly) groups who rely heavily on fish, typically fish using multiple means after a variety of fishes (Morales 2010). However, given the prevalence of gadids, the number of fishhooks recovered and the environmental conditions in western Norway, angling must have been of considerable importance. Spearing may also have played a role, perhaps especially for flatfishes or diadromous species (e.g. eel and salmonids) during their migrations. The find of a sturgeon scute (*Acipenser* sp.) at Olsteinhelleren supports spearing or even harpooning as part of the fishery there (Ritchie et al. 2016). Netting and trapping were likely practiced based on the possible netting needles and large sinkers, and on contemporaneous finds of fishing structures in nearby regions such as northern Germany and Denmark (e.g. Gramsch 1987; Pickard & Bonsall 2007; Andersen 2013); but do not seem to have played a major role, at least not in the central parts of the region. This may help to explain why herring and salmon, although periodically present in great quantities in waters close to known sites and a favoured fishery in later periods, do not seem to have been extensively targeted during the Mesolithic based on the fishbones identified. However, taphonomic factors must also be considered.

The importance of fishing vs. hunting

Based on the above discussions of site locations, faunal data and fishing equipment, it can be argued that fishing made up a significant part of the subsistence base during the Middle and Late Mesolithic. One might be tempted to conclude that fish played a more important role than mammals and birds. However, comparing the relative contributions of different animals to human subsistence based on bone evidence is notoriously difficult for numerous reasons. Taphonomy, the various factors that influence the likelihood of preservation, recovery and quantification of animal remains, is too complex to engage with in any detail here (see Lyman 1994 for an introduction). A sampling of the relevant issues would include: different bone densities and lipid concentrations affecting bone survival, excavation methodology (especially the decision to screen and what size mesh to use) and different animals have different numbers of bones in a complete skeleton. Even within the same category (e.g. fish), taphonomy makes an evaluation of relative contributions to the fishery challenging (for example, flatfish have ca. 30–35 vertebrae while eel have over 100). Still, the overwhelming predominance of fish in bone assemblages that were excavated with methodologies appropriate for recovering representative faunal samples (e.g. Sævarhelleren and Olsteinhelleren) suggests that they were of prime importance at least some of the time. Additionally, the large quantities of shellfish remains at some of the above localities further implicate aquatic resources as fundamental to the subsistence base (Åstveit 2008b:584; but see Bjerck 2007 for a different view).

Concerning birds, the bird bone assemblages in the Viste Cave are relatively diverse (Degerbøl 1951). However, this is not the case at more systematically excavated sites, and may indicate that birds played a minor role during the Mesolithic (Hufthammer 1992; Bergsvik et al. 2016). Mammals are another matter. In all the sites discussed above, despite low degrees of determination to species, there are extensive amounts of mammal bones, from seal (Phocidae), red deer (*Cervus elaphus*), elk *(Alces alces*) and wild boar (*Sus scrofa*), as well as from several fur-bearing animals (e.g. Hufthammer 1992; Bergsvik et al. 2016). Furthermore, almost all bone artefacts were made from mammal bones. This clearly shows that mammals were important for food as well as for tools and clothes. It is important to remember the limitations of how animal importance is commonly assessed archaeologically (i.e. number of identified specimens, NISP): a single adult elk, weighing 200–700 kg, would contribute as much meat to the diet as hundreds of young saithe or pollock, even if the former is only represented by a handful of bones in an assemblage otherwise dominated by fish. Red deer were clearly also of major importance in cosmology and rituals in this region, considering the large amount of red deer (and no fish!) representations in Mesolithic rock art in western Norway (e.g. Lødøen & Mandt 2012).

Stable isotope analysis of human bones has opened an exciting means of directly assessing the contribution of various dietary components. In Denmark, analyses have shown an important aquatic aspect to human diet already in the Early Mesolithic Maglemose period, with some individuals having possible indications of marine resource use (Fischer et al. 2007). In Norway, human remains at Hummervikholmen (dated to c. 8250–6950 cal BC, the Boreal or Early Atlantic period) show a pronounced marine component in the diet, although with foods from a trophic level that probably indicates marine mammals (Skar et al. 2016). Unfortunately, because of the poor conditions for the preservation of bone in Norway, human skeletal materials from the Mesolithic are quite rare and this line of investigation awaits new discoveries.

One should also be careful in using the observed pattern of site locations as an argument that fish dominated the subsistence base. Crucial in this respect is that probably the main Mesolithic transportation mode was by boat (Bjerck 2008, 2017). Interesting in this respect are the rockshelter sites in the fjords.

At Sævarhelleren and Olsteinhelleren, fish bones dominate the faunal assemblages, but there are also bones of cloven-footed as well as fur-bearing animals. A question, however, is whether fish was the most important resource at these sites, and if fishing was even the main reason for travelling into the fjords. As pointed out initially, the availability of fish is better at the coast, which suggests that going into the fjords would not have been primarily for fishing. A perhaps more reasonable alternative, therefore, is that these forays from the coast were mainly related to other activities, such as hunting elk, deer and wild boar. Stocks of these mammals might even have been greater along the fjords due to heavier predation on the coastal islands, whereas the availability of fish in the fjords – although less than at the coast – was sufficient for daily provisioning.

The implications of this are important on a general level, because fishing of gadids and labrids may have represented the fundamental security of the populations – also in the coastal areas, because it was always possible to catch them. In a comment on the nutritional value of shellfish vs. large land mammals for coastal groups, Erlandson (2001:294) makes the point that all people in a society could gather shellfish, whereas much hunting may have been more restricted in terms of age and gender. This argument is probably also relevant for fishing, and we suggest that most group members could have conducted nearly all the fishing that took place in western Norway.

Fishing in protected waters

The above data on site locations indicates that Mesolithic fishing in western Norway was mainly carried out in protected waters, close to the shore. Fish sizes and the sizes of fishing equipment are largely in accordance with this observation.

Based on her analyses of the faunal material from Kotedalen, Hufthammer shows that younger specimens of saithe dominate the fish assemblage (Hufthammer 1992:50). These fish, along with other gadids such as cod and pollock, were also common at the other sites, but size data is mostly not available. Size measurements (of otoliths) have, however, been done at Sævarhelleren and Olsteinhelleren (Figure 10.9a and b). At Sævarhelleren, saithe lengths are 31–59 cm (mean/median 44), pollock are 28–45 cm (mean/median 35) and cod are 33–70 cm (mean/median 47/45). At Olsteinhelleren, saithe lengths are 15–62 cm (mean/median 40/39), pollock are 16–54 cm (mean/median 32) and cod are 30–76 cm (mean/median 50). These are small gadids, perhaps just 2- to 3-years-old (in comparison, cod may be as much as 40 years old and 180 cm long). Numerous labrids were also found. These are generally small and they move close to the shore, which is also the case with flatfish (Ritchie et al. 2016). Fishhook sizes have been measured at the Sævarhelleren, Olsteinhelleren and Skipshelleren sites. They show that at all three sites the lengths of the hooks vary between 1.5 and 4.5 cm (Figure 10.10). The hooks from Olsteinhelleren are slightly smaller than those from Sævarhelleren and Skipshelleren; however, most of the hooks from all sites are less than 3 cm

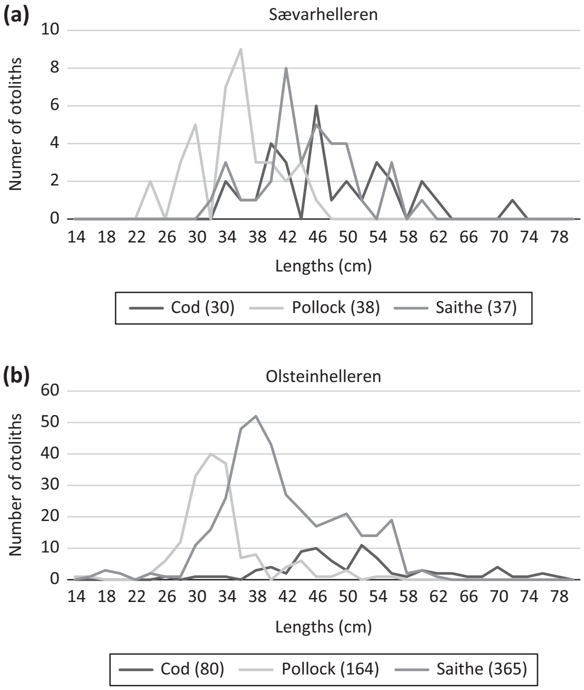

Figure 10.9 Lengths of the fish species cod, pollock and saithe based on measurements of otoliths from the sites Sævarhelleren (a) and Olsteinhelleren (b). *Source*: Data extracted from K. Ritchie et al. (2016).

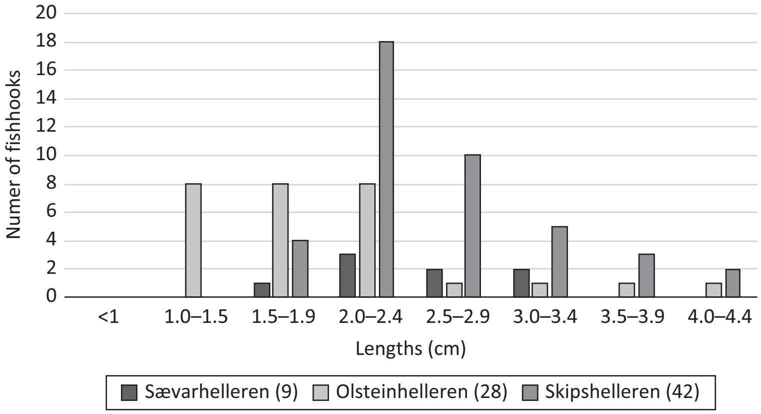

Figure 10.10 Lengths of bone fishhooks from the rockshelter sites Sævarhelleren, Olsteinhelleren and Skipshelleren. Only hooks where the stem was preserved from the tip to the bow were measured.

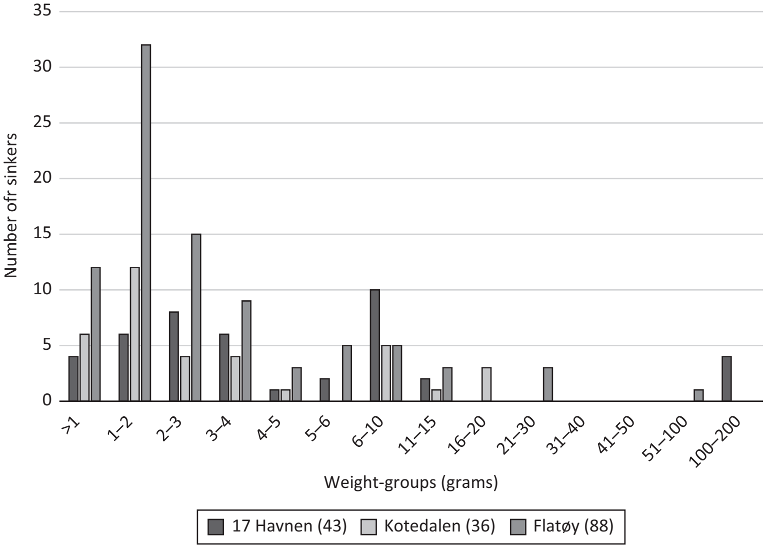

Figure 10.11 Weight groups of soapstone line sinkers from the 17 Havnen, Kotedalen and Flatøy sites. Only complete specimens were weighed. Data from Flatøy and Kotedalen is from T. Bjørgo (1981:110) and A.B. Olsen (1992:92).

long. Small-size groups also dominate the assemblages of soapstone line sinkers from the 17. Havnen and Kotedalen sites, and a site complex on Flatøy island (Bjørgo 1981). Common to the three sites is that most sinkers weigh between 0.5 and 10 g and that there is a marked concentration of sinkers weighing around 2–3 g. In the case of 17. Havnen, there is also a concentration around 7–8 g, and another group of large sinkers weighing 150–200 g (Figure 10.11).

The close correspondence between the sizes and weights of these different data types indicates that the main targets of the fisheries in western Norway were relatively small specimens of cod, saithe and pollock that had very high return rates. As has been pointed out by others (Hufthammer 1992; Olsen 1992; Åstveit 2008b), this indicates that fishing was performed regularly and took place in protected waters close to the residential sites. It probably happened as part of the daily routine, most likely conducted by all able members of the population. It is also likely that a significant share of the fishing technology, such as sinkers, lines, hooks and even boats, was designed to maximize catches of this group of fish.

Differences within western Norway

Setting the data analyzed here into a broader geographical context, some differences can be observed which may indicate regional variation. At several Middle and Late Mesolithic sites at Nyhamna in Romsdal in the northernmost part of western Norway, large sinkers dominate, and Åstveit (2008b:574) argues that they were primarily connected to fishing with nets and traps, not hooks and lines. His interpretation is also based on an evaluation of the micro-topography, which is characterized by quiet waters and long and shallow beaches – in some respects similar to the situation in parts of Denmark and northern Germany where such structures are identified (see above). However, since small bone fishhooks (and no nets or traps) have been identified at the Nyhamna sites, an alternative interpretation is that the large sinkers were used together with these hooks, or preferably with larger hooks, and from boats in deeper waters further away from the sites.

As noted previously, the 17. Havnen site in Nordfjord has a high proportion of small line sinkers, just like sites further south along the coast. Bone fishhooks were not preserved at the site, but the few fish bone fragments identified were of gadids (Senneset & Hufthammer 2002:328), which corresponds with the faunal data from the other sites. However, one difference at 17. Havnen compared to the sites further south in Hordaland is that large soapstone sinkers make up a fair share (around 14%) of the total. In line with the above reasoning, this could indicate that deepwater fishing accounted for a somewhat larger portion of the fishery than further south along the coast. These differences may have been related to variations in the local environment. The coastal topography in the outer part of Nordfjord is characterized by large islands, steep cliffs, relatively exposed coastlines and broad as well as deep stretches of water. Here (as in Romsdal), it may have been necessary to apply a broader variety of techniques, including deepwater kits with large sinkers. This argument is also relevant to the exposed coast of Jæren further south, where deepwater fishing may also have been more common. Even if the assemblage of fish bones from Viste Cave is not suitable for comparative purposes, M. Degerbøl (1951) notes that there were bones of some very large fish in the cave. It should also be noted that one of the largest Mesolithic sinkers in Norway (1096 g) has been found on the coast of Jæren, whereas small sinkers are less common (Bang-Andersen 2009; Bergsvik 2017). In contrast to these areas, the topography in Hordaland is characterized by smaller, low-lying islands along channels and sounds in shallow and protected waters. In this particular region, smaller fishing gear may have been sufficient to secure a reasonable return.

The many similarities in faunal data and fishing equipment throughout the area of analysis seem to indicate that the entire region shared the same basic fishery system. A question is how the variations between the districts should be interpreted. As indicated above, a likely possibility is that they are the results of local adjustments to varying environmental circumstances. On the other hand, once established, such diversity in the fisheries may also have helped define group identities. Such a situation is indicated by the Danish Mesolithic evidence, where marked differences between eastern and western Denmark are observed (e.g. Ritchie 2010; Enghoff 2011). For western Norway, other types of data (mainly distributions of stone adzes and lithic raw materials) show pronounced regional differences and social boundaries (Olsen & Alsaker 1984;

Skjelstad 2003). However, the distribution of fishing equipment and fishing practices discussed here does not clearly relate to these differences – in fact they largely cross-cut the boundaries based on the lithic data (e.g. Bergsvik 2017). This may indicate that in Mesolithic western Norway, fishing itself and artefacts related to fishing – even if there were variations within the region – were not mobilized for the purpose of signalling group identities.

Changes during the Middle and Late Mesolithic

Several changes took place during this long period in terms of technology as well as fish species caught. For fish species, this may be studied from the fjord sites Sævarhelleren (MM1–LM1) and Olsteinhelleren (LM3–4), where excavation methods and conditions for preservation are comparable. Several interesting patterns emerge from this data. First, a shift happened from cod being the most important fish in Sævarhelleren to a marked dominance of saithe in Olsteinhelleren (Table 10.2). Ling and pollock also increased in importance at the latter site. The same was the case with salmonids, whereas mackerel was slightly more common at the older Sævarhelleren. Generally, species variety is higher at Olsteinhelleren (but note that the assemblage is considerably larger). These authors have suggested elsewhere that the changes between these two sites are mainly the result of fundamental changes in mobility patterns among the coastal groups during this period with increased sedentism in the LM, implying that task groups stayed longer and thus practiced more varied fishing at Olsteinhelleren than at the older site (Bergsvik et al. 2016). Therefore, the changes need not reflect a general change in emphasis on different fish species in this region. Ideally, this trajectory should be studied in a comparative perspective where the sedentary coastal sites are also included; unfortunately, the assemblage from Kotedalen only covers the early part of the period (LM1–2), and not the period covered by Olsteinhelleren.

A few technological changes took place during this period (Table 10.3). During MM3 and LM1, flutters were used during fishing, but this practice did not continue during the rest of the Mesolithic. Also, fishhooks changed in style around the transition to LM2, when the Skipshelleren type replaced the Viste type. At the same time, line sinkers joined the fishing inventory. A problem is that it is difficult to say what these changes implied – if they were real technological improvements, making fishing more productive – or if they were stylistic and technical adjustments which were insignificant in terms of efficiency.

Nevertheless, even if the observed changes in the fisheries cannot be unequivocally connected to social and economic change, fishing may still have contributed to such developments in western Norway (e.g. Åstveit 2008b:585; see also Boethius 2017 for southeastern Sweden). A key aspect of this is that fishing was generally conducted in a manner that made it accessible to most group members, meaning that a large proportion of the population could be involved in provisioning. This, in turn, could have favoured demographic expansion, and as the region became more populated, people grew increasingly sophisticated in their knowledge of prime fishing grounds. This created incentives to control key localities, such as along the tidal current channels. The most effective way to accomplish this was to have at least part of the group maintain a continuous physical presence. Sedentism, in turn, would have increased pressure on terrestrial prey near the settlements (especially on the coastal islands) and encouraged further reliance on aquatic resources along with logistical forays to other areas such as the fjords. The nucleation of settlements at prime locations leading to higher local group sizes, with groups being more constantly present, in conjunction with the need to organize and manage an increasingly complex subsistence regime, would have provided powerful incentives for more elaborate social interactions locally as well as regionally. An example of elaborate local social interactions may be a stronger focus on ritual activities. In western Norway, this took place at the large rock art site Vingen, which lies just to the south of the tidal current channel Skatestraumen and the 17. Havnen site. At Vingen, around 2200 figures were carved during the period LM4–5, making them contemporary to – and most likely made by – the people who occupied the 17. Havnen site or the other large Late Mesolithic sites along this channel (Bergsvik 2002; Lødøen & Mandt 2012; Hjelle & Lødøen 2017). In terms of regional social interactions, the emergence of sedentism has consequences for intergroup relationships: when some groups become sedentary (and territorial), this inevitably leads to similar developments in other districts, because residential mobility is a less viable option than before (e.g. Kelly 2013:106). Intergroup contacts are instead organized through task group mobility or exchange, with the potential for the development of social inequality that this entails. In western Norway, social boundaries and territories clearly developed during the Mesolithic, and so did long-distance interregional exchange networks (Olsen & Alsaker 1984). Most likely, none of this would have happened if the populations did not have the predictability, security and solid economic basis that fishing provided. Seen in this light, fish may have hooked people on greater social inequality and cultural diversity.

Conclusion

As in other areas of northern Europe, people of the western Norwegian Mesolithic appear to have placed great reliance on fishing as part of their subsistence regime. While the evidence for fishing in the Early Mesolithic is equivocal, data for all types of subsistence are quite rare, and with the indirect evidence available a good argument can be made that fish were important from the earliest colonization of the region. During the rest of the Mesolithic, the data become more robust, and it seems that not only were the fisheries important, but they may also have frequently been the deciding factor in where people chose to live. Site location analyses show that the productive outer coast was clearly most attractive, although fishing was also carried out from sites along the fjords. Seven sites with preservation conditions for organic material provided data on fish species as well as fishing equipment. A remarkable correspondence was noted between the sizes of fish and the gear used to catch them. This clearly shows that 2- to 3-year-old gadids were the most common catch, and they were primarily caught with hook and line. It is argued that although fishing may not necessarily have been more important than hunting measured calorically, it was carried out by all group members and it represented the daily security of the Mesolithic populations. The extensive and stable fisheries at the western Norwegian coast were an important factor in the development of sedentism in this region.

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11 Resource management in Late Mesolithic Eastern Norway?

Fishing in the coastal, interior and mountain areas and its socio-economic implications

Axel Mjærum and Anja Mansrud

Introduction and research questions

Eastern Norway is one of the few areas in Europe where the postglacial coastlines are not submerged, and where early maritime subsistence and settlement patterns are well documented from the Early Mesolithic, c. 9300 cal BC (Bjerck 2007, 2008; Solheim & Persson 2018). A foraging lifestyle, based on aquatic resources and terrestrial hunting and fishing, remained essential to the subsistence economy throughout the Mesolithic, and most parts of the Neolithic (9300–2400 cal BC) in Norway. Fishing was also an important supplement to the agricultural economy that commenced in the Late Neolithic (c. 2400 cal BC; Prescott 2005, 2009). The economic importance of different types of fisheries (see Figure 11.2) as a supplement to other forms of sustenance is also well documented throughout historical times (Eknæs 1979; Dannevig & Eynden 1986:195–196; Hesthagen & Kleiven 2016a).

Fishing has been considered a key factor in the intense utilization of the landscape by people living by the coast, as well as the interior lowlands of eastern Norway, during the Mesolithic (c. 9200–3900 cal BC; e.g. Brøgger 1905:68; Hagen 1959:141–143; Mikkelsen 1989:65, 73, 297; Indrelid 1994:263; Glørstad 2010:78), but the lack of faunal evidence has hampered our understanding of the past Mesolithic fishing in the region.

A tremendous taphonomic loss, prompted by a combination of environmental conditions, such as acidic soils, and archaeological recovery procedures, as for example the absence of fine-meshed sieving, has caused fishbone and fishing gear to be severely underrepresented in the archaeological record (Mansrud 2014; Hufthammer & Mjærum 2016). Hence, the interpretation of the modes of subsistence in this region relies heavily on the location of the sites. Recently, new archaeological data, as well as reassessments of previously unpublished collections of faunal remains and fishing gear, have made coastal and freshwater fishing a more tangible topic of research in the region (Mansrud 2014, 2017; Mjærum & Wammer 2016; Mansrud & Persson 2018). The main aim of this chapter is to explore the socio-economic importance of fishing in eastern Norway during the Mesolithic period. Novel finds of fishbone,

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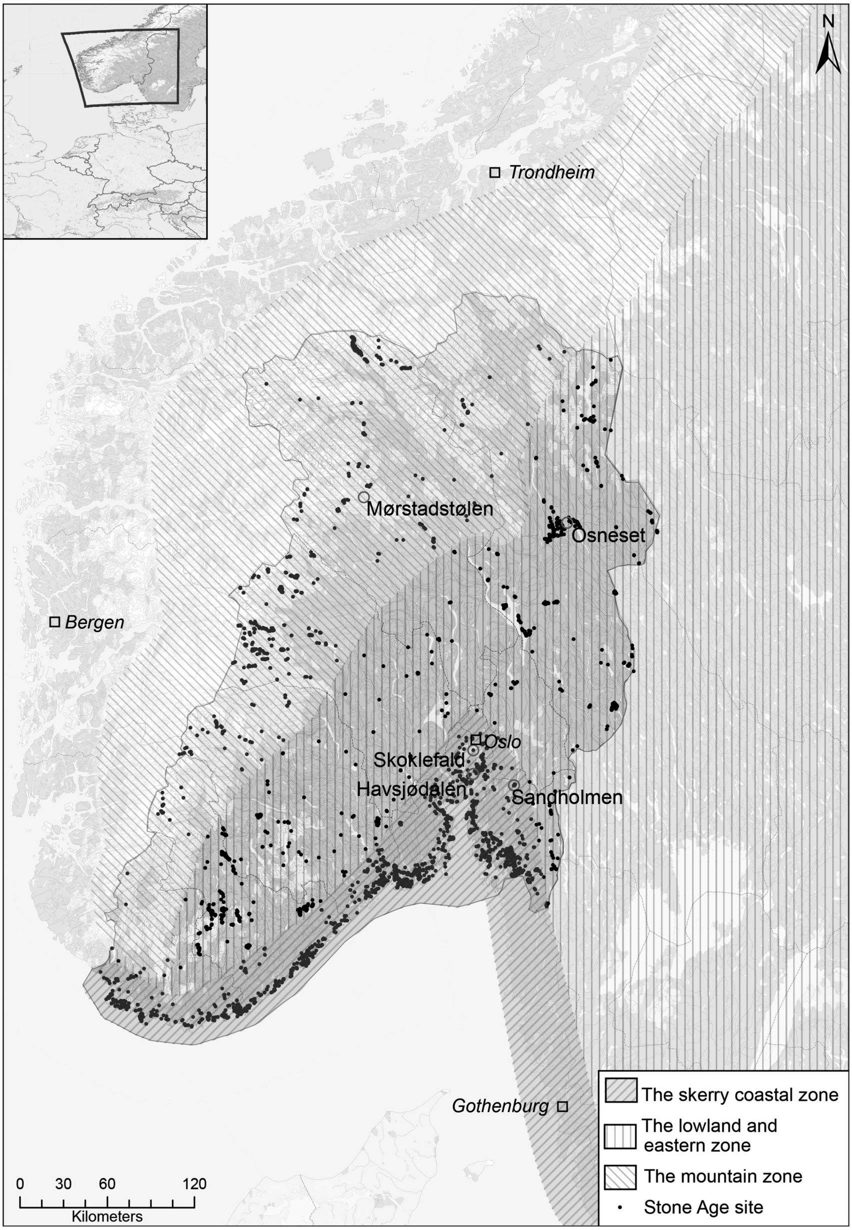

Figure 11.1 Southeastern Norway with recorded Stone Age sites (Askeladden) and the three major regions discussed in the chapter: The coastal zone, the lowland and eastern zone and the mountain areas, which provided different natural conditions for past fishing. Map: A. Mjærum, MCH, UiO.

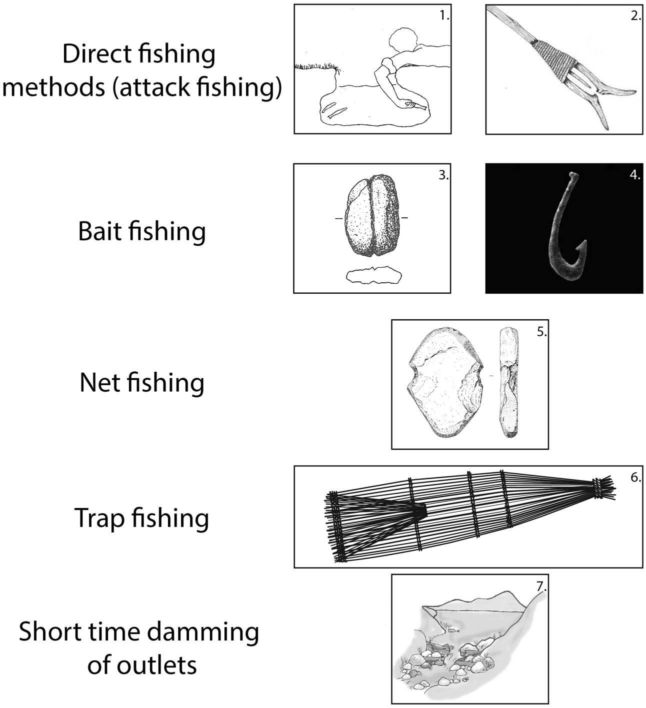

Figure 11.2 A large range of fishing methods have been utilized during the last centuries in Scandinavia (Eknæs 1979; Dannevig & van Eynden 1986, Hesthagen & Kleiven 2016a), and most of these were likely applied in the Mesolithic period. 1. Fishing by hand (illustration: NFS Ord og Sed, no. 27, reprinted with permission). 2. Fishing leister from Syltholm, Denmark (illustration © Anne Vibeke Knöchel Christensen, Museum Lolland-Falster, reprinted with permission). 3. Line sinker from Farsund, Vest-Agder (Ballin & Lass Jensen, 1995:192; length 3 cm). 4. Fishhook from Sande, Vestfold (photo: Kirsten Helgeland; MCH, UiO, length 3.3 cm). 5. Net sinker from Åmot, Hedmark (illustration by S. Thingnæs; Damlien 2010:420; length 13 cm). 6. Reconstruction of a Mesolithic fishing trap (illustration: Axel Mjærum, MCH, UiO). 7. Short-term damming of an outlet (illustration: © Sigrid Skoglund, NINA, reprinted with permission).

fishing equipment and site locations from three different habitats will be compared and discussed: the *coastal zone*, the *interior lowland zone* and the *mountain area* (Figure 11.1). Furthermore, the results will be considered in relation to new evidence obtained from adjacent areas in western Norway and Sweden. These findings constitute an important backdrop for evaluating the aquatic component of subsistence livelihoods in eastern Norway, where faunal fish remains are few and difficult to date directly by radiocarbon analysis (Mjærum 2016:60–61). Following K.A. Bergsvik and A.K. Hufthammer (2009), as well as P. Rowly-Conwy and S. Piper (2016), the notion of hunter-fisher-gatherers (HFG societies) is utilized here to capture the Mesolithic way of life in eastern Norway.

In western Norway, Sweden and southern Scandinavia, the fundamental importance of coastal and freshwater fisheries has been thoroughly demonstrated based on zooarchaeological records (Karsten & Knarrström 2003; Bjerck 2007, 2008; Fischer 2007; Bergsvik & Hufthammer 2009; Boethius 2016, 2018a; Ritchie et al. 2016). The same conclusions have been drawn based on isotopic analyses of Mesolithic human bone remains from coastal and interior lowland sites in large parts of Scandinavia (e.g. Lidén et al. 2004; Fischer et al. 2007; Eriksson et al. 2017; Boethius & Ahlström 2018; see, however, Skar et al. 2016 for a discussion of the importance of seal hunting).

Recent excavations, carried out with improved excavation techniques, also demonstrate that *freshwater fisheries* may have been more important for the Early and Middle Mesolithic societies than previously acknowledged. Of particular importance is the Norje Sunnansund site in Blekinge, southern Sweden (Boethius 2016, 2018b). Exceptional preservation and methodological aptness, such as fine-meshed sieving of earth samples, resulted in enormous quantities of fishbone – statistical calculations indicate that approximately 60 tons of freshwater species, in particular roach, were caught at the site. Additionally, a presumed fermentation gutter for the preservation of fish was identified. The earliest settlement phase at Norje Sunnansund was dated to 7600–6900 cal BC. Furthermore, archaeological finds from the eastern lowland region in Sweden (e.g. Bergstrand 2005; Nilsson et al. 2018) and other parts of Scandinavia also attest that a wide range of fishing equipment came into use during the Mesolithic period (e.g. Fischer 2007; see also Figure 11.2). Fish traps were previously known from the Late Mesolithic Ertebølle culture (c. 5300–3950 cal BC), but have now been identified at Middle Mesolithic sites in southern Scandinavia and in the southern Baltic region (Boethius 2018b, with further references; Nilsson et al. 2018). This shows that complex technologies for catching, preparing and preserving fish were known much earlier than formerly assumed.

Why is it imperative to expand our knowledge of the prehistoric fisheries in eastern Norway? The main reason is that inquiries into aquatic adaptations and technologies have been considered vital for understanding early human societal formation, variation and change. It has been strongly argued that a more sedentary utilization of the landscape is only sustainable in bountiful natural environments, which contain sufficient resources to sustain a foraging population throughout the year. Sedentary societies are often associated with reliable aquatic resources (Kelly 1983; Renouf 1984). Trap fishing, storage and conservation techniques have been considered important prerequisites for decreased mobility and succeeding social complexity. Social complexity commonly implies larger groups, longer stays, more elaborate technology, intensified subsistence, broader resource utilization and the like. Furthermore, decreased mobility is often coupled with the development of inequality and social differentiation (Hayden 2001; Price & Brown 1985). Recent ethnographic inquiries even suggest that fisheries enabled hunter-gatherer groups to develop long-lasting social and technological features that are associated with food cultivation and land tenure (Thornton et al. 2015). Hence, a more profound understanding of the nature of prehistoric fishing technologies allows for addressing questions concerning the societal as well as the economic dimensions of fishing.

Geography and topography and the establishment and development of the ichtyfauna

The investigation area presented here constitutes 104 000 km^2 and includes one-third of present-day Norway (Statistics Norway 2013). The topography is varied, with a large coastal zone with nemoral forest in the south, coniferous forest areas in the interior and mountain areas up to an altitude of around 2000 m a.s.l. (Figure 11.1). Topographic differences and climatic conditions influenced the availability of fish, and the applicability of fishing methods is of major importance for understanding past and present fishing in the region (Hesthagen og Kleiven 2016a). The eastern Norwegian landscape was formed by geological processes, in particular by glacier activity, during the Quaternary time period. The melting and moving glaciers eroded the surface, conveyed sediments and ultimately created the characteristic landscape of different regions, glacial fjords, rivers and valleys (Fredin et al. 2013:6). During the Weichselian Ice Age, the whole region was glaciated, and the ice initially started to retreat from the outer coast approximately 17 000 years ago (Fredin et al. 2015). The main parts of the interior zone became free of ice during the Preboreal climate phase (Figure 11.3; c. 9300–8200 cal BC). The deglaciation opened up an archipelago that stretched from continental Europe, along the Swedish west coast, to the Oslo fjord area (Påsse & Andersson 2005). In the Oslo fjord area, the initial deglaciation of the ice sheet led to rapid and continuous isostatic uplift, resulting in considerable elevation of the shorelines and the absence of later transgressions. Today, the coastal regions of eastern Norway are characterized by a skerry coastal landscape, with an outer coast exposed to the Skagerrak Sea, and numerous inlets and islands (Puschmann 2005).

Initially after the deglaciation, a northward and westward expansion of people from southern Scandinavia commenced, and the resource-rich areas along the Norwegian coast were rapidly populated (Bjerck 2008:103; Glørstad 2016). Today, most of the Mesolithic settlements are far away from the sea; however, when the sites were occupied by prehistoric hunter-fisher-gatherers, they were located close to the shore. The rapid shoreline elevation permits dating by thoroughly scrutinized shoreline displacement curves, which have become important tools for establishing a timeline for the Mesolithic period in the Oslo fjord area (Solheim & Persson 2018).

In the newly emerged ice-free areas, the warmer climate enabled the immigration of plants and animals (Jonsson 1995; Hufthammer 2006:193).

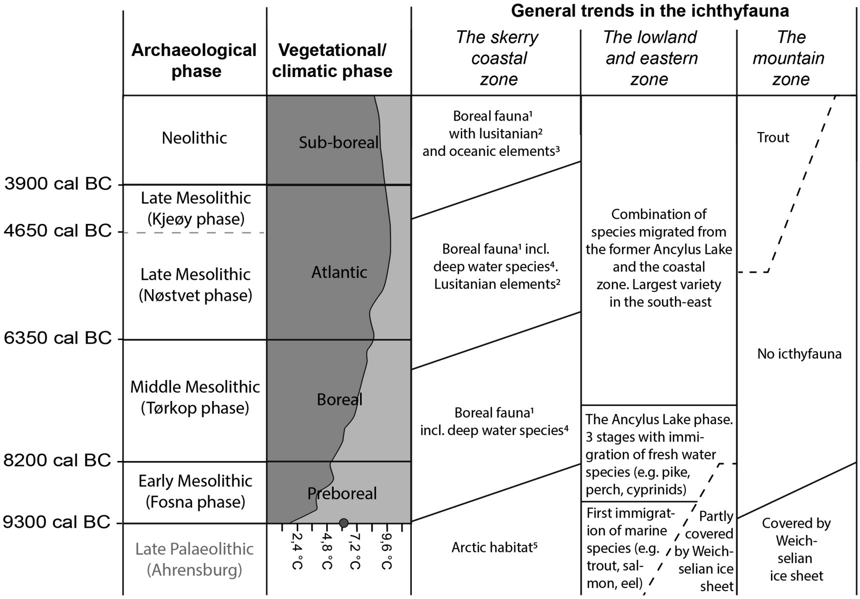

Figure 11.3 Archaeological and vegetational/climatic phases based on climate reconstructions from Bohuslän, southwest Sweden, in an area where the modern mean annual temperature is 6.1°C. After Antonsson and Seppä 2008: figure 5. The figure also includes the main developments in fish fauna in the three regions discussed in the text. The fish fauna from the skerry coastal zone is based on records from Denmark (Enghoff et al. 2007), the Swedish west coast and Norway (Table 11.2; Hufthammer 2006). (1) Boreal fauna include cod, saithe, pollock and herring. (2) Lusitanian (southern) fauna include bogue, anchovy and sea bass. (3) Oceanic fauna include mackerel, bluefin tuna and swordfish. (4) Deep water fish fauna include ling, redfish and halibut. (5) Arctic fish fauna include capelin, herring, whiting, ling and char. Eel, trout and salmon have also been present in the Skagerrak area as well as in the lowland and eastern zone since the earliest parts of Preboreal. Illustration: A. Mjærum, MCH, UiO.

Concerning the human and animal colonization of eastern Norway, a southern and a northeastern immigration route has been verified. When the first narrow strip of land emerged from the ice, trout, char and three-spined stickleback, species that are tolerant to high salinity, began to migrate into the pristine areas (Huitfeldt-Kaas 1918:23). Other species of fish migrated into the interior of eastern Norway from the Ancylus Ice Lake, a freshwater lake that existed in the present Baltic Sea area (c. 9000–6900 cal BC). Fluctuations in salinity, sea currents and water temperatures gradually caused several changes in the coastal ichtyfauna during the Mesolithic period (Figure 11.3; Jonsson 1995:152; Enghoff et al. 2007). During the Ancylus Lake stage, several freshwater species of fish – pike, perch and different types of cyprinids – had the opportunity to drift westwards when the ice disappeared (Figure 11.3; Jonsson 1995:151). The consequence was the accumulation of a large variety of freshwater fish in the lower interior zones of Sweden and eastern Norway. Waterfalls and rivers with steep elevation made it impossible for the fish to naturally migrate into the mountain areas (Huitfeldt-Kaas 1918; Heggenes 2016; Hesthagen & Kleiven 2016b; see also Figures 11.6 and 11.7). Therefore, the mobile Mesolithic populations who initially visited the higher parts of the inland areas in eastern Norway *encountered a landscape with lakes and rivers without fish*.

Fishing in the mountain zone

The western part of the mountain areas in eastern Norway consists of plateaus and plains situated above 1000 m a.s.l., cut by deeply incised valleys (Puschmann 2005; see Figure 11.1). So far, there is no evidence of fishing prior to the Late Mesolithic period (Figures 11.6 and 11.7 and Table 11.1; see Mjærum 2016). One of the well investigated areas with evidence of early fishing is Mørstadstølen on the north shore of Lake Vinstre (1030 m a.s.l.; 28 km^2) in the upper part of Gudbrandsdalslågen (Figures 11.1 and 11.4–11.6). Today, the area is located above the tree limit, but during the Mesolithic period it was covered by forest (Selsing 2010:113–140). The watercourse forms a bottleneck in the area, through which ran a reindeer migration route (Bergstøl & Friis in prep). High numbers of animals passed through this bottleneck formation every spring and autumn. Seasonally migrating elk and reindeer commonly follow river and lake shores in the interior areas, making river mouths and outlets excellent hunting grounds (Mjærum 2016:62–64). A large number of sites have been found along the shore of the lake, some with up to 1 m thick cultural deposits (see Figure 11.5; Mjærum 2016). The oldest sites are dated to c. 6000 cal BC, and the hunting activities have been continuous in the area for 5000 years. Along the shore of Lake Vinstre, a few fragments of trout bones have been found in contexts dated to c. 4500 cal BC (Figure 11.6 and Table 11.1). Additionally, a presumed fragment of a fishhook and a set of stone sinkers, probably used for gillnet fishing, have been recovered from a site dated to c. 2600 cal BC, further down river at Olstappen (662 m a.s.l., Figure 11.8; Mjærum 2016:245–246). Importantly, these Neolithic finds support the assumption that mountain fishing already took place in the Stone Age.

Both in the past (Table 11.1) and today, the waterways in the mountain zone are dominated by trout, and ecologists and DNA scientists assert that trout must have been *transported to the rivers and lakes by humans* (Heggenes 2016; Hesthagen & Kleiven 2016b). Some of the trout transport happened during the last centuries, and is mentioned in historical records (Hesthagen & Kleiven 2016b; Severinsen 2016). The first written records that mention fishing are dated to medieval times (e.g. Hesthagen & Kleiven 2016b:37–38; Ugulen 2016). However, as demonstrated here, the archaeological results show that fish were present in many lakes and rivers long before the Middle Ages.

Trout is adaptive, productive and can survive at high altitudes. It is rich in calories and easy to catch, especially when it spawns in streams and rivers

Table 11.1 Mesolithic finds related to fishing from the mountain area

Present altitude (m a.s.l.)	*Site*	*Municipality*	*County*	*Contextual date (cal* BC*)*	*Fish bones*	*Quantity*	*Fishing gear*	*Reference*
1130	Halnefjorden Hein, lok. 33	Nore og Uvdal	Buskerud	5300–3500	Trout (*Salmo trutta*)	6	–	Hufthammer and Mjærum (2016:257)
1000	Øyangen	Nord-Fron	Oppland	4940–4785	Trout (*Salmo trutta*)	5	–	Hufthammer and Mjærum (2016:257)
1206	Langesjøen, lok. 1039	Nore og Uvdal	Buskerud	4900–4250	Trout (*Salmo trutta*)	1	–	Hufthammer and Mjærum (2016:257)
1030	Øvre Bjørnhølen	Øystre Slidre	Oppland	4880–4490	Trout (*Salmo trutta*)	1	–	Hufthammer and Mjærum (2016:257)
740	Røyrtjønna, Pålsbufjorden, RT12–04	Nore og Uvdal	Buskerud	4830–4340	Fish (*Pisces*)	1	–	Hufthammer and Mjærum (2016:257)
740	Røyrtjønna, Pålsbufjorden, RT12–09	Nore og Uvdal	Buskerud	Before 2350	Fish (*Pisces*)	2	–	Hufthammer and Mjærum (2016:257)
1031	Vinstri I	Øystre Slidre	Oppland	Before 2350	Trout (*Salmo trutta*)	1	–	Hufthammer and Mjærum (2016:257)
1031	Mørstadstølen	Øystre Slidre	Oppland	Before 1000	Trout (*Salmo trutta*)	26	Net sinker?	Hufthammer and Mjærum (2016:257)

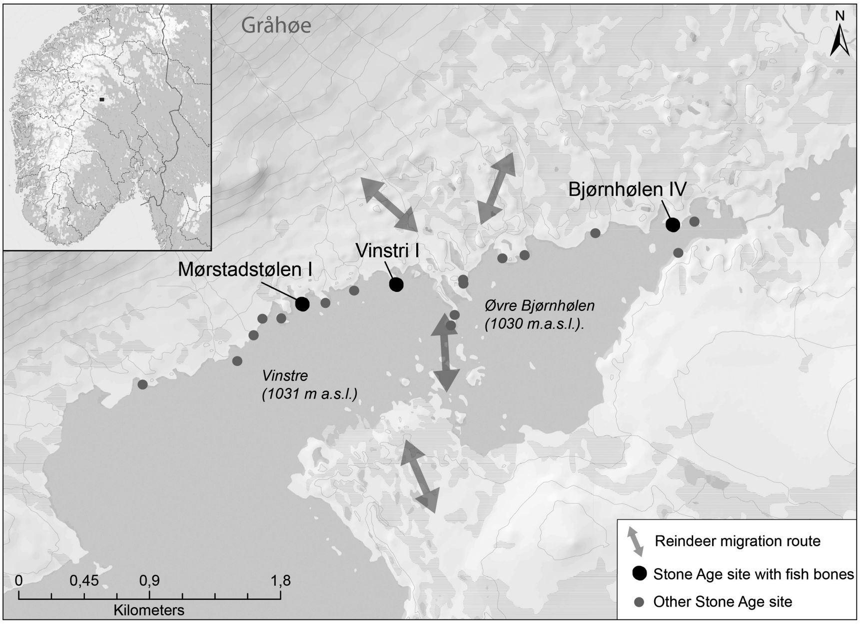

Figure 11.4 A large number of small headlands stretch out into Lake Vinstre. Many of these were settlement areas in the Late Mesolithic period. Photo: K. Helgeland, MCH, UiO.

in the autumn, and is possible to carry in small containers. The locations with high densities of Mesolithic finds in the mountains are topographically well suited for hunting as well as for net fishing and fish traps (see Figure 11.2; Hagen 1959:141–143, Mikkelsen 1989:65, 73, 297; Indrelid 1994:263; Mjærum 2016). Therefore, it is difficult to determine which resources primarily attracted people to these areas.

Large game, such as elk and reindeer, can provide a great outcome in term of meat, calories and raw materials such as bone, antler and hide, and compared to fish it was presumably a more important resource overall. However, big game hunting is also more unpredictable, and fishing could have served as a staple food for hunting crews or mobile families (cf. Kelly 2013:134–135).

Fishbones are small and difficult to date directly by radiocarbon analyses. Additionally, multiple revisits and a lack of stratigraphy make precise contextual dating problematic. This makes the precise time of the initial transportation of living fish upstream difficult to assess; however, a thorough evaluation of all known contexts of fishbones in the mountain region permits the conclusion that fishing commenced in the Stone Age, most likely in the Late Mesolithic phase (see Table 11.1, Figures 11.6 and 11.7;

Figure 11.5 A migration route for reindeer across Lake Vinstre, which may have contributed to the intense activity reflected in the Stone Age sites along the lake. Illustration: A. Mjærum, MCH, UiO.

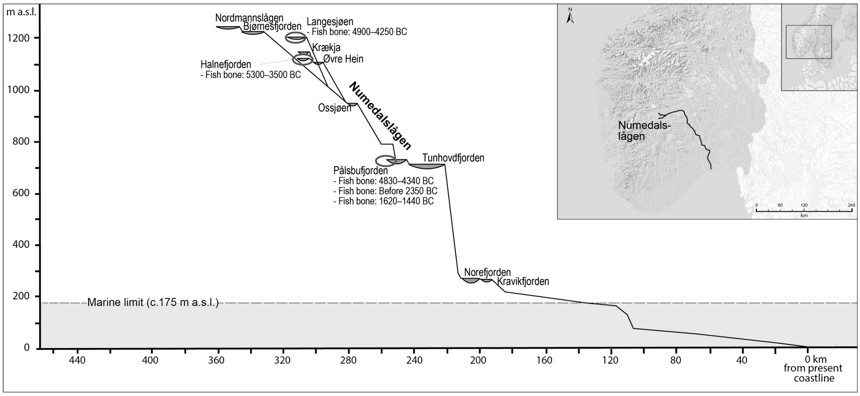

Figure 11.6 Sites with burnt bone of trout in Numedalslågen, one of the main watercourses in the mountain areas. The figures also show the steep elevation of the rivers, thus demonstrating why it was impossible for fish to naturally migrate into these areas. Illustration: A. Mjærum, MCH, UiO.

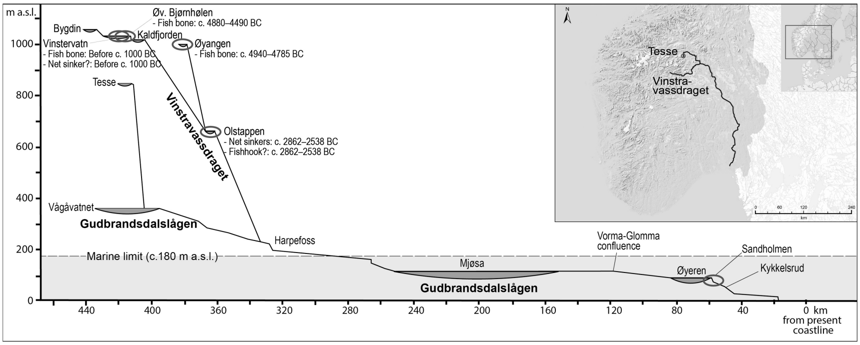

Figure 11.7 Sites with burnt bone of trout in Gudbrandsdalslågen, one of the main watercourses in the mountain areas. The figures also show the steep elevation of the rivers. Illustration: A. Mjærum, MCH, UiO.

Mjærum 2016:75–76). New data from the coast and the interior areas support this viewpoint.

Fishing in the coastal zone

The coastal settlements in eastern Norway are clustered along former straits and islands, in sheltered bays and inlets with natural harbours in all parts of the Mesolithic (e.g. Figures 11.1 and 11.8). This has led to the conclusion that the daily food procurement was largely based on marine resources in the region (e.g. Brøgger 1905; Glørstad 2010:97–100; Mansrud 2014; Åstveit 2014; Mansrud & Persson 2018). This argument has mainly been based on site location and analogies to present-day environments, and to a lesser degree on more systematic landscape analyses (Fischer 2007:fig. 5.2). It can be argued that the importance of fishing cannot be deduced from site locations exclusively, because the coastal habitat is characterized by a large variety of species in addition to fish – sea birds, sea mammals and shellfish – which are also attractive to humans. The finds of fishing gear and fishbone and the indication of the Mesolithic diet, based on C13 values in large parts of southern and central Scandinavia, do, however, support the assumption that fishing was an activity of great importance also in Mesolithic eastern Norway (Enghoff 1994; Fischer 2007; Bergsvik & Hufthammer 2009; Boethius 2016, 2018a, 2018b; Solheim & Persson 2016; Boethius & Ahlström 2018; Mansrud & Persson 2018).

The recurring settlements and the lack of transgressions make the coastal zone of the Oslo fjord particularly well suited for investigating long-term trends in the Mesolithic coastal settlement, and tangible evidence of fishing, in terms of zooarchaeological remains and fishhooks, is most frequently encountered here. The location of the Early Mesolithic sites (c. 9300–8200 cal BC) is linked with the marine biotopes, and some researchers have claimed that the marine

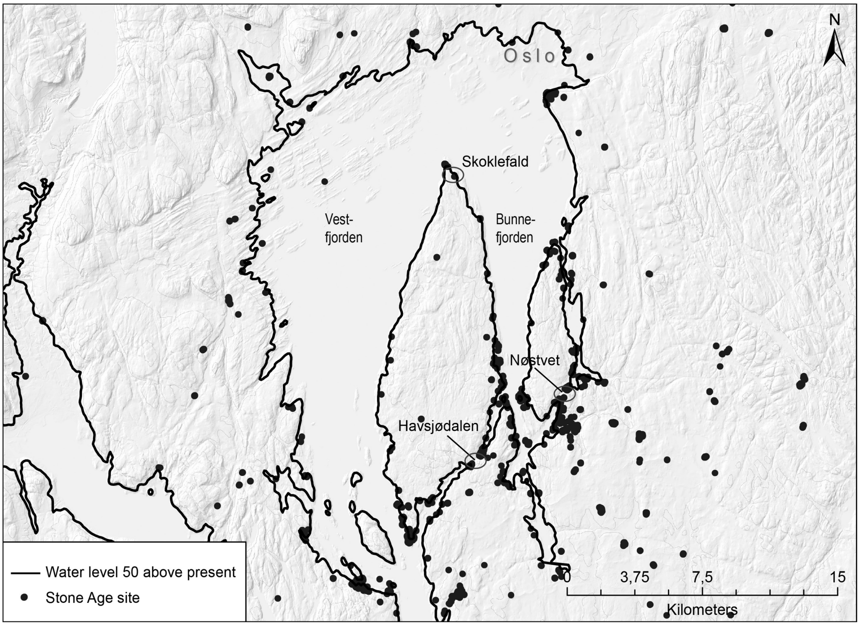

Figure 11.8 The inner part of the Oslo fjord with modelled sea level, 50 m above the present, as it was approximately around 5000 cal BC. At this time, numerous sites were located along the straits at Havsjødalen and in the Nøstvet area, while the kitchen-midden site at Skoklefald was situated at the northern end of a large island in the inner part of the fjord. Map: A. Mjærum, MCH, UiO.

bioproductivity in the Skagerrak was particularly high during the Preboreal (e.g. Schmitt et al. 2006; see discussion in Mansrud & Persson 2018:134–135). No faunal remains are preserved at any eastern Norwegian coastal site dated to the pioneer phase in Norway, but capelin, herring, whiting and ling have been identified in Late Glacial non-antropogenic deposits (Jonsson 1995:150–151; Sørensen et al. 2014:210–211; see also Figure 11.3). After 9000 cal BC, the sites are no longer exclusively found at the coastlines and outer fjord basins, but are also found in the newly ice-free hunting grounds in the interior and the mountain areas, thus pointing to differentiated subsistence strategies being used (Bang-Andersen 2012; Breivik & Callanan 2016).

From the Middle Mesolithic period, which started at the onset of the Boreal climate period (Figure 11.2), several coastal faunal assemblages are preserved in the Oslo fjord area and along the Swedish west coast (Glørstad 2010; Mansrud & Persson 2018).These assemblages encompass a large variety of species and a variable proportion of fishbone, which is suggestive of a mixed subsistence practice. Fish remains are reported from nine sites dated to the Middle Mesolithic period in the southeastern Skagerrak area. Six bone assemblages are from transgressed localities in western Sweden and four are located in southeastern Norway (Table 11.2). In total, 27 different species of fish have been identified, but their distribution varies considerably among the sites (Table 11.2). Marine species such as cod, ling, saithe, haddock, pollock and whiting are the most numerous, but a few fragments of flatfish and freshwater species such as pike, salmon and trout also occur. Food from the sea apparently made up a significant part of the diet, although this is difficult to assess, based on highly fragmented faunal material (Glørstad 2010:78; Mansrud & Persson 2018:154–155). With the exception of ling, which prefer deep water, the marine fish from the Middle Mesolithic sites are demersal species, which may have been caught with a line and hook, or nets. During the Middle Mesolithic phase, in particular from c. 7500 cal BC onwards, a systematic and varied utilization of a wide range of biotopes commenced (Bjerck 2008:104; Solheim & Persson 2016; Mansrud & Persson 2018). At the same time, the first traces of more permanent dwellings appear (Solheim & Olsen 2013; Fretheim 2017).

For the Late Mesolithic period (c. 6350–3900 cal BC), fishbones have been found at six coastal sites in eastern Norway (Table 11.2), and five sites from the Swedish west coast (Glørstad 2010:80–84, with further references). A particularly interesting Late Mesolithic site is Skoklefald in the inner part of the Oslo fjord (Figure 11.8), where a cultural layer containing periwinkles, oysters and animal bones was excavated in 2001; 75% of the bones were unburnt, an extremely rare situation in this region. Three radiocarbon samples date the site within the time frame c. 5900–5600 cal BC (Jaksland 2001:17–18). The site was interpreted as a small kitchen-midden, measuring approximately 30 m^2 (Figure 11.9). A total of 509 fragments of fishbone were found, of which 228 fragments were identified as herring. Cod, pollock and sea eel are also represented (Table 11.2). The Skoklefald midden only yielded 257 lithic finds and a small fireplace, and the site was interpreted as the result of a single or several shorter visits over an extended period of time (Jaksland 2001:19). In this respect, Skoklefald differs from large Late Mesolithic coastal settlements, of which several comprise dwelling structures and large amounts of lithic debris. These larger sites are often interpreted as marine-based residential sites in a logistical settlement system, where a wide spectrum of activities took place (Glørstad 2010:64, with further references).

The Havsjødalen site complex is a recently excavated example of a large Late Mesolithic coastal settlement (Figure 11.8). At Havsjødalen 3, a sunken dwelling hut was identified. The floor of the dwelling measured 6 × 3 m, and was visible as a dark cultural layer (Figure 11.10); 61 500 lithic artefacts were recovered from the site. This points to intensive use, and the site was interpreted as a residential unit used for a longer period. Unfortunately, only a few fragments of burnt animal bone were preserved. Among them were unidentified mammal bones, one bird bone and a possible fish tooth. Cultural deposits from another excavated site in Havsjødalen, which were chemically analyzed, had calcium-phosphorus-fluorine values that correspond with a high content of decomposed bone, possibly from fish (Macphail & Linderholm 2016).

Table 11.2 Mesolithic finds related to fishing from the coastal zone

Site	*Municipality*	*County*	*Contextual date (cal BC)*	*Fish bones*	*Quantity*	*Fishing gear*	*Reference*
Prestemoen 1	Porsgrunn	Telemark	7600–7300	Cod (*Gadus morhua*)	Present	11 fragments of fishhooks, fishhook debris	Persson (2014); Mansrud and Persson (2018); Mansrud (2017:table 1)
				Ling (*Gadus marhua*)	Present		
				Whiting (*Marlangius marlangius*)	Present		
				Pollack (*Pollachius pollachius*)	Present		
				Saite (*Pollachius virens*)	Present		
				Saite/Pollack (*Pollachius pollachius/Pollachius virens*)	Present		
				Herring (*Clupea harengus*)	Present		
				Gray gurnard (*Eutrigla gurnardus*)	Present		
				Ballan wrasse (*Labrus bergylta*)	Present		
				Flunder-fishes (Pleuronectidae)	Present		
				Salmon/trout (*Salmo salar/Salmo trutta*)	Present		
Skutvikåsen 3	Skien	Telemark	7500–7000	Fish (*Pisces*)	15	1 fragmented fishhook, fishhook debris	Ekstrand (2013); Mansrud (2017:table 1)
Søndre Vardal 3	Sande	Vestfold	7200–6800	Cod (*Gadus morhua*)	Present	Shaft of fishhook	Mansrud and Persson (2017); Mansrud (2017:table 1)
				Whiting (*Marlangius marlangius*)	Present		
				Saite (*Pollachius virens*)	Present		
				Codfishes (Gadidae)	Present		
				Salmon/trout (*Salmo salar/Salmo trutta*)	Present		

(*Continued*)

Table 11.2 Continued

Site	*Municipality*	*County*	*Contextual date (cal* BC*)*	*Fish bones*	*Quantity*	*Fishing gear*	*Reference*
Tørkop	Halden	Østfold	7200–6600	Cod (*Gadus morhua*) Whiting (*Marlangius marlangius*) Pollack (*Pollachius pollachius*) Codfishes (Gadidae) Gray gurnard (*Eutrigla gurnardus*)	Present Present Present Present Present	Fishhook debris	Mansrud and Person (2018); Mansrud (2017:table 1)
Kongsdelene R71-2	Farsund	Vest-Agder	After 6500, cf. Sørensen (2006:46)	–	–	Line sinker/net sinker?	Ballin (1998:88)
Saugbruksforeningen 3	Halden	Østfold	c. 6300	Cod (Gadidae) Fish (*Pisces*)	2 5	–	Melvold (2006:table 8)
Frebergsvik	Horten	Vestfold	6300–4500	Fish (*Pisces*)	3	Line sinker/net sinker?	Mikkelsen (1975:79)
Kjellsvika III	Farsund	Vest-Agder	After 6300	–	–	Line sinker/net sinker?	Reitan (2009)
Krøgenes D1	Arendal	Aust-Agder	After 6300	–	–	Line sinker/net sinker?	Reitan (in press)
Vinterbro 3	Ås	Akershus	6300–4500	–	–	Fishhook debris	Mansrud (2017:table 1)
Kongsdelene R70/71	Farsund	Vest-Agder	c. 5800, cf. Sørensen (2006:46)	–	–	Line sinker/net sinker?	Ballin (1998:79–80)
Skoklefald	Nesodden	Akershus	5900–5600	Cod (*Gadus morhua*) Codfishes (Gadidae) Saite/Pollack (*Pollachius pollachius/Pollachius virens*) Herring (*Clupea harengus*) Sea eel (*Conger conger*) Fish (*Pisces*)	40 19 20 343 1 86	Fishhooks and hook production	Glørstad (2010:73)

Nøstvet	Ås	Akershus	c. 5500	Fish (*Pisces*)	2	–	Jaksland (2005)
Vinterbrokrysset	Ås	Akershus	c. 5500	Fish (*Pisces*)	1	Fishhook	Eymundsson (2012: fig. 10)
Lundevågen R6	Farsund	Vest-Agder	5900–4000, cf. Bergsvik (2017)	Fish (*Pisces*)?	4?	Small furrowed sinker in soapstone	Ballin og Lass Jensen (1995:156)
Lundevågen R18	Farsund	Vest-Agder	5900–4000, cf. Bergsvik (2017)	–	–	Small furrowed sinker in soapstone	Ballin og Lass Jensen (1995:192), see also Figure 11.2
Lundevågen R24	Farsund	Vest-Agder	5900–4000, cf. Bergsvik (2017)	–	–	Small furrowed sinker in soapstone	Ballin og Lass Jensen (1995:138)
Torpum 9b	Halden	Østfold	5500–5200	Saite/Pollack (*Pollachius pollachius/Pollachius virens*)	1	–	Tørhaug (2004)
				Fish (*Pisces*)	8		

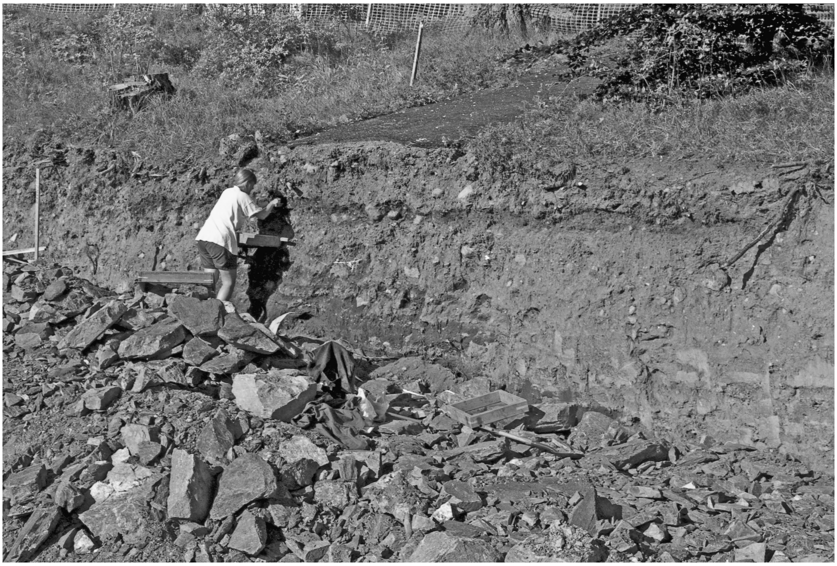

Figure 11.9 Skoklefald is the only known Mesolithic kitchen-midden in eastern Norway. An approximately 30 m^2 area with molluscs, bones and lithic artefacts was superimposed by later deposits. Photo: L. Gustafson, MCH, UiO.

The location of the site complex provides a better basis for a discussion of the resource base for the people that lived there. The Havsjødalen site was situated at the southeastern side of Nesodden, which was a large island when the sea levels were 50 m higher than the present day (Figure 11.8). Such locations are known to generate superior conditions for fishing (Bergsvik 2001). The stream between this island and the mainland was probably ideal for fishing, especially using weirs, a method well known from southern Scandinavia (Fischer 2007). Havsjødalen, and other similar residential sites of the time, point towards fish as a central resource harvested in the coastal zone during the Late Mesolithic period, while smaller sites such as Skoklefald may have functioned as specialized locations for fishing and the gathering of molluscs (Glørstad 2010:79).

Several studies of fishhooks from Middle and Late Mesolithic sites have been conducted during recent years (Bergsvik & David 2015; Mansrud 2017; Mansrud & Persson 2018). The archaeological finds of Mesolithic fishing equipment in the coastal zone is limited to fragments of bone fishhooks and debitage from fishhook manufacture, although other fishing methods were probably also in use. The fishhooks are similar throughout a large region in the Middle Mesolithic period. They are relatively small (approximately 3 cm long on average), made without barbs, and the shanks have notches for fastening the line (see Figure 11.11; see also Mansrud 2017). Two fishhooks and a

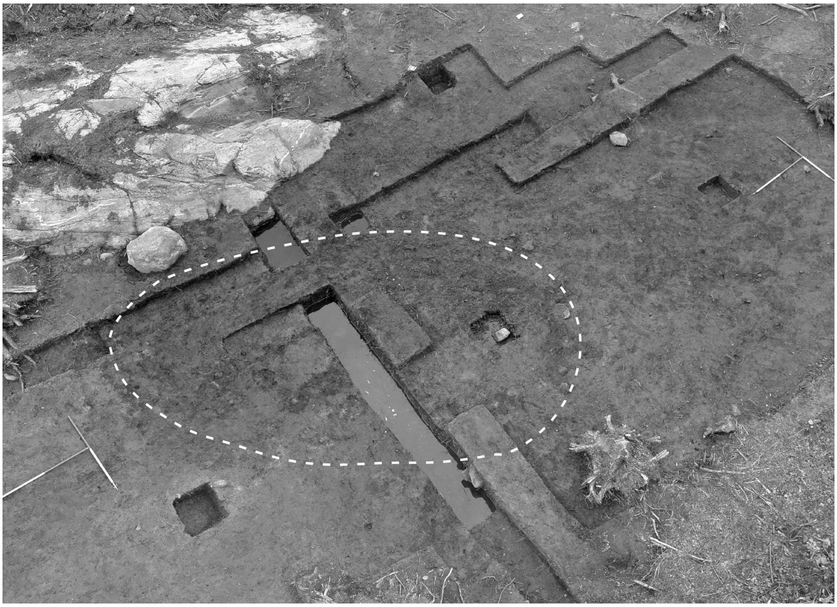

Figure 11.10 At the Havsjødalen 3 site, a sunken hut floor was identified. The floor measured 6 × 3 m and was visible as a dark cultural layer. A total of 61 500 lithic artefacts were recovered. This points to intensive use, and the site is interpreted as a residential unit used over a longer period. Photo: C. Eymundsson, MCH, UiO.

fragment of debris from fishhook manufacture were found in the cultural layer at Skoklefald (Figure 11.4). Unlike the Middle Mesolithic fishhooks, this shank does not have a notch, but a small bulb for tying the line, similar to an undated fishhook from Sande in Vestfold (Figure 11.11). Small stone sinkers are found in large numbers at Late Mesolithic sites in western Norway (Ritchie et al. 2016; Bergsvik 2017). Despite the large number of Mesolithic sites excavated in southeastern Norway, stone sinkers are uncommon in this area, except at Lista, close to the west coast region (Table 11.3). Presumably, small pebbles not recognizable as sinkers must have been used. Nicely crafted stone sinkers must thus be considered a regional phenomenon in western Norway (Bergsvik 2017).

Fishing in the interior zone

Zooarchaeological analyses show that elk and beaver were the most important animals hunted in the interior Boreal forest areas throughout the Mesolithic (Ekman & Iregren 1984; Mansrud 2009; Hertell & Tallavaara 2011; Mjærum 2018). Thus, the interior settlements contrast with the broad and varied

Figure 11.11 Fragments of Middle and Late Mesolithic fishhooks from coastal sites in the Oslo fjord area. 1. Shank with bulb for fastening the line. 2. Bend of fishhook, both Skoklefald. 3 and 4. Bends of fishhooks, Prestemoen 1. 5. Bend of fishhook, Vinterbro 3. 6. Bend of fishhook, Skutvikåsen 3. Photos 1 and 2: Ellen C. Holte, MCH, UiO. Photos 3–6: K. Helgeland, MCH, UiO.

faunal economy observed in the coastal zone. However, what these zones do have in common is the availability of fish as a stable resource. Previous studies concerning the fisheries in the interior areas have emphasized the importance of pike, perch and different types of cyprinids (Ekman & Iregren 1984). The earliest site with preserved fishbone in the interior zone is Almeö in western Sweden, situated along the large Hornborga Lake, and dated to the Preboreal climate phase. Fishbone, mainly pike and perch, constitute 30% of the faunal assemblage (Kindgren 1995:173). No fishhooks have been identified at Almeö. Pike may have been caught with leisters, but the presence of perch indicates that nets or fishhooks had also been used. The use of leisters for lake fishing is documented throughout the Mesolithic (Vankina 1999; Johansson 2006; Carlsson 2007; Gummesson 2018:53–54), and large amounts of sinkers also point to the use of fishnets (Carpelan 2008; Sjöström & Hammarstrand Dehman 2010:13, 42–43). Stone sinkers, most likely used to weight down gillnets, have a wide distribution in the eastern interior zone, but as stray finds they are difficult to date (Broadbent 1979:127–128;

Table 11.3 Mesolithic finds related to fishing from the eastern interior zone

Site	*Municipality*	*County*	*Contextual date (cal BC)*	*Fish bones*	*Quantity*	*Fishing gear*	*Reference*
Osneset	Åmot	Hedmark	6205–5326	Perch (*Perca fluviatilis*)	48	Fishing spear?	Winther og Persson (2016)
				Pike (*Esox lucius*)	67		
				Cyprinids (Cyprinidae)	69		
				Burbot (*Lota lota*)	7		
				European whitefish (*Coregonus lavaretus*)	1		
				Fish (*Pisces*)	1240		
Melle, Rena elv	Åmot	Hedmark	6110–5980	Trout (*Salmo trutta*)	4	–	Hufthammer and Mjærum (2016:257)
				Fish (*Pisces*)	24		
Stene terrasse, Rena elv	Åmot	Hedmark	4220–3800	Trout (*Salmo trutta*)	2	–	Hufthammer and Mjærum (2016:257)
Melvold, Rena elv	Åmot	Hedmark	Before 1700	Trout (*Salmo trutta*)	1	–	Melvold (2010:345); Hufthammer and Mjærum (2016:257)
				Salmon/trout (*Salmo salar/ Salmo trutta)*	3		
				Fish (*Pisces*)	5		
Svevollen	Elverum	Hedmark	4650–3800	Trout (*Salmo trutta*)	Present	–	Mikkelsen (1989a); Fuglestvedt (1992)

Lannerbro 1997:25–26; Stene et al. 2010:516). One of the most common types (Indreko (1956):type A) are flat stones with notches at the sides. They are often dated to the Middle Neolithic, but this type, as well as other types of net sinkers, were also in use during the Mesolithic (Mjærum 2016:60, 72–73, with further references).

Finds of fishing weirs make fishing evident in the interior lowland areas of Sweden from around 7500 cal BC (Boethius 2018b), and from c. 7000 cal BC in the southern Baltic area (Nilsson et al. 2018). It is likely that this practice commenced not much later in eastern Norway. From the Oslo fjord area, several large rivers extended into the interior, and Middle and Late Mesolithic sites are frequently encountered at the outlets or along these riverine systems (e.g. Fuglestvedt 1992; Boaz 1997; Stene et al. 2010). Bones of trout have been found at some of these sites (Table 11.3; see also Mjærum 2016:60). Most of the sites with finds of fishbone in the lower interior zone are, however, located along large lakes (Ekman & Iregren 1984:33), such as Lake Osen (44 km^2) in Hedmark county, Norway (438 m a.s.l.). The Osneset site, situated at the northern shore, is positioned at a promontory at the mouth of the river Osa (Figures 11.12 and 11.13). The site is one of the largest settlement areas in the whole region (c. 44 000 m^2), and like many other sites in the interior, it was visited repeatedly throughout the Stone Age. Lithic material, large amounts of

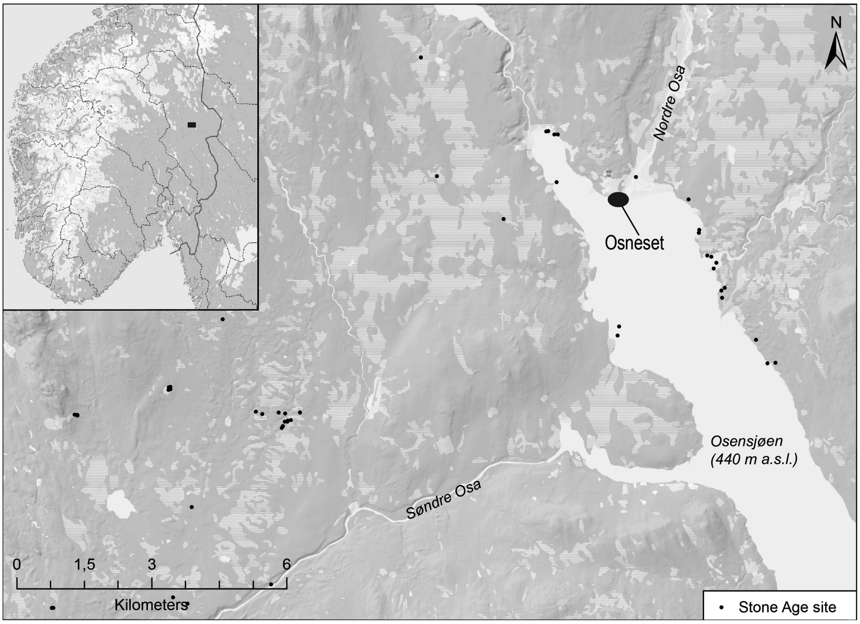

Figure 11.12 Osneset has a prominent location in the northern part of Lake Osen, in the lowland of Hedmark, close to the border of Sweden. Map: A. Mjærum, MCH, UiO.

Figure 11.13 Osneset is located at the shore outlet of the river. The shallow, sandy lakebed in front of the headland is well suited for gillnet fishing. Two small pieces of bone with serrations were found among the fish bones at the site (bottom left). The fragments could have been part of a fishing spear. Photo: T. Winther, MCH, UiO. Illustration: P. Persson, MCH, UiO. Map: A. Mjærum, MCH, UiO.

fire-cracked stones and bones have been found during surveys and small test pit and trench excavations (Winther & Persson 2016). Artefacts and radiocarbon dating demonstrate human activity at the site on several occasions, from the last part of the Middle Mesolithic until the Bronze Age (c. 6500–1500 cal BC). A total of 1432 fragments of burnt fishbone can be related to the initial phase of activity, together with mammals (428 pieces), undetermined bones (1627 pieces) and two parts of a fishing spear (Figure 11.13). The material includes pike, perch and different types of cyprinids, and must have been caught in large quantities (Table 11.3). Large and reliable recurring species of fish were most likely a key factor for the activity at Lake Osen. Great amounts of fire-cracked stones, such as those found in the cultural deposits at Osneset, have been commonly interpreted as evidence of heating during winter occupation (Lundberg 1997; Fretheim 2017:36). Pike and perch are species that are well suited for drying and storage (Eknæs 1977), and we may speculate that the heaps of fire-cracked stones stem from the drying of fish, although this cannot be directly proven.

The Sandholmen site is located on a small islet in Norway's longest and largest river – Glomma (Figure 11.14). The Sandholmen site is renowned for its large number of depressions interpreted as Mesolithic pit dwellings – in all, 25 depressions have been registered on the islet (Fuglestvedt 2006; Eigeland et al. 2016; see also Figure 11.15). Two of the depressions were situated at the brink of the islet, and were highly exposed to erosion from the annual floods of the River Glomma. In 2015, a small rescue excavation was undertaken in order to protect the site from further damage (Eigeland et al. 2016). The investigation verified that the depressions were indeed Mesolithic pit houses, dug into the moraine sediments (see Mansrud & Persson 2016 for details). Their

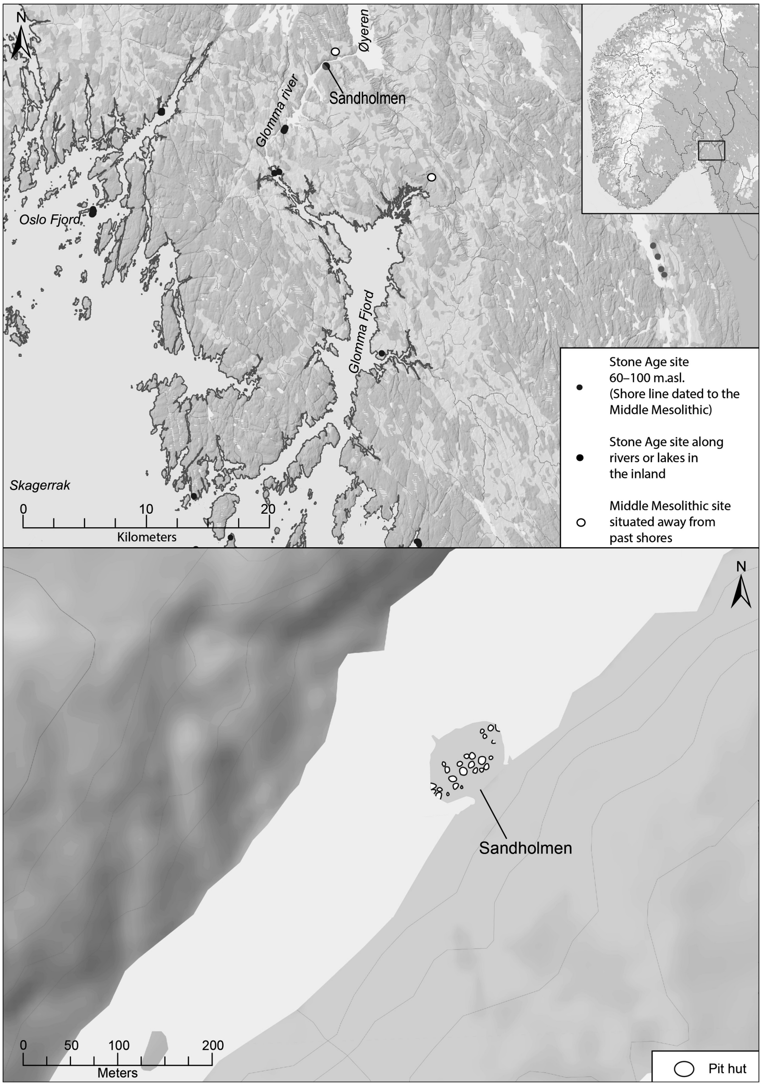

Figure 11.14 The pit huts are located at the small islet Sandholmen. Some of them could have been constructed when the sea was nearby (c. 7800 cal BC). The area was also in use when the large River Glomma passed nearby, and most likely offered excellent conditions for salmon fishing. Illustration: P. Persson, MCH, UiO.

Figure 11.15 One of the 25 pit huts at the southeastern part of Sandholmen. Photo: A Mansrud, MCH, UiO. Drawing: P. Persson, MCH, UiO.

construction must have required considerable temporal and organized effort. Three radiocarbon samples from a test pit inside one of the dwellings showed Middle/Late Mesolithic dates. New data of the local shore-level displacement indicate that the islet was shore bound around 7800 cal BC (Sørensen 2015). The oldest radiocarbon sample from Sandholmen is dated to c. 7500 cal BC. During this time, the site would have been located near the sea. Just a few hundred years later, land rise had transformed Sandholmen into an inland site. The youngest C14 sample is dated to the earliest part of the Late Mesolithic (c. 6100 cal BC). At this time, the site would have been situated between 16 and 41 m a.s.l. and approximately 100 m from the river (Mansrud & Persson 2016:17).

Salmon can be caught in the lowermost parts of Glomma today, but it is not possible for the fish to reach higher areas such as Sandholmen (Figure 11.14). However, during the Middle Mesolithic period when the sea level was higher, salmon must have been able to reach the waterfalls close to the area with pit dwellings. This could tentatively imply that *seasonal fisheries of salmon and other species have been a key factor for the location* during the early phase. Underwater investigations outside Sandholmen in 2007 identified traces of what may well have been permanent fish traps in the narrow stream close to the site (Nævestad 2007). Fish traps aimed at specific species have been widely used on a large scale during modern times (Dannevig & Eynden 1986:48; Hesthagen & Kleiven 2016a), and we do not know the age of the traps in Glomma. However, based on the local topography, and by an analogy with Mesolithic finds from Sweden and Finland, it is likely that fish traps and weirs were in use, and these fishing technologies may have been utilized for catching salmon.

A large number of Mesolithic sites are known in the vicinity of Sandholmen (Lindblom 1984) and further up the Glomma River system (e.g. Fuglestvedt 1992; Boaz 1997; Stene et al. 2010; see also Figures 11.1 and 11.14). At some of these sites, fishbones from trout have been recovered (Table 11.3). Hence, we find it likely that the large-scale activity at Sandholmen and adjacent sites may have been related to fishing, at least until around 7200 cal BC, when the migration of spawning salmon was stopped further down the river, as the waterfalls became too steep for the fish to pass due to the postglacial rebound.

The socio-economic implications of Mesolithic fishing: discussion and conclusions

Based on new findings of fishbone and fishing gear and the locations of the settlements, we have shown that fishing was important for subsistence from at least the beginning of the Middle Mesolithic period in eastern Norway. The overall faunal composition at the Middle (8200–6350 cal BC) and Late Mesolithic (6350–3900 cal BC) coastal sites displays a great variety of species from marine and terrestrial habitats, and a large variety of demersal and pelagic species have been identified in the coastal areas. Both seasonal pelagic species of fish, such as mackerel and herring, which move in large schools, and more stationary coastal species have been identified. Bone fishhooks were in use throughout the Middle and Late Mesolithic periods, and based on the location of sites close to tidal currents, such as the Havsjødalen site complex, similar coastal adaptations have been suggested for western Norway during the Late Mesolithic (Bergsvik 2001).

For the interior lowland zone, freshwater fish such as perch, pike and trout have been identified at riverine sites and lakes. We have suggested that the intense activity documented from the Middle Mesolithic period onwards in the Glomma estuary might have been connected to the exploitation of spawning salmon, at least until c. 7200 cal BC, when the migration of spawning fish most likely stopped further down the river. Access to several sources of water, such as freshwater lakes, streams and the sea is considered to be of primary importance for the development of a sedentary way of life (Boethius 2017:157–158). Mesolithic settlements are often placed in ecotone environments, bordering between different biomes, thereby enabling the optimal exploitation of different habitats and reducing the risk of food depletion. As an overall tendency, from around 7500 cal BC, there is evidence of a greater differentiation in resource utilization, stronger attachment to local areas and more labour energy invested in the landscape, as shown by the construction of pit houses in the ecotonal interior zone at Sandholmen and along the coast at Havsjødalen. Large-scale semi-permanent residential camps were now established along the shores, on the coast as well as in the interior (Glørstad 2010:87–91). Additionally, modelling of radiocarbon dates, from a large number of excavated sites and surveys in eastern Norway, indicate a population peak around 7500 cal BC, followed by a stable settlement throughout the Mesolithic in the area (Solheim & Persson 2018).

As stated in the introduction, it has been maintained that the commitment to temporally and spatially predictable aquatic foods (including coastal, freshwater and anadromous fish) is linked with socio-economic consequences such as reduced mobility, delay return systems, larger group size, population growth, decreased territories, complex technologies, increased economic and social differentiation, and more intense and wide-ranging gift exchange and ritual activity (e.g. Woodburn 1982; Paulin 2007; Marean 2014; Bergsvik et al. 2016; Boethius 2017). By ethnographic analogy with the Northwest Coast tribes of northern America, T.D. Price (1991:231) and others have argued the Late Mesolithic coastal groups in southern Scandinavia were sedentary. The Northwest Coast tribes differ from the other hunter-gatherer peoples in the northern coniferous forest area. Their settlements were situated at the outskirts of rivers, where salmon fishing was a regular and stable resource. Additionally, their coastal adaptation was based on fishing, shellfish and hunting for marine mammals. The rich fisheries and the predictable resources formed the basis for permanent settlements, and the rich seasonal food resources were conserved and stored. Through preservation and storage techniques, the fisheries created the basis for the accumulation of surplus (Renouf 1984:18–19). Excavations at well-preserved sites such as Tågerup in Scania show unequivocal evidence of a large and sedentary coastal settlement in the Late Mesolithic Ertebølle phase (c. 5400 cal BC; Karsten & Knarrström 2003:131, 160–165).

The emphasis on social inequality, power and consumption control has also been suggested for the Mesolithic period in Norway. Several researchers have advanced the idea that the Late Mesolithic communities in western and eastern Norway developed into 'big-man-societies' (Fuglestvedt 1999; Bergsvik 2002, 2006; Glørstad 2010:193–197), that is, societies socially structured as clans rather than as mobile bands, who controlled the aquatic resources within more confined territories, and were socially characterized by logistical mobility, task-group organization, inter-group alliances and gift exchange. It has also been proposed that a long-standing tradition of socially complex, (semi-)sedentary and aquatically dependent populations may have extended as far back as the Middle Mesolithic period (Bergsvik & Hufthammer 2009; Glørstad 2010:187; Boethius 2017). Our interpretation of the socio-economic structures in eastern Norway, based on site locations, new archaeological evidence of fishbone and fishing gear and analogies with neighbouring areas, has principally supported previous explanation models, emphasizing a socio-material development leading to aquatic adaptations, reduced mobility and a larger degree of social complexity during the Middle and Late Mesolithic in eastern Norway. It has also been suggested that permanent trap systems for elk were in use in eastern Norway from the Late Mesolithic period (one pit fall system has been dated to c. 6100–5500 cal BC; Bergstøl 2015). This adds to the emerging picture of increased investment in the landscape.

As contended by B. Finlayson (2017:57), *complexity* is a relative term and phenomenon. He urges archaeologists to acknowledge different forms of complexity, which allows us to discuss a wider range of social formations within the Mesolithic period. The indigenous HFG societies, commonly utilized as ethnographic analogies for interpreting the social organization of past societies, had wide-ranging and varied subsistence economies and social organizations (Rowley-Conwy & Piper 2016; Grier 2017). This provides opportunities to assess the prehistoric situation from a different perspective, and we will close this discussion by pointing out some alternative approaches to the social significances of the term complexity, and its archaeological implications.

Fishing with stationary tools such as fish traps can be considered as a form of collection, rather than the active pursuit of prey, and a limited amount of energy is needed in terms of subsistence strategy. For example, salmon are abundant and easy to catch, during short and intense spawning seasons, and knowledge of fish life cycles and seasonal movements enables an easily accessible, high return catch. The exploitation of large catches of fish, documented from different aquatic habitats in ethnographic accounts, point to *the need for communal cooperation* (Swezey & Heizer 1977:21; Paulin 2007). The manufacture of fishing gear, such as seines, nets and lines, is particularly time-consuming, and constant maintenance of the equipment is required (Stewart 1982; Paulin 2007:21–23). C.D. Paulin (2007:21–24) describes how the Māoris of New Zealand made nets that measured several thousand meters in length. The manufacture, utilization, maintenance and repair of these were communal tasks that could preoccupy a whole village. Technologies tend to generate and maintain social relationships and a society relying on fishing as a stable and predictable resource facilitated the communal engagement of all members of society in food procurement. At such communal gathering places, centred on joint food production, forms of social dynamics, other than competition, may have come into play.

Societal changes following increased societal complexity can also affect the relationships between humans, animals and the environment. Fish maintenance can be considered as resource management (Grøn & Turov 2007), even as a type of low-scale *food production*. There is ample evidence that indigenous non-agrarian people employed management techniques that allowed them to enhance the productivity of the specific local environment, and sustain supplies of key species (Grøn & Turov 2007; Thornton et al. 2015:189). For example, tribes of the northwest coast of America were harvesting, burning, weeding, transporting and seeding plants to improve their environment; they kept clam gardens, bird and marine mammal rookeries, and made spawning beds for herring. Salmon was particularly central to these cultivation practices, and included multigenerational community linkages to salmon fishery locations, dismantling of weirs when they were not in use to avoid unintentional catches and the transplantation of eggs, smolt and adult fish between streams to address shortages (Thornton et al. 2015:190, 192–193). Detailed examinations of well-preserved faunal remains from southern Scandinavia, Siberia and Ireland also show that the resource utilization and hunting strategies among Mesolithic hunter-fishers was well planned, and also possibly conscious of sustaining certain key species (Eriksson & Magnell 2001; Magnell 2005; Losey et al. 2008; Warren et al. 2014; Boethius 2018b). A premise for this type of hunter-fisher-gatherer situation was long-term physical and conceptual relationships with specific places in the landscape, and deep historical connections to particular places. Based on what we have discussed here, we believe that Late Mesolithic population in eastern Norway were well organized, accomplished hunter-fisher-gatherers, with extensive knowledge of the behaviour of fish, and with the know-how, skills and motivation to transport trout to the upper part of the large watercourses in eastern Norway during the last part of the Mesolithic period, and thus to 'cultivate' the mountain waters that hitherto had been without fish. Trout was the most likely fish to have been transported, and subsequently became a key resource in the mountain zone. Rather than a passive adaptation to the constraints of the environment, Mesolithic people actively intervened, transformed and affected their landscape.

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12 Seals on the ice

Integrating archaeology, zooarchaeology and isotopic studies to discuss some aspects of landscape use and subsistence choices in Stone Age coastal societies of the Baltic Sea

Aikaterini Glykou

Introduction

Exploitation of marine resources was of great economic significance for the Stone Age hunter-gatherer groups that lived in coastal areas of the Baltic Sea region. In particular, evidence of seal hunting has been encountered in many archaeological sites from the Late Mesolithic and Neolithic time. Zooarchaeological data from the sites provide information on local faunal abundances that helps reconstruct palaeoenvironmental conditions in micro-scale, dietary preferences and subsistence strategies. They also show the degree of adaptation of human exploitation patterns to different ecological niches. In order to understand exploitation patterns and hunting methods in prehistory, it is necessary to initially understand the ecology and physiology of the hunted prey, as these are determinants in humans' decisions on hunting strategies and landscape use. This chapter will discuss aspects of harp seal hunting during the Late Mesolithic and Neolithic in the Baltic Sea region, as well as the palaeoenvironment, landscape use and human subsistence strategies. Also, it will discuss how the presence of different species can contribute to palaeoenvironmental reconstruction through an acknowledgment of their biological and ecological specificities, by applying a multidisciplinary approach that integrates archaeology and zooarchaeology. Furthermore, how isotopic studies can contribute to better understand past societies by providing information on animal mobility and human exploitation patterns.

Seal species in the Baltic Sea

Four seal species were present in the Baltic Sea during the Holocene: the ringed seal (*Phoca hispida*), the grey seal (*Halichoreus grypus*), the harbour seal (*Phoca vitulina*) and the now extinct harp seal (*Phoca groenlandica*). The presence of seals in the Baltic Sea is strongly related to the postglacial development of the Baltic Sea Basin and fluctuations in climate and salinity (Lepiksaar 1986; Lõugas 1997; Ukkonen 2002; Sommer & Benecke 2003; Storå & Lõugas 2005; Schmölcke 2008). During the last deglaciation of the Baltic Basin, the Baltic Ice Lake

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(around 16 000–11 700 cal BP) was formed by melt water. During the succeeding Yoldia Sea stage (11 700–10 700 cal BP), which coincides with the onset of the Holocene Epoch, marine water entered the Baltic Basin for the first time and a brackish environment was established (Andrén et al. 2011). The ringed seal was the first species to enter and reproduce in the Baltic Sea Basin at this stage (Lõugas 1997; Ukkonen 2002; Schmölcke 2008). A continuous glacio-isostatic land uplift of Scandinavia led to the closure of the connection between the Baltic Sea and the Atlantic Ocean that resulted in a decrease in salinity. The freshwater Ancylus Lake was then formed (10 700–9800 cal BP; Andrén et al. 2011). Hence, the ringed seal was the only seal species present in the Baltic Sea, and specifically in the Gulf of Bothnia and Finland, until the Late Atlantic climatic period (Ukkonen 2002; Sommer & Benecke 2003; Aaris-Sørensen 2009). During the following millennia, a permanent connection between the Baltic Sea and the Atlantic Ocean was established that allowed saline water to enter the Baltic Sea, forming the brackish Littorina Sea (9800 cal BP–present; Andrén et al. 2011). The Littorina Sea stage of the Baltic Sea is divided into three substages: the Initial Littorina Sea (9800–8500 cal BP) with very low salinity levels; the Littorina Sea (8500–3000 cal BP), which was the most marine stage of the Baltic Sea; and the Post-Littorina Sea (3000 cal BP–present; Andrén et al. 2000).

Seals in the archaeological context

The general consensus is that the increase in seal populations in the Baltic Sea coincides with the increase in salinity and the high organic productivity that followed the Littorina transgressions in the Atlantic period (e.g. Schmölcke 2008; Enghoff 2011). From that time, seal hunting starts to become of great significance for the coastal cultures around the Baltic Sea. Bones from harp, grey and ringed seals are recorded at numerous prehistoric coastal occupation sites during the Mesolithic and Neolithic (Lindqvist & Possnert 1997; Ukkonen 2002, 2004). According to archaeological contexts and zooarchaeological analyses (frequencies, butchering, filleting marks), seals were a significant meat, skin and blubber supplier for the Mesolithic and Neolithic hunters (Storå 2001; Ukkonen 2002; Glykou 2013, 2014). This chapter focuses on harp seals, therefore grey and ringed seals will only be discussed in association with that species.

Bones from harp seals are first recorded in the context of the Late Mesolithic Ertebølle culture (5500–3900 cal BC), during the Late Atlantic climatic period. They occur in numerous archaeological deposits from the southwestern Baltic Sea region (present-day Denmark and northern Germany), but are usually represented by a few bones (Table 12.1, Figure 12.1; see also e.g. Møhl 1970, 1971; Andersen 1995; Schmölcke et al. 2007; Enghoff 2009, 2011; Trolle 2013; Hartz et al. 2014).

The subsistence of the Late Mesolithic Ertebølle culture, known from numerous sites in Denmark and northern Germany, was heavily reliant on

Table 12.1 Marine mammal remains from the Neustadt LA 156 site and other sites of the Late Mesolithic in Denmark and Germany

Species/site	*Neustadt*		*Wangels*	*Rosenhof*	*Timmendorf-Nordmole I*	*Agernæs*	*Tybrind Vig*	*Ringkloster*	*Ronæs Skov*
	NISP	*MNI*	*NISP*	*NISP*	*NISP*	*NISP*	*NISP*	*NISP*	*NISP*
Terrestrial mammals total	**2442**		**441**	**276**	**532**	**3960**	**2428**	**5036**	**470**
Phocidae (undet.)	913		5	8	172		21		24
Harp seal	243	18			17	1			6
Grey seal	116	7		4	60	2	14		3
Ringed seal	20	2			8				
Harbour seal									1
Dolphin	3	1							2
Porpoise	137	6		1		1	1		3
Bottlenose dolphin				1					2
White-beaked dolphin							2		
Killer whale							1		1
Cetacea (undet.)							2		5
Marine mammals total	**1432**		**5**	**14**		**4**	**41**	**0**	**47**

The 'terrestrial mammals total' summarizes the find of all species. For details see the publications: Neustadt LA 156 (Glykou 2016); Wangels (Heinrich 1999); Rosenhof (Schmölcke 2008); Timmendorf-Nordmole I (Hartz et al. 2014); Agernæs (Richter & Noe-Nygaard 2003); Tybrind Vig (Trolle 2013); Ringkloster (Rowley-Conwy 1998); Ronæs Skov (Enghoff 2009).

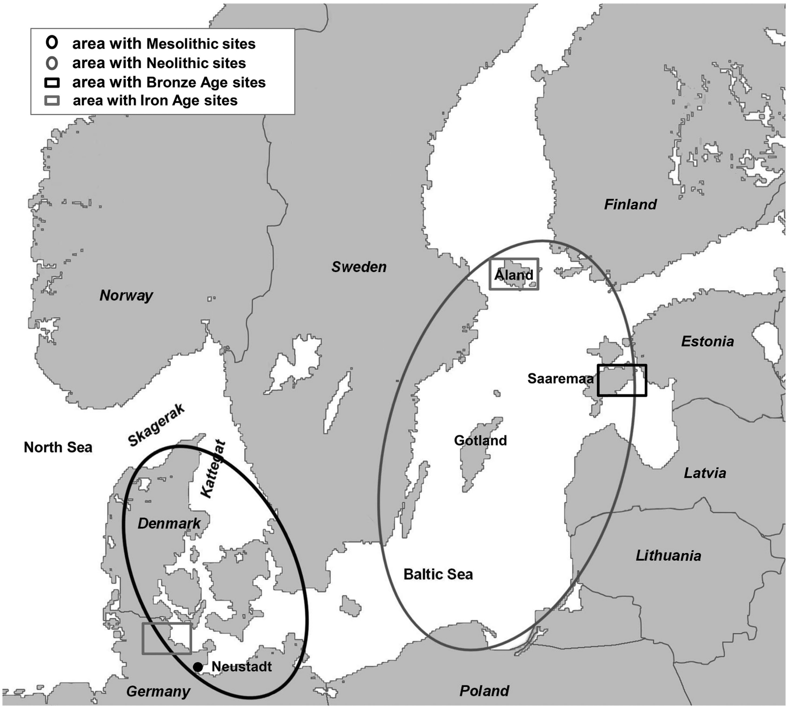

Figure 12.1 *Map* with the approximate distribution of coastal sites from the Mesolithic, Neolithic, Bronze Age and Iron Age with the presence of harp seal bones within their faunal assemblages. *Source*: Map after Glykou (2016, 2018). Data to archaeological sites from Storå (2001), Storå and Lõugas (2005) and Glykou (2016).

the exploitation of both terrestrial and aquatic resources. The location of the sites close to freshwater or marine water systems (e.g. Terberger et al. 2009) facilitated the inhabitants of the sites direct access to forest/land and water resources. Exploitation of terrestrial resources in search of food or raw materials included a wide range of terrestrial mammals reflected in the composition of the faunal assemblages and intensive exploitation of plant resources (nuts, grains, etc.), according to macro analyses of plant remains (e.g. Glykou 2016). While the importance of aquatic resources for the subsistence of the Mesolithic hunter-gatherers varied through time and space (e.g. Robson & Ritchie 2018), fish, freshwater or marine, depending on the site location, was a substantial part of the economy throughout the Mesolithic (e.g. Ritchie 2010; Enghoff 2011; Craig et al. 2011; Boethius et al. 2017). Waterfowl were also exploited, but to a much lesser extent. Only some faunal assemblages display intensive exploitation of grey and harp seals (Table 12.1; e.g. Schmölcke et al. 2007; Enghoff 2011; Glykou 2014, 2016). Especially regarding harp seals, the richest archaeological collection within the context of the late Ertebølle culture derives from the submerged site of Neustadt at the German Baltic coast (Figure 12.1), dating to the Late Mesolithic–Earliest Neolithic (4400–3800 cal BC; Glykou 2013, 2014, 2016). Osteometrical analysis and ageing of harp seal bones from this site helped identify bones from harp seal pups younger than 3 months old, indicating the exploitation of a breeding colony that was eventually located somewhere in the southwestern Baltic Sea area (Glykou 2014, 2016). Thus, dated by the archaeological context, this would be the oldest breeding colony in the Baltic Sea so far (Glykou 2016). Another case of extensive harp seal exploitation is observed some millennia later within the context of the coastal hunting and fishing societies of the Middle and Late Neolithic Pitted Ware culture known from sites on Gotland, Åland, eastern and middle Sweden and Poland (Figure 12.1; Storå 2001). High relative frequencies of harp seal bones and osteometrical age determinations bring the extensive hunting of harp seals in association with the presence of a local breeding ground in the Baltic Proper, presumably located somewhere between Gotland and Åland (Figure 12.1; Storå & Ericson 2004). Harp seal bones from the Bronze and Iron Ages, known mainly from Estonian sites and some sites on Åland, could be associated with a local breeding population, but evidence for this is still missing (Storå & Lõugas 2005).

The fact that harp seals dominated in some marine mammal faunal assemblages during the Late Mesolithic Ertebølle culture, and in most sites of the Middle Neolithic Pitted Ware culture, may indicate the exploitation of harp seal breeding grounds. Some issues concerning exploitation patterns, the reconstruction of the palaeoenvironment and hunting strategies, landscape use and mobility will be discussed below.

Results and discussion

Exploitation patterns

Observing the distinct differences in seal species abundances represented on the coastal sites of the Late Ertebølle culture in Table 12.1, some questions related to the exploitation patterns of the prehistoric inhabitants of these sites arise: Why do certain seal species dominate at some sites, while they are 'underrepresented' or not represented at others? What does the composition of faunal assemblages reflect? Does it reflect distinct subsistence practices, prey preferences or specialization?

Prey preferences and subsistence choices can be biased or determined by complex cultural norms. While these have to be considered when interpreting archaeological and zooarchaeological data, one should be aware that data are quite often interpreted as the result of ritual practices, selective hunting or specialization. In some cases, archaeological assemblages provide indisputable evidence of ritual practice (e.g. Sørensen 2016) or selective hunting (e.g. Rowley-Conwy 1998; Richter & Noe-Nygaard 2003), but in most cases evidence is not that conclusive. To avoid misinterpretations, faunal remains should primarily be evaluated in connection with their natural context and by consideration of their ecological and physiological behaviour. This can be achieved by examining if species frequencies in archaeological assemblages could potentially reflect their abundances in nature. By studying modern seal species (Table 12.2), one can retrieve information about the animals' geographical distribution, social behaviour, seasonal migrations, breeding habits and feeding, which consequently would help understand and reconstruct human subsistence choices with regard to preferable prey.

It is worthwhile outlining some methodological biases and considerations that one should be aware of when interpreting faunal frequencies. (1) If the archaeological assemblage can reflect the natural abundances. Faunal frequencies can be biased by taphonomic processes that may influence the archaeological record and recovering techniques (e.g. sieving). Both can potentially impact the final results of faunal composition and lead to erroneous conclusions about the choice of prey. (2) Comparability of different faunal assemblages. When it comes to comparative studies, the same quantification methods are not always applied, and faunal remains may originate from contexts with different preservation, or they may even have been subject to different taphonomic alterations, ultimately making a comparison biased. Nevertheless, if these factors are being taken into account during the faunal analyses, then some general traits can be described here.

In the case of harp seals, information on their ecological and physiological behaviour is retrieved from the modern Atlantic population, given that the Baltic Sea population is now extinct (Table 12.2). So far, modern harp seals are known as not being adaptable to climatic and habitat change. On the contrary, population declines are recorded where their habitat and breeding ecology are disturbed (Stenson & Hammill 2014). Consequently, we assume that similar ecological requirements (dependence on pack ice), life cycle (season of breeding, start and end of migration) and breeding habits (in colonies on pack ice) applied to the prehistoric harp seals of the Baltic Sea as well. Judging from the highly migratory modern harp seals, which during the breeding season form huge colonies of up to thousands of animals (Figure 12.2), we can assume that the prehistoric harp seals were only seasonally available to the prehistoric hunters in a region. The presence of harp seal pups younger than 3 months old indicates that they were hunted at their breeding ground, given that harp seal pups of that age are unable to enter the water and swim long distances until the moulting is completed approximately 6 weeks after birth. This would suggest that hunting was taking place during the breeding season, before the migration season started, and the dense frequencies of harp seals in archaeological assemblages associate with the presence of local breeding populations. Such an exploitation pattern would allow hunters to catch many seals with the lowest possible investment in terms of logistics, by taking advantage of the vulnerability of breeding seals and their large aggregations. Harp seal breeding grounds have been suggested to have occurred in the southwestern Baltic Sea during

Table 12.2 Ecological requirements of modern seal species

Ringed seal	*Distribution*	Circumpolar throughout the Arctic Basin. Separate populations occur at the Baltic Sea and Lakes Ladoga and Saimaa. The population of the Baltic Sea is distributed in Bothnia Bay, the Archipelago Sea and the Gulfs of Riga and Finland. Baltic ringed seals are larger than the other sub-species averaging 95 kg, while males are slightly larger than females (Härkönen et al. 2008).
	Behaviour	Solitary and stationary.
	Breeding	On dense pack ice and fast ice. They build lairs in the fresh snow on the ice where they give birth in February–March (Baltic Sea population). These lairs are essential for the survival of newborn pups (Lydersen & Smith 1989) as they offer protection from predators. They maintain a network of breathing holes in the sea ice which helps them to escape from predators (Figure 12.4). Lactation lasts approximately 39 days and pups reach an average weight of 20 kg towards weaning (Härkönen 2015). Baltic ringed seals moult from early April to early May on ice. During the summer, they haul out on islands and rocks when ice is not available (Härkönen et al. 1998).
	Prey	Small fish and crustaceans.
Harp seal	*Distribution*	North Atlantic and adjacent Arctic Ocean (Kovacs 2015). Nowadays, three breeding groups occur in the White Sea, near the Jan Mayen Islands and around Newfoundland. There is no sexual dimorphism between males and females. The harp seal is a medium-sized phocid with a mean body length that reaches approximately 169 cm and a maximum weight of 130 kg in the winter and 100 kg in the summer (Sergeant 1991).
	Behaviour	Gregarious migratory, they form large colonies during the breeding period (Figure 12.2).
	Breeding	On floating pack ice from late February to April. Breeding time differs slightly between the different populations and depends on the ice conditions (Sergeant 1991; Øritsland & Øien 1995). Lactation lasts 10–12 days and pups gain 2.2 kg per day (Kovacs & Lavigne 1985; Kovacs 1987; Kovacs et al. 1991; Lydersen & Kovacs 1996). After an abrupt weaning, harp seal pups are left to fend for themselves and cannot enter the water until moulting is completed, 4–6 weeks after birth (King 1983; Sergeant 1991; Kovacs 2015).

Table 12.2 Continued

		In the spring, adult and subadult seals congregate to form large moulting rookeries, and they undertake long migrations to their summer feeding grounds. Young seals are solitary before reaching the age of 10–11 months when they form migratory groups moving separately from those of the adults (Sergeant 1991:15, 85–87). They migrate northwards, and generally they stay near the fast ice during the whole year (Sergeant 1991:31).
	Prey	The diet of the harp seal consists of invertebrates (*Thyanoessa* spp.) and fish, such as Polar cod (*Boreogadus saida*), Arctic cod (*Arctogadus glacialis*), Capellin (*Mallotus villosus*) and Herring (*Clupea harengus*).
Grey seal	*Distribution*	Cold temperate and sub-Arctic distribution with three geographically distinct populations: the western Atlantic population, the Baltic Sea population and the eastern Atlantic population (Anderson 1992; Bowen 2016). The Baltic Sea population is distributed in high densities in the northern part of the Baltic Proper (east-west of Åland islands). They are encountered in Bothnian Bay and the Gulf of Finland, when these areas are free from ice.
	Behaviour	The grey seal is a gregarious species but does not form breeding colonies (Figure 12.3). They spend most of the time in proximity to the breeding area and can undertake long migrations in search of food.
	Breeding	They breed on islets in the northern Baltic Proper and Estonian coastal areas during mild winters. Under suitable ice conditions, they give birth on the drift ice south of Åland (Härkönen 2016). Pupping occurs in late February to late March. Lactation lasts approximately 3 weeks, with a slightly shorter lactation period for grey seals that breed on ice (Kovacs 1987). Males are considerably larger than females. An adult male can be up to 2 m long and weigh up to 310 kg (males from the UK population). Pups of the Baltic Sea population weigh approximately 12 kg at birth while their weight at weaning can differ substantially between pups born on ice (48.3 kg) and those born on land (37.4 kg; Jüssi et al. 2008).
	Prey	The diet of the Baltic grey seal is dominated by herring, whitefish, sprat, cyprinids, eelpout and salmon (Lundström et al. 2013).

The chapter focuses on the exploitation of harp, grey and ringed seals which are more common in the archaeological assemblages from the Late Mesolithic and Neolithic in the Baltic Sea region. Therefore, only information on these three species is provided here.

Figure 12.2 Group of harp seals on floating pack ice. Svalbard. Illustration: imageBROKER, Alamy Stock Foto. Printed with permission.

the Late Mesolithic and Early Neolithic (Glykou 2014, 2016), and in the Baltic Proper during the Middle Neolithic Pitted Ware culture (Storå & Ericson 2004), based on the age structure (newborn, yearlings, subadults and adults) of the faunal assemblages and the dominance of harp seals.

That the prehistoric hunters of the Late Mesolithic–Early Neolithic site of Neustadt and eventually also of other sites in the same region had access to a harp seal breeding ground is supported by additional osteological analyses on kill-off patterns and the representation of the different parts of the skeleton, which showed that the hunters brought and processed the entire seal on-site (Glykou 2014). Similar observations have been made regarding the extensive harp seal exploitation at the coastal sites of the Middle Neolithic Pitted Ware culture and other contemporary sites in Poland and Estonia (Storå 2001). Most of these marine mammal assemblages are dominated by harp seals. Analyses on age distribution revealed a scattered age distribution in most of the sites, suggesting that harp seals were hunted throughout the year, apparently also during the migration season. However, the Ajvide D-upper site on Gotland yielded a significantly different age pattern, showing that hunting took place mainly during the breeding season, associating this site with the exploitation of a local breeding ground in the Baltic Proper (Figure 12.1; Storå 2001; Storå & Ericson 2004).

Accordingly, the dominance of harp seal in the faunal remains of some archaeological contexts (Table 12.1) most likely reflects a seasonal presence of harp seals in some regions during the breeding period; in other words, it reflects the natural abundances of harp seals in a seasonal pattern. This would imply that they would have been absent from other regions, at least during the breeding season, and therefore not available to hunters in other sites/regions. If we assume that the sites dominated by harp seal had direct access to the breeding regions, then this could explain why harp seals were absent in other contemporaneous sites. Subsequently, not only the presence, but also the absence of a species in an archaeological context might reflect seasonal faunal composition, and thus might not necessarily be connected with subsistence preferences or cultural norms.

Finally, a last question related to the interpretation of the relative frequencies of seals, as presented in Table 12.1, is why harp and grey seals are represented in high frequencies, while ringed seals only by two individuals in the faunal assemblage of Neustadt (Table 12.1). The high frequencies of harp seals can be explained by their distinct social behaviour, which is responsible for the large colonies they form seasonally during breeding and moulting (Table 12.2, Figure 12.2). Grey seals can be found in groups of several hundred individuals at their resting areas throughout the year (Figure 12.3), while ringed seals are solitary and non-migratory (Figure 12.4). Thus, the Late Mesolithic–Early Neolithic hunters of the Neustadt site would have taken advantage of the seasonal abundance and availability of harp and grey seals, making them more preferable than the solitary and rarer in nature ringed seals. Therefore, the underrepresentation of ringed seals may simply be the result of their special ecology and social behaviour, and does not necessarily reflect a conscious subsistence choice of the hunters, but rather an opportunistic behaviour. On the other hand, considering that hunters were aware of the specific ecology and

Figure 12.3 Group of grey and harbour seals resting on the beach. Helgoland, Germany. Photo: A. Glykou.

Figure 12.4 Ringed seal lying close to a breathing hole. White Sea, Russia. Photo: A. Nekrasov, Alamy Stock Foto. Printed with permission.

seasonal presence of seals, it is highly likely that they chose the sites primarily to exploit this prey, which suggests a conscious and targeted subsistence choice.

Summing up, the intensive harp seal exploitation southwest of the Baltic Sea during the Late Ertebølle culture, and in the Baltic Proper during the period of the Middle Neolithic Pitted Ware culture, is linked to the existence of harp seal breeding colonies. The implications of this observation for the subsistence, hunting strategies, landscape use and mobility of the hunters of these regions will be discussed in the following sections.

Reconstruction of palaeoclimate

Faunal remains can be used as proxies to obtain insights into paleoenvironmental aspects. Paleoenvironmental reconstructions based on faunal remains help us understand in which environments prehistoric humans operated and how they used their landscape. Such reconstructions require knowledge of species' ecology, distribution, habitat, environment and niches (Lyman 2017).

Seals show different degrees of adaptability to climatic change and habitat alteration (Table 12.2). Modern harp and ringed seal populations are strongly dependent on specific ice and snow conditions for breeding. More importantly, nowadays, being confronted with climatic change and associated declines in the sea ice cover, neither harp nor ringed seals show any kind of adaptation towards breeding on land (Ukkonen et al. 2014). On the contrary, declines in the reproductive success of harp seals have been observed due to the impact climatic change has on ice conditions (Kovacs et al. 2011). In poor ice conditions, harp seals give birth either on the existing thin ice, which results in high pup mortality, or due to lack of ice they move northwards in search of pack ice (e.g. Stenson & Hammill 2014). Similar observations have been made with breeding ringed seals in the Arctic. Snow cover on sea ice is essential for the breeding and survival of the newborn ringed seals, which have a longer lactation period than other seal species. In years with poor ice conditions and snow cover, ringed seal pups are endangered due to their exposure to predators (Kovacs et al. 2011). The grey seal, however, is the only one of the three species that exhibit a high degree of adaptive flexibility in response to different climatic conditions and can breed on both land and ice (Härkönen 2016). Therefore, grey seals cannot be used as a palaeoclimatic indicator, but the ice-dependent harp and ringed seals are excellent proxies.

If the prehistoric harp seal populations of the Baltic Sea were ice dependent as the modern harp seals, then we would expect winters with low temperatures and suitable ice conditions for successful breeding in the Baltic Sea during the Middle Holocene. Pack ice would have been there for several weeks, at least during the breeding season in March, and would last until seals completed moulting in late spring. It has been strongly debated, if, during the warm climatic phase of the Middle Holocene, ice conditions in the Baltic Sea were optimum for harp and ringed seals to breed (see Ukkonen et al. 2014). Even though the discussion is ongoing, climatic reconstructions based on lake and sea sediments indicate strong temperature fluctuations during this phase of the Holocene, which might have resulted in periods with hard and cold winters appropriate for harp seal breeding (e.g. Dörfler et al. 2012; Krossa et al. 2017). A shift to a cooler climate is recorded during the Subboreal climatic period after c. 3500 cal BC (e.g. Seppä et al. 2005), and this would explain the harp seal finds during the Neolithic.

Accordingly, it can be assumed that seal hunters of the Late Mesolithic Ertebølle culture in the southwestern Baltic Sea area, as well as seal hunters of the Middle Neolithic Pitted Ware culture in the Baltic Proper, were confronted with such cold winters that would have allowed the formation of appropriate pack ice conditions (thickness and duration) thereby ensuring successful breeding for the harp seals.

Hunting strategies

The above observations about hunters operating during very cold winters lead to the following questions about hunting strategies: Firstly, what are the implications of such climatic conditions for the subsistence of the prehistoric hunters, in particular concerning the methods hunters used to exploit the ice-dependent seals? Secondly, did hunters undertake long expeditions to catch harp seals in their breeding grounds and bring them back to their occupational sites, or were the occupational sites situated in proximity to the seal colonies?

The use of fishing nets, clubs, harpoons, as well as bow and arrow, has been associated with seal hunting during the Mesolithic (Møhl 1970; Andersen 1995; Zagorska 2000; Glykou 2013; 2016). Based on the differential fragmentation of skulls between harp and grey seals, it has been suggested that hunting methods were species dependent (Glykou 2013), in the sense that they were adapted to the ecology and behaviour of each species (Table 12.2). For instance, clubs were used to kill the land-breeding grey seals. Wooden clubs were found in association with grey seal bones in the Neolithic layers of the island of Hesselø in Zealand (Møhl 1970). Clubbing is a seal-killing practice widely known from ethnoarchaeological records, commonly used up to modern times (Clark 1946; Boyle 2005). In ethnographic sources, clubbing is often reported in connection with fishing nets, in which seals become trapped and are then killed with clubs (Clark 1946; Sergeant 1991). Killing grey seals with clubs is a method customized to the special behaviour of this species, as it can easily be practiced either while these animals rest or breed on land (Figure 12.3).

On the other hand, harpooning and the use of bow and arrow would have been more appropriate to hunt ice-breeding seals. Two seal skeletons were found together with harpoons in Närpiö and Oulujoki in Finland (Sauramo 1937). It has been assumed that the wounded seals escaped their hunters with the harpoons embedded in their bodies and died several kilometres away from the coast (Zagorska 2000). Interestingly, both seals are ice-breeding species. One has been identified as a harp seal (Närpiö; Sauramo 1937) and the other as a ringed seal (Oulujoki; Sauramo 1937). The use of harpoons was an important method for Eskimos hunting ringed seals. They used them either from their kayaks in open water or when hunting on the ice (Clark 1946). As ringed seals maintain breathing holes (Figure 12.4), it is possible that hunters waited for them to surface and then hit them with their harpoons.

The bow and arrow is another hunting strategy that can be connected with ice-breeding seals (Figure 12.5a and b). An impact rib injury caused by the lithic projectile found embedded in the bone has been associated with the use

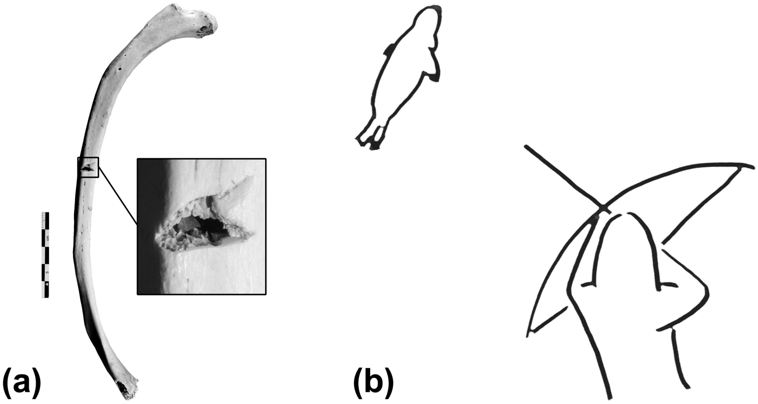

Figure 12.5 (a) Seal rib with an injury caused by an arrow. The detail shows part of the lithic projectile embedded in the bone. (b) Reconstruction of the hunting episode based on the position of the injury on the rib. *Source*: After Glykou (2013). Drawing: H. Erlenkeuser.

of a bow and arrow as a killing method for seals. The position of the injury at the caudal-medial side of the rib allowed the reconstruction of the hunting episode, according to which the seal was hit from behind, on its right side (Glykou 2013). For harp seals, which are not as easily accessible as they breed on floating pack ice (Figure 12.2), hunters could have easily used a bow and arrow to kill them either from their dugout canoes or by being on the ice. This hunting method gives the hunter the advantage to shoot from a distance and stun their prey that otherwise, in a landscape of water and ice, would have had the chance to notice the hunters approaching and eventually escape. This method could have been used in combination with other methods and would have required the contribution of several well-coordinating hunters.

These different and species-dependent hunting practices suggest deep knowledge of the behaviour and habitat of the animals and show humans' capability to adapt their hunting strategies to the ecological behaviour of the hunted prey. Hunting during the breeding season was a highly opportunistic subsistence choice, as it gave hunters the full advantage of animal vulnerability. Seal cows are vulnerable when trying to defend their offspring during an attack, and seal pups are vulnerable to predators during lactation, which, depending on the species, can last from 10 days to some weeks, as they are not able to enter the water during this time. A good example of taking advantage of breeding grey seals in the Gulf of Bothnia is illustrated in Carta Marina from Olaus Magnus 1539 (Figure 12.6). The scene is wonderfully described by J.G.D. Clark (1946), who presents the hunters holding pikes and dressed in black in order to confuse the seals. Some already-killed seals are on the boats. On one ice float, a suckling seal can be recognized.

This scene triggers the question of where harp seals were caught by the Mesolithic and Neolithic hunters. As described above, the composition of the faunal assemblages, the age structure and kill-off patterns strongly suggest exploitation of breeding grounds in the Baltic Sea, eventually in proximity to the sites, if the winter conditions, as discussed above, were appropriate for breeding in the Baltic Proper and in the southwest of the Baltic Sea. Otherwise, it remains open if hunters undertook long-distance trips to catch the seals in other parts of the Baltic Sea.

The question of mobility and foraging patterns on prehistoric seals in the Baltic Sea has recently been discussed on the basis of strontium isotope analysis (Glykou et al. 2018). Stable isotopes have been applied in archaeology in the analysis of human and faunal remains. They can give insights into the palaeoclimate and elucidate palaeoecological aspects, dietary practices, maternal strategies (Eriksson & Lidén 2002; Eriksson 2004, 2013; Lidén & Eriksson 2007; Howcroft et al. 2014) and mobility patterns (Eriksson et al. 2018).

Strontium isotope ratios (^{87}Sr/^{86}Sr) have been extensively used in archaeology to study human and animal mobility as it helps to reconstruct resource acquisition strategies and interactions between groups (e.g. Makarewicz & Sealy 2015). Radiogenic strontium (^{87}Sr) is formed by the decay of rubidium (^{87}Rb). The strontium isotopic composition (^{87}Sr/^{86}Sr) in bedrock depends on

Figure 12.6 Carta Marina of Olaus Magnus 1539, detail. Grey seal hunting in the Gulf of Bothnia. *Source*: (2017, November 19) Wikimedia Commons, the free media repository. Retrieved April, 2018: https://commons.wikimedia.org/w/index.php?title=File:Carta_Marina.jpeg&oldid=268155201.

the age of the rock and the initial Rb/Sr ratio. Intra-tooth sequential sampling to measure $^{87}Sr/^{86}Sr$ ratios by using laser ablation MC-ICP-MS has been performed to identify mobility and foraging patterns on prehistoric seals in the Baltic Sea (Glykou et al. 2018; Figure 12.7).

The pilot study showed that $^{87}Sr/^{86}Sr$ differences among different seal species might reflect differences in their ecology and life history, suggesting a possibly different geographic origin for the seals or seasonal movement to different regions in the Baltic Sea during their lifetime (Glykou et al. 2018). Regarding the harp seals, the measurements of two harp seal canines yielded $^{87}Sr/^{86}Sr$ ratios that correspond to the Baltic Sea water $^{87}Sr/^{86}Sr$ ratios or river discharge areas in the Baltic Sea (Glykou et al. 2018). Since the enamel of pinniped teeth forms during gestation, one can assume that the $^{87}Sr/^{86}Sr$ ratios largely reflect the isotopic composition of the seal cow during gestation (Glykou et al. 2018). Thus, the $^{87}Sr/^{86}Sr$ ratios of those teeth show clearly that harp seals gave birth in the Baltic Sea, verifying the notion of existing local breeding grounds in the Baltic Sea demonstrated by osteometrical analyses which showed the presence of harp seals younger than 3 months (Storå & Ericson 2004; Glykou 2016).

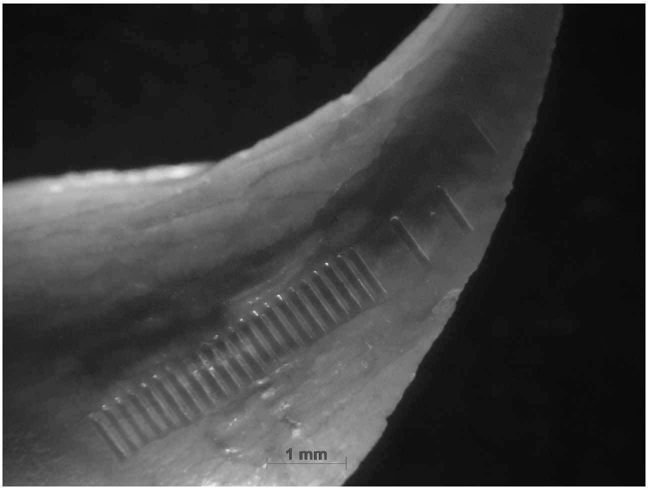

Figure 12.7 A canine from a grey seal with sampling lines for $^{87}Sr/^{86}Sr$ analysis by laser ablation MC-ICP-MS. *Source*: After Glykou et al. (2018).

By implication, it can be concluded that the seals were most likely caught close to the sites, making it less probable that hunters undertook long-distance trips to reach the breeding grounds, showing a relative low mobility of the hunters. Previous studies of the mobility based on strontium isotopes of prehistoric people have assumed that the marine signature is uniform in all environments (e.g. Bentley 2006). However, the variation seen in the $^{87}Sr/^{86}Sr$ ratios of the Baltic suggests that mobility studies of humans in coastal areas who consumed marine mammals and fish extensively may be affected by this variation in strontium isotope ratios and thus should be performed in combination with isotopic studies on diet (Glykou et al. 2018). Thus, the study shows the potential of faunal isotopes to provide insights into the mobility patterns of humans connected to seal hunting.

Conclusion

This chapter shows the importance and beneficial value of a multidisciplinary approach where archaeological, zooarchaeological and isotopic studies are integrated to provide information on the special ecology, breeding and social behaviour of different seal species. To understand the ecology and physiology of animals hunted by prehistoric humans is a step forward to shed light on human subsistence choices and hunting strategies as it helps us reconstruct the paleoenvironment in which humans operated.

- The hunters of the Late Mesolithic Ertebølle culture and later of the Middle Neolithic Pitted Ware culture were aware of the breeding habits and seasonal presence of harp seals in specific regions and took advantage of the seasonal prey availability.

- Hunting weapons and exploitation patterns show the potential of human adaptation to the special ecology of the hunted prey as it seems that different exploitation patterns were used for land-breeding and ice-breeding seals.
- Strontium isotope analysis of two harp seal teeth yielded ^{87}Sr/^{86}Sr ratios that correspond to the Baltic Sea ^{87}Sr/^{86}Sr ratios, confirming that harp seals gave birth in the Baltic Sea.
- By combining results from previously undertaken strontium isotopic analysis of harp seal teeth, age-oriented osteometrical analysis of harp seal pups and analysis of kill-off patterns, we may conclude that hunters exploited harp seal breeding grounds in the proximity of their sites. This further implies low mobility for hunters when it came to seal hunting.

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13 The use of the Mesolithic coastal hinterland – an example from the palaeoecological investigations from Lake Skogstjern, Telemark, southeastern Norway

Magdalena Wieckowska-Lüth and Wiebke Kirleis

Introduction and background

The study of the effects of human presence on the Mesolithic's environment is a controversial issue (Bishop et al. 2015). Referring to this period, the evaluation of pollen diagrams in terms of the anthropogenic impact on vegetation is thus often given little attention. It is commonly assumed that foragers did not change or affect their environment in a way that can be traced by means of pollen analysis. Pollen stratigraphical signs, such as short-term fluctuations in arboreal pollen, abrupt changes in tree pollen curves and increases in disturbance indicators, are often interpreted as signals of natural forest succession stages, grazing pressure by large herbivores or climate change. Furthermore, the continuous evidence of micro-charcoal within the Early and mid-Holocene palynological records is only tentatively attributed to human activity, and natural fires are always taken into account as a possible source for its accumulation. This may certainly have been the case in some regions, but in areas with a deciduous forest cover, regular natural fire events appear rather unlikely (Chandler et al. 1983; Moore 1996). Anyway, when these effects are considered as possible factors that have changed the environment, why are humans assigned such an insignificant role, especially considering, from today's perspective, what we are able to accomplish? Even beavers are given a bigger role in shaping the vegetation, being responsible for creating large clearings of several hectares by tree felling to make river dams and by consuming tree bark (Peterken 1996).

But there are also studies that do not exclude human impact in principle. Some palynological records even discuss the increases in pollen proportions of certain shrubs and trees, the occurrence of plant disturbance indicators together with constant micro-charcoal levels and the increases in palynological diversity within the light-demanding and/or nitrophilous taxa as signs of different land-use strategies (Iversen 1973; Boyd & Dickson 1986; Latalowa 1992; Huntley 1993; Brown 1997; Gumiński & Michniewicz 2002; Edwards 2004; Poska et al. 2004; Bos et al. 2005; Hörnberg et al. 2005; Wacnik 2005; Kuneš et al.

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2008; Bishop et al. 2015). Furthermore, the occurrence of certain non-pollen palynomorphs (NPP) indicative of grazing, local burning, soil erosion or the accumulation of dead organic material provides additional evidence of disturbance within the vegetation (Edwards 1990; Mason 2000; Mighall et al. 2008; Innes et al. 2010; Wieckowska et al. 2012).

The palaeoecological investigations dealt with in this chapter were conducted on the deposits from the small Lake Skogstjern, located in the municipality of Bamble in the county of Telemark, southeastern Norway (Figure 13.1). Lake Skogstjern is situated 57.2 m a.s.l., and its outflow, to the southeast, reaches the Åbyfjorden after 2.4 km. However, the lake was connected to the sea in the Late Glacial and the Early Holocene, constituting the inner part of a fjord reaching the Skagerrak (Stabell 1980; Høeg 1982). After the retreat of the Scandinavian ice sheet, there was continuous land uplift (Bergstrøm 1999; Sørensen et al. 2014), leading to its isolation from the sea at c. 8000 cal BC (Wieckowska-Lüth et al. 2017). From the beginning of the Middle Mesolithic, approximately, the lake was a part of the landscape of the coastal hinterland (Wiekowska-Lüth et al. 2018). Today, the lake's hilly surroundings are dominated by forest, but farmland is located on the more gentle slopes.

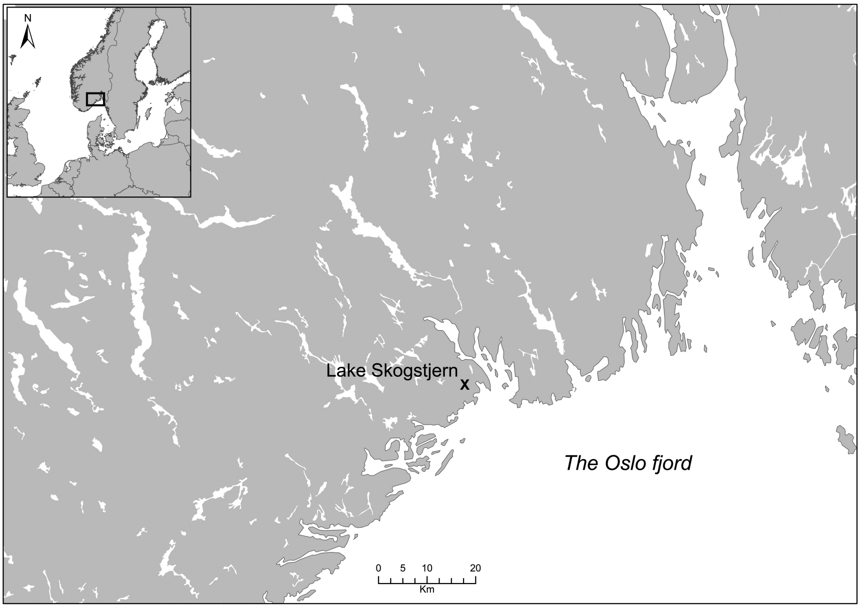


Figure 13.1 Location of the coring site Lake Skogstjern in the municipality of Bamble, in the county of Telemark, in southeastern Norway. *Source*: Magne Samdal, MCH, UiO. Geographic information: Statens Kartverk.

The study on the Mesolithic section of the sediment core was performed in connection with the archaeological project E18 Rugtvedt–Dørdal, conducted by the Museum of Cultural History in Oslo (Solheim 2017). In the frame of this project, 30 former coastal Mesolithic sites, dating from c. 8700 to 4000 cal BC, were excavated between 2013 and 2015, prior to the highway construction measure through the county of Telemark (Solheim 2017). The discussion of man's role with respect to environmental transformations and thus the formulation of this chapter was further supported by the CRC1266 'Scales of Transformations' (DFG – German Research Foundation, Project Ref. 2901391021 – SFB 1266).

The Mesolithic sediment sequence from Lake Skogstjern was chosen for the palaeoenvironmental investigations because of its location only a few hundred metres from the project area and the Mesolithic sites (Figure 13.2), making it very suitable for a discussion of human–environment interactions during the time in question (Wieckowska-Lüth et al. 2018). Against this backdrop, the

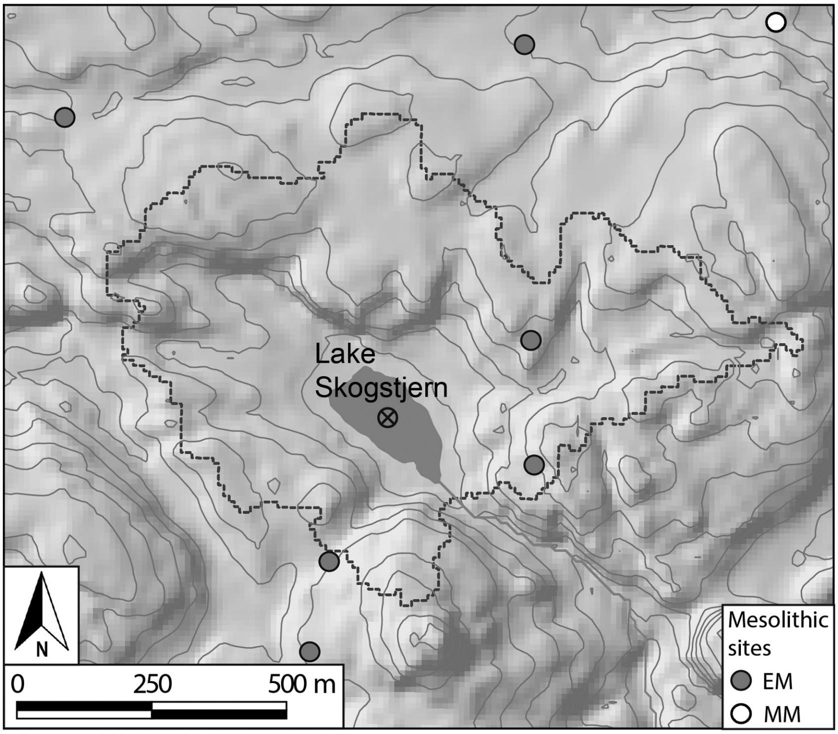


Figure 13.2 Location of the coring site, Lake Skogstjern, and the Mesolithic sites in its surroundings. The dashed line indicates the catchment area of the lake. *Source*: Ph. Lüth, www.lueth-archaeologie.de, after the metadata of Kartverket (www.data.kartverket.no)/S. Solheim, MCH, UiO.

focus of the palaeoecological analyses was to supplement the archaeological record with knowledge of how Mesolithic marine foragers may have used and altered the landscape in the coastal hinterland. The aims were to (a) gain better understanding of the development of Mesolithic woodlands with regard to climate development and available plant resources, (b) trace human manipulation of the vegetation during the course of the Mesolithic and (c) supplement the outcomes with knowledge of erosion history. This chapter summarizes the results of the palaeoecological study from Lake Skogstjern (Wieckowska-Lüth et al. 2017, 2018).

Case study Lake Skogstjern, southeastern Norway

The study of Lake Skogstjern is characterized by a well-dated sediment sequence (five accelerator mass spectrometry [AMS] ^{14}C dates for the Mesolithic section of the core) with a high temporal resolution (c. 38–12 yr/cm; Figure 13.3) complemented by a multi-proxy record (pollen, non-pollen palynomorphs, micro-charcoal, geochemistry and loss-on-ignition; Wieckowska-Lüth et al. 2017). Furthermore, due to its small size (2.6 ha), it can be deduced that the sediments of Lake Skogstjern mainly reflect the plant cover of approximately 800 m around the lakeshore (Figure 13.2) – in other words, the pollen signal of extra-local vegetation (Sugita 1994, 1998). Consequently, this lake offers an important source of information for a precise description of local human–environment interactions during the course of the Mesolithic period.

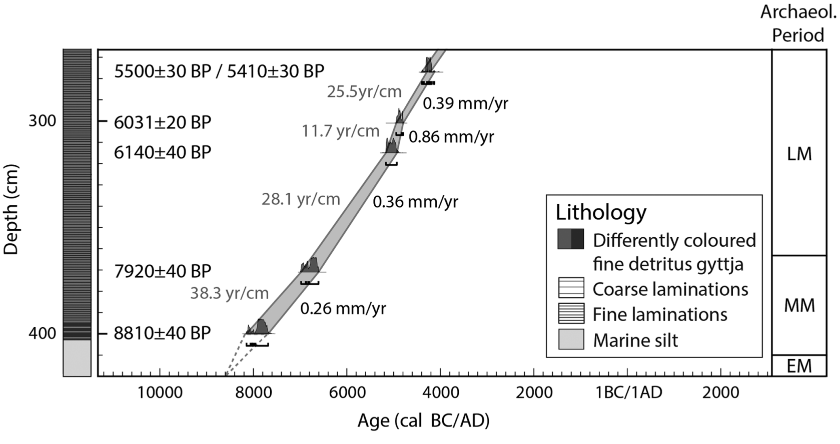


Figure 13.3 Lithology as well as age–depth model, accumulation rates (mm/yr) and time resolution (yr/cm) for the Mesolithic section of the sediment core from Lake Skogstjern (OxCal, Bronk Ramsey 2013; IntCal13, Reimer et al. 2013). Archaeological periods according to L.E. Gjerpe (2013). EM: Early Mesolithic; MM: Middle Mesolithic; LM: Late Mesolithic. *Source*: M. Wieckowska-Lüth.

The sediment record of Lake Skogstjern begins around 8550 cal BC (Figure 13.4) during the marine stage of the basin. At that time, the sediment sequence is marked by a strong accumulation of eroded terrigenous material (Figure 13.5), as deduced from geochemical and physical proxy (loss-on-ignition) analyses (Wieckowska-Lüth et al. 2017). During this last part of the Early Mesolithic, the landscape is characterized in the pollen record by the deciduous tree taxa *Betula* (birch) and *Corylus* (hazel; Figure 13.4). In addition, a relatively open vegetation structure is reflected in a fairly high abundance of shrubs, dwarf-shrubs and other non-arboreal pollen from *Hippophaë* (sea buckthorn), *Juniperus* (juniper), *Salix* (willow), *Vaccinium*-type (cranberry), *Calluna* (heather), Poaceae (grasses) and Chenopodiaceae (goosefoot family).

At the transition to the Middle Mesolithic, visibly elevated proportions of microscopic charcoal particles appear between c. 8100 and 8020 cal BC. This is accompanied by distinct rises in Poaceae and several herbs (Liguliflorae and *Thalictrum*), which show the presence of some disturbed ground. Among the herbaceous taxa are also nitrophilous species (*Artemisia* and Chenopodiaceae), indicating habitats with fresh organic waste. Contemporaneously, the occurrence of fungal spores of *Glomus* sp. points to erosion of the surrounding soils (van Geel et al. 2003). At the same time, there is a decrease in the amount of arboreal pollen, whereas there is a slight increase in light-demanding shrubs such as *Juniperus*, *Sorbus/Rubus*-type (whitebeam/raspberry) and *Salix*. These changes in pollen taxa composition may have been induced by burning, as evidenced by the synchronous presence of micro-charcoal within the sediment. It is at least conceivable that burning may have been used to maintain or extend the openness of the seashore vegetation (cf. Mellars & Dark 1998; Edwards 2009). The increased microscopic charcoal record may also be associated with domestic fires from hearths (Bennett et al. 1990; Edwards 1990), although these are likely to have been on a much smaller scale (Ryan & Blackford 2010). Natural woodland fires cannot be ruled out, of course, as another potential source of the charcoal dust.

At approximately 8000 cal BC, the change from marine to gyttja sediments marks the isolation of the basin from the sea. The decrease in the sedimentation of clastic material and the disappearance of marine dinoflagellates (HdV-704A and HdV-704C) succeed the immediate rise in freshwater plant communities. This stage of the lake development is placed at the beginning of the Middle Mesolithic. The following time between c. 8000 and 7450 cal BC is distinguished by the occurrence of some heliophilous shrubs and dwarf-shrubs, such as *Salix*, *Sorbus/Rubus*-type, *Viburnum opulus*-type (guelder-rose), *Juniperus*, *Calluna* and *Vaccinium*-type, which, together with relatively high values of Poaceae, reflect openings in the forest canopy. This change is coupled with an expansion of herbaceous taxa, particularly *Rumex acetosa*-type (common sorrel) and *Artemisia* (mugwort), but pollen of other ruderals, such as *Urtica* (nettle), Caryophyllaceae (carnation family), Chenopodiaceae, *Senecio*-type (groundsel) and *Geum*-type (avens), also occur occasionally. These pollen signals of the representatives of disturbed vegetation appear together with

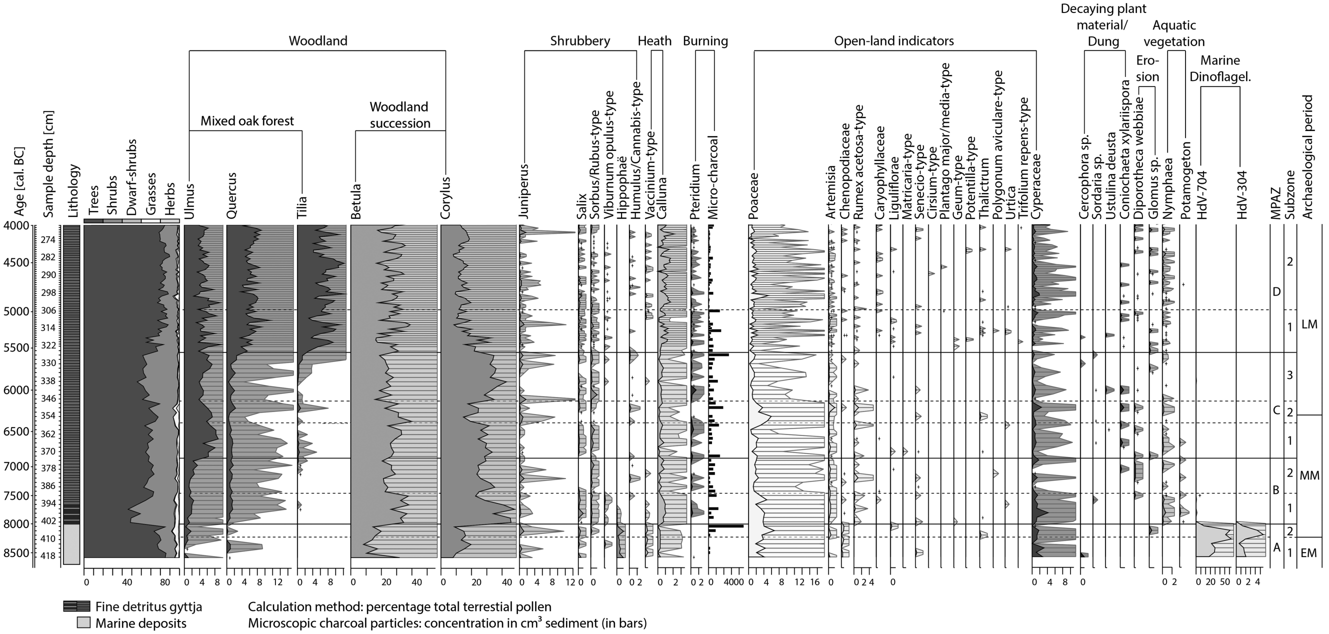
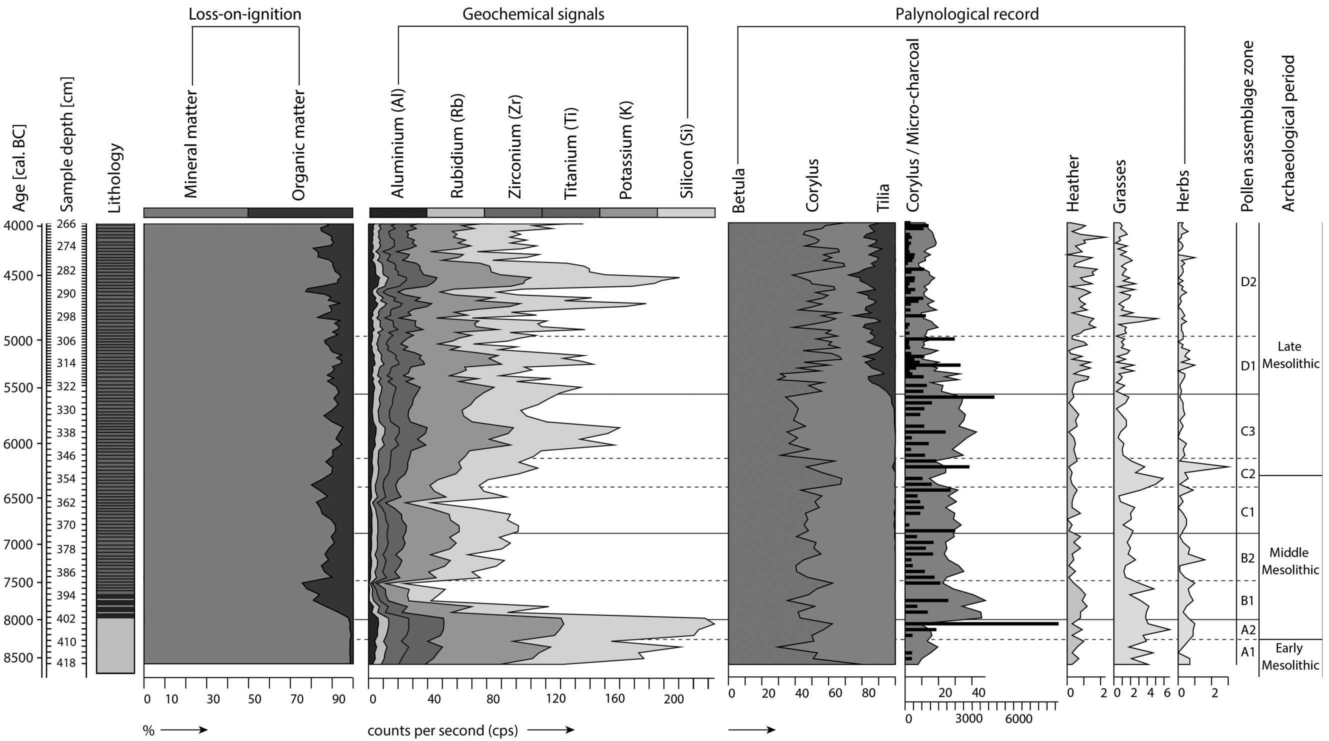


Figure 13.4 Palynological diagram of the Mesolithic section of the sediment core from Lake Skogstjern, showing the curves and sum-curves of selected taxa. Curves of the pollen record are exaggerated by factor 10. *Source*: M. Wieckowska-Lüth.



Calculation method: percentage total terrestial pollen
Microscopic charcoal particles: concentration in cm³ sediment (in bars)

Figure 13.5 Multi-proxy record for Lake Skogstjern, Bamble, Telemark. The diagram shows, from right to left, loss-on-ignition, showing the ratio of organic matter content to mineral matter content; geochemistry (XRF scan), showing the intensities of selected elements; and a palynological diagram, showing the sum-curves and curves of selected taxa as well as the micro-charcoal. *Source*: M. Wieckowska-Lüth.

elevated levels of microscopic charcoal particles, albeit that the latter were not recorded continuously throughout this phase. The presence of micro-charcoal remains is followed by the presence of *Calluna*, which is known to have a positive association with fire (Rodwell 1991; Blackford et al. 2006), as well as by *Pteridium* (bracken), a common fire-adapted fern (Tinner et al. 2000; Bińka & Nitychoruk 2013). During this time, *Corylus* seems to have been influenced by fire, as its highest abundance correlates positively with the increase in micro-charcoal (Figure 13.5), whereas the rises in *Betula* pollen usually follow the declines in hazel, pointing to phases of forest succession. The increase in charcoal dust could be a result of natural burning, but the pollen stratigraphical evidence shows deciduous tree cover dominated by birch and hazel stands. *Betula* and *Corylus* do not burn as readily as conifers and their litter (Ryan & Blackford 2010); therefore, natural fires in such environments appear unlikely (Edlin 1970; Rackham 1986). Hence, anthropogenically induced small-scale openings in the woodland resulting from the use of fire also have to be taken into consideration. Whatever the case, a possible occupation of the lakeshore by coastal foragers is indicated by the evidence of *Artemisia*, Chenopodiaceae and *Urtica*, which are primary nitrophilous species that occur on highly disturbed shorelines/riverbanks and that may also be associated with nitrogen-rich areas around dwellings (Behre 1981). Elevated levels of Cyperaceae (sedges), along with *Humulus/Cannabis*-type (probably *Humulus lupulus*), also demonstrate the existence of open ground close to the lake basin, in particular, as wild hop occurs preferentially at nitrogen-rich sites with higher soil moisture, at forest margins or in shrubbery (Düll & Kutzelnigg 2005). At the same time, the occurrence of *Rumex acetosa*-type, *Senecio*-type, Caryophyllaceae and *Geum*-type may represent the floral signal for open ground disturbed by trampling. Besides, the occurrence of decomposing fungi (*Sordaria* sp. and *Coniochaeta xylariispora*) indicates phases of increased amounts of dead wood (van Geel 1978) or the presence of game dung (Blackford et al. 1996; Ellis & Ellis 1988) within the lakeshore habitat. In addition, disturbed ground around the water basin is indicated by the appearance of the fungal erosion indicator *Diporotheca webbiae* (Hillbrand et al. 2012; Hawksworth et al. 2016).

At c. 7370 cal BC, there is a general decline in the light-demanding shrubs *Corylus*, *Viburnum opulus*-type and *Salix*, together with the presence of other open-land indicators. This could be indicative of smaller-scale forest disturbances compared with the previous period. Nevertheless, even though the values of Poaceae have diminished, they remain at a more or less constant level, showing that there were still small gaps in the forest canopy. Besides, the proportions of micro-charcoal remain at approximately the same level as before, demonstrating no reduction in fire activity. Probably, the microscopic charcoal particles represent the leftover from domestic fires within campsites at the lakeshore, which were recurrently used.

The following periods of the late Middle Mesolithic and the Late Mesolithic are characterized by increasingly dense woodland after the expansion of the warmth-demanding *Ulmus* (elm) from c. 6800 cal BC. Nevertheless, *Corylus* and *Betula* still prevail in the forest inventory. During this time, the values of micro-charcoal reach, in some horizons, higher frequencies as before. Besides, the values of *Calluna* show several small increases, nearly always matching the elevated amounts of *Pteridium*. In most cases, both taxa seem to follow the peaks in micro-charcoal. On the other hand, some of the steepest *Corylus* increases correspond to the highest records of microscopic charcoal particles (Figure 13.5). This indicates that the spread of hazel shrubs was probably promoted through burning. Furthermore, this phase displays a comparatively higher abundance of spores of fungal decomposers (*Cercophora* sp., *Sordaria* sp., *Coniochaeta xylariispora* and *Ustulina deusta*), indicating the deposition of animal dung or accumulations of other organic substrates, which may hint at temporary concentrations of game in the surroundings of the lake. Disturbed areas within the forest, referring to grazing animals, may also be attested to by the occurrence of *Rumex acetosa*-type.

In the further course of this period, two sudden and distinct declines in the frost-sensitive *Corylus* are recorded between c. 6400 and 6150 cal BC (Figure 13.4). In contrast, the low temperature–adapted *Juniperus* increases, pointing to the 8.2 ka cooling event (e.g., Alley et al. 1997; Seppä et al. 2005; Antonsson & Seppä 2007; Wieckowska-Lüth et al. 2017). At the same time, the visible reduction in pollen of some representatives of disturbed forest vegetation, such as *Sorbus/Rubus*-type, *Salix*, *Calluna* and *Pteridium*, reflects fewer gaps in the forest canopy. The amounts of microscopic charcoal particles, on the other hand, remain, at least in part, relatively high, and may reflect the input of micro-charcoal fragments from domestic fires into the lake sediment. Slightly increased frequencies of *Rumex acetosa*-type, *Artemisia*, Cyperaceae and *Humulus/Cannabis*-type, together with conspicuously high values of Poaceae over a longer time period, point to open areas that may relate to the existence of campsites at the lakeshore.

A little later, a series of strong catchment erosions are documented from c. 6100 cal BC until the end of the Mesolithic period (Figure 13.5). This is shown by the significant increases in both the mineral matter content in the sediment column and the elemental ratios, indicative of allochthonous minerals or clastic sediments (Wieckowska-Lüth et al. 2017). At approximately the same time, some significant changes in the lake state are also suggested by the minimal presence of aquatic plant communities between c. 6100 and 5100 cal BC, which seems to be associated with the in-lake sediment instability. The high erosional rates correlate with the beginning of the Holocene Thermal Maximum, a period characterized by, on the one hand, warm and dry summer conditions (Seppä et al. 2005; Antonsson & Seppä 2007; Wanner et al. 2011) and, on the other hand, intense summer rainstorms, triggering floods, eroding and transporting material to lakes (Støren et al. 2016). Coinciding with the high signals of erosional input, there is a distinct decline in the assemblages of grasses and herbs, which may be indicative of a general reduction in open areas within the woodland. At the same time, however, the proportions of microscopic charcoal particles remain at approximately the same level as before, suggesting that small groups of humans still visited the lakeside. The signals of the charcoal dust may thus demonstrate fire activity within the campsites along the lakeshore.

According to the pollen record, a new type of forest characterizes the stage from 5600 cal BC onwards. At the beginning of this period, there is a strong decrease in the pollen values of *Corylus*, along with parallel rapid increases in *Tilia* (lime) and *Quercus* (oak). At the same time, however, recurrent, strongly fluctuating values, particularly for lime, indicate repetitive small gaps in the forest canopy. These declines in the quantities of *Tilia* are often succeeded by increased proportions of the light-demanding *Corylus* and *Juniperus*. These shrubs, in turn, are coincident with the marked increases in the open-land indicator *Calluna*. Conversely, frequent phases of woodland regeneration are demonstrated by the strongly oscillating curve of *Betula* (Figure 13.5), reflecting its nature as a pioneer tree that expands in open areas. Such locations are further reflected in the pollen record by the repetitive small peaks of pollen of several ruderals, such as *Rumex acetosa*-type, *Artemisia*, Caryophyllaceae, Chenopodiaceae, *Urtica*, *Trifolium repens*-type (white clover), *Senecio*-type, Liguliflorae (a composite family), *Polygonum aviculare*-type (common knotgrass), *Potentilla*-type (cinquefoils), *Geum*-type, *Thalictrum* (meadow rue), and Poaceae. Moreover, the regular occurrence of *Humulus/Cannabis*-type may point to frequent, small-scale open locations along the lake.

Synchronously, finds of fungal spores of *Glomus* sp. and *Diporotheca webbiae* can be linked to increased erosional input into the lake due to human activities at its shore. Other representatives of fungi indicative of accumulations of dead organic plant material, such as *Cercophora* sp., *Coniochaeta xylariispora* and *Ustulina deusta*, are most abundant in the older part of this period between c. 5550 and 5000 cal BC, as is the strongest evidence of microscopic charcoal particles. In contrast, the decline in the frequency of *Pteridium* over the further course of this period may be associated with reduced fire activity, as demonstrated by the visibly diminished amounts of charcoal dust from c. 4990 cal BC onwards. This may be indicative of a general decrease in human activity in the surroundings of the lake during the final part of the Late Mesolithic.

Discussion of human impact on the landscape of the coastal hinterland

The multi-proxy data from Lake Skogstjern suggest both climate-controlled and human-induced changes in the vegetation cover as well as possible uses of available plant resources throughout the Mesolithic. As shown by the gradually immigrating, warmth-demanding trees (elm, lime and oak) and the distinct reductions in hazel around the 8.2 ka event, the local forest composition appears to be dependent on the general climate development. However, the visible oscillations of the curves of some arboreal taxa (birch, lime), along with that of the shrubs (hazel, juniper, willow, guelder-rose, whitebeam/

raspberry), dwarf-shrubs (heather, cranberry), grasses and herbs suggest that the vegetation has also been influenced anthropologically, at least on a small-scale level.

There is increased palynological evidence of forest disturbances around the lake together with quite high proportions of micro-charcoal, in particular at the Early/Middle Mesolithic transition and in the further course of the Middle Mesolithic (Figure 13.4), pointing to artificial manipulation of the vegetation through burning. Deliberate firing to maintain or extend the openness of the vegetation during the Mesolithic, creating more productive habitats, is under debate in northern Europe (Mellars 1976; Innes & Simmons 1988, 2000; Simmons & Innes 1996; Moore 2000; Bos & Urz 2003; Blackford et al. 2006; Ryan & Blackford 2010). Thus, the clearings in the woodland, as shown by the parallel rises in the charcoal dust and the light-demanding shrubs, grasses and herbs in the Lake Skogstjern record, may also have been induced using fire. These palynological signals could reflect, for example, a hunting technique. As highlighted in several studies, the creation of attractive browse or grazing places for wild animals by burning off the vegetation to improve the chances of hunting success can, in principle, be taken into consideration (Zvelebil 1994; Blackford et al. 2006; Rowley-Conwy & Layton 2011).

Intentional firing could also have been applied to increase the productivity of certain plants, such as hazel (Huntley 1993; Blackford et al. 2006; Holst 2010; Bishop & Rowley-Conwy 2013; Warren et al. 2013). In the pollen record from Lake Skogstjern, there are rising proportions of hazel often corresponding with the highest records of microscopic charcoal particles. This may be indicative that the spread of hazel shrubs was promoted through burning. However, the strongly fluctuating amounts of hazel may also point to the influence of these shrubs by cutting or even coppicing in order to gain construction material for shelters, fences, walls, baskets, fish traps, arrows and tools (Wilkinson & Vedmore 2001; Regnell 2012; Bishop et al. 2015; Klooß 2015; Groß et al. 2018a).

The creation of fire-induced openings in the forest for reasons other than economic – e.g., ritual and social motives – is also possible (Davies et al. 2005; Innes et al. 2010). Whatever the case, it can also be taken into account that the increased microscopic charcoal record may result from domestic fires from campsites (Bennett et al. 1990; Edwards 1990). Of course, natural fires should be born in mind, too. However, it is inconceivable that these events took place regularly over a longer period of time. Disturbances within the forest vegetation are also demonstrated by the occurrence of nitrophilous plants and certain fungi indicative of the accumulation of dead organic material, pointing to the presence of recurrently used dwelling sites, or other actions, such as the processing of plant material or trampling. Likewise, the appearance of fungal erosion indicators may be a signal of soil disturbances at the lakeshore caused by these activities.

Compared with the Middle Mesolithic, a general decrease in the anthropogenic impact on the vegetation is recorded during the Late Mesolithic period.

During this time, the palynological data show that the openings in the woodland were of smaller scale. The same is true for the quantities of micro-charcoal, which – apart from its initially still high presence – shows distinctly reduced amounts in the second half of the Late Mesolithic, demonstrating reduced disturbances within the vegetation through fire. Climate-related strong soil disturbances in the catchment of the lake, which have been recorded throughout the Late Mesolithic, could have been one possible reason for the general reduced human activity during this time. It is conceivable, for instance, that intense slope erosion occurring over lengthy periods of time could have had a negative effect on the choice of such 'instable' hinterland locations as dwelling sites (Wieckowska-Lüth et al. 2017). Strong erosional inputs into the lake may also have had an effect on both its water quality and biota, changing the range of limnic food resources (Wieckowska-Lüth et al. 2017).

Nevertheless, even though both the proportions of the herbal disturbance indicators and the microscopic charcoal particles diminish in the Late Mesolithic period, they remain at a more or less constant level, showing that there were still minor gaps in the forest canopy as well as anthropogenic fire events. In addition, as discussed by Wieckowska-Lüth et al. (2018), the contemporary strongly fluctuating proportions of lime pollen supported by archaeological data hint at the use of lime as a raw material for wooden implements. In accordance with this, the appearance of decomposing fungi may indicate the presence of wounded and dying deciduous trees.

Conclusion

The palynological record from Lake Skogstjern indicates that the coastal human communities used the lake and its surrounding area recurrently during the Mesolithic. After Lake Skogstjern was isolated from the sea, it offered, as a coast-near-freshwater reservoir, faunal and vegetational resources different to those of the seashore, such as freshwater fish, water birds and their eggs, rhizomes, tubers and seeds of certain water plants. Besides, its surroundings provided fruits, nuts, acorns, branches and timber of specific wood species. In addition, the lake may have attracted animals for drinking, and thus became a focal point for the hunting of prey. This demonstrates that the coastal hinterland was also attractive for the marine foragers, representing a complementary economic zone, a supplementary source of daily nutrition or a dwelling area. Thus, similar to the hunter-gatherer-fisher communities around the Baltic Sea (Groß et al. 2018b), it could be shown that people in the coastal hinterland of the Oslo fjord region were integrally intertwined with their environment. They followed a lifestyle that closely connected seashore environments, riverbanks and the hinterland (Wieckowska-Lüth et al. 2018). It can also be stated that the multi-proxy record from Lake Skogstjern hints at more stable settlement along the lake during the Early/Middle Mesolithic transition and in the further course of the Middle Mesolithic. During the Late Mesolithic, however, the use of the lakeside is limited to shorter visits.

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Part IV

The coastal zone: Time depth, historicity and ritual practice

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14 Nodal points in a Mesolithic mobile coastal world

Monumental quarries in south Norway

Astrid J. Nyland

Introduction and background

The Mesolithic of southern Norway (Figure 14.1), from c. 9500 to 4000 cal BC, was a period of relatively rapid, large-scale changes in climate, topography, flora and fauna. However, the archaeological record shows that there were also persisting social traditions comprising mobility patterns, settlement organization and resource exploitation, including lithic raw material procurement. In this chapter, regional variation is interpreted in relation to the changing Mesolithic coastal landscape. I propose that procurement practices became part of a social strategy that established places of social significance, *nodal points* in the changing Mesolithic coastal landscape.

During the Early Mesolithic, the climate had warmed up significantly: the inland glaciers had retreated and had more or less disappeared by the Early–Middle Mesolithic transition, around 8000 cal BC (Andersen 2000; Påsse & Andersson 2005; Balbo 2010). With a warmer climate, the conditions for flora and fauna improved. For example, the Boreal forest peaked (Nesje & Dahl 1993) and with the disappearing glaciers, the mountainous regions became more accessible. Hence, moving between regions inland became less risky, and resources more abundant and varied. In the context of this chapter, the most important aspect of this period's climate change is the enduring geological isostatic process initiated by melting glaciers causing significant changes to the coastline. On a global scale, the melting ice had caused the sea level to rise in most of Europe. In Norway, however, when the weight of the ice covers was reduced, the landmasses rose too, in some regions quicker than the sea, hence a descending shoreline. In the Early Mesolithic, along some parts of the coast of south Norway, the sea level dropped as much as 3 m per 100 years (Figure 14.2). This meant that sea-level changes would have been perceptible within a generation. In other regions, the pace of the falling shoreline was slower, and the changes less noticeable but continuous. How did this affect the Mesolithic coastal inhabitants?

In the Middle Mesolithic, the pace of landscape changes slowed down. Nevertheless, for a marine-oriented and coastal population, even small changes would surely have been noticeable from one generation to another. The waters

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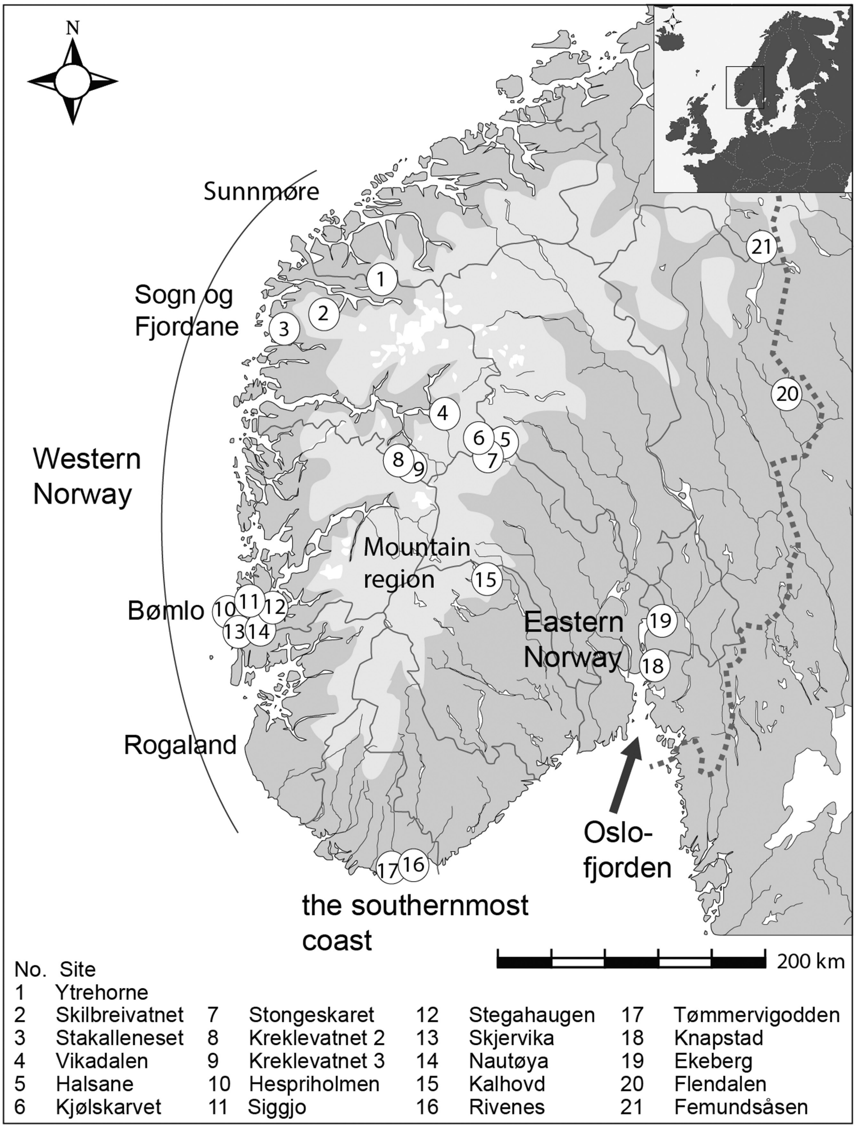


Figure 14.1 Southern Norway comprises the regions of western and eastern Norway and the southernmost coast. The referenced PhD project analyzed 21 quarries and sources of raw material exploited during the Mesolithic, Neolithic and Bronze Age across southern Norway. Illustration: A.J. Nyland.

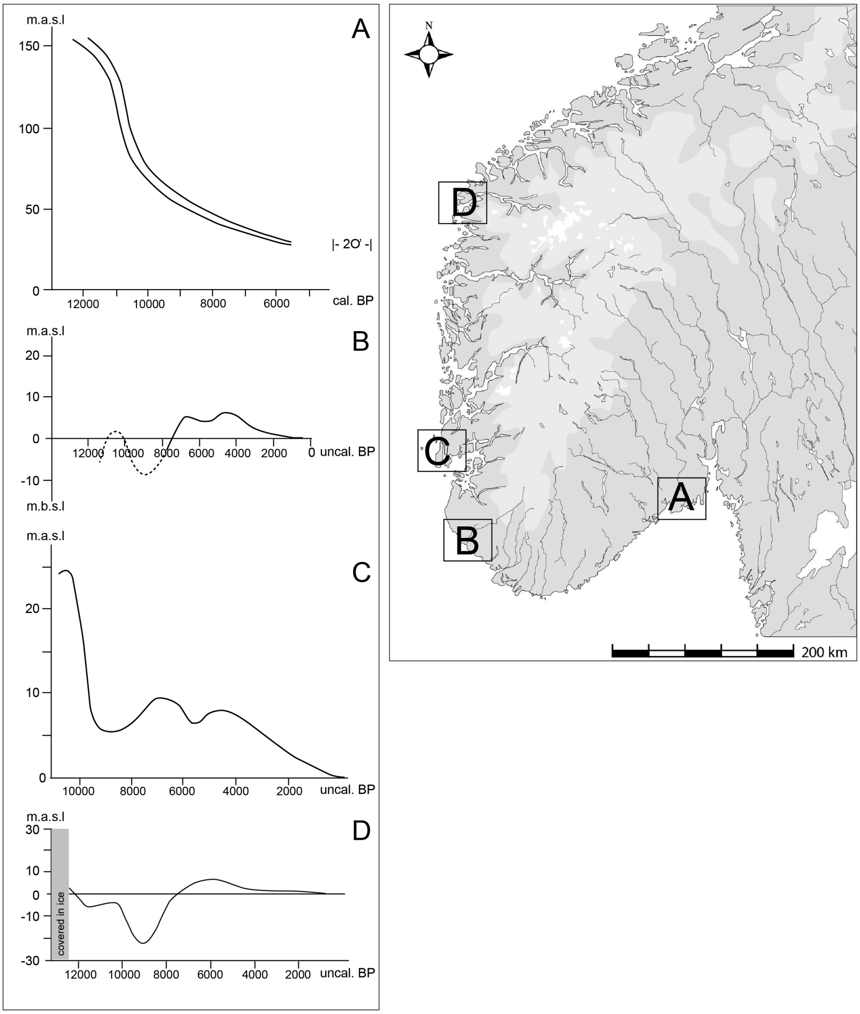


Figure 14.2 The sea-level curves vary significantly between the different parts of south Norway. A: Larvik, Vestfold (see original in Sørensen et al. 2014:206). B: Eigersund, Rogaland (see original in Prøsch-Danielsen 2006:79). C: Fosen, Rogaland (see original in Midtbø 2011:64). D: Skatestraumen, Sogn og Fjordane (see original in Bergsvik 2002:301). Compilation and illustration: A.J. Nyland.

slowly became too shallow for landing boats, leaving perhaps familiar fishing grounds desolate, or the terrain became too steep to favour shore-bound settling. Furthermore, fluctuating ocean temperatures due to climate changes, as well as the salinity levels in the ocean, affected marine productivity (summarized in Breivik 2014). These conditions dictate whether various species of plankton thrive. In turn, this influenced marine resources such as fish and marine mammals, as well as the proliferation of seabirds with related resources such as eggs and feathers. Hence, changing parameters caused by climatic variation would also have influenced the settling of the Norwegian coast during the Early Mesolithic (Breivik 2014). People's familiarity with the landscape, the predictability of resources, and thus their trust in traditions, must also have been affected. If people's knowledge of their surroundings as well as immaterially transferred knowledge, traditions, memories and practices could no longer be trusted, how did people handle it? Societies often establish social strategies to cope with change (Berger & Luckmann 1967). In this chapter, I argue that people regained a sense of control by creating sites, institutionalizing or maintaining certain traditions to counteract the instability. The conservative lithic technology traditions of the Early Mesolithic could be perceived as one type of culture-preserving tradition (e.g. Fuglestvedt 1999, 2009; Berg-Hansen 2017), an apparent standardized settlement pattern in the same period as another (e.g. Nærøy 1995; Bjerck 2009; Nyland 2017a). Standardizing the organization of dwellings is a known strategy for keeping the world stable among mobile communities (Grøn & Kuznetsov 2003). Hence, I argue that stone quarries similarly became anchors and focal points and places, representing stability in a changing Mesolithic natural environment and landscape.

Through repeated quarrying at certain places, nodal points developed. Nodal points are significant sites or places in the landscape that may reify collective memories and ideas, anchoring group identity as a result (e.g. Boyd 2002). The control of such places may have been pertinent, and reflexively ensured the sites' continual exploitation. A particular quarry may have started out as a place revisited due to its high-quality rock. Regular visits by people living in an area, making the quarry part of a seasonal movement through the landscape, district or region, including the place in stories and social memories, may have made it into something more than 'just' a place for rock procurement. Yet, not all quarries developed to nodal points representing long-lasting identity. Whereas some rock sources were used for millennia, others appear to have been only sporadically used and relatively quickly abandoned; but how can we distinguish which sites became nodal points?

Investigating quarries and lithic procurement

The discussion in this chapter springs from a PhD study of 21 Stone Age and Bronze Age quarries and lithic procurement practices in southern Norway (Nyland 2016a, but see also 2017b, 2017c). Through detailed and comparative investigation, variations in the sites' time-depth, scale and intensity of exploitation were identified. The sites comprise various rock types suitable for different types of tools. There is variation in geographical location, geology and natural topography, that is, obvious natural differences between the sites. Despite this, elements of common or varying practices were detected. Furthermore, the varying character of exploitation indicated that there was more to a quarry and lithic raw materials than solely their availability, or the physical properties of the rocks.

Fundamental to this was to approach the quarries as a stage in the *chaîne opératoire* of lithic procurement. The theoretical foundation of *chaîne opératoire* analysis is the understanding of practices and human behaviour, from gestures to technology, being socially and culturally situated (e.g. Mauss 1979; Leroi-Gourhan 1964). Thus, investigating technological choices, the execution of tasks or other chains of actions can provide insight into the choices and preferences of a group of people (e.g. Edmonds 1990; Schlanger 1994; Dobres 2010; Soressi & Geneste 2011). The operational chain of lithic procurement was divided into seven stages, starting with the choice of whether or not to quarry. All decisions and operations undertaken before even reaching the quarrying site, as well as what happened to the rock after quarrying, are necessary to consider in order to identify variation in the character of exploitation of the different sites. In line with one of the fundamental theoretical perspectives of the *chaîne opératoire* approach, social or cultural preferences or norms regulate choices; in this context, this means deciding what and where to quarry. This includes whether to keep the quarry secluded from the household sphere, or to settle next to a source. Depending on the geological deposit, people would have needed to make preparations before quarrying, for example preparing suitable dry firewood or collecting hammerstones. Quarrying techniques varied, as did the scale of quarrying and waste management. The analytical approach required an extended understanding of what constitutes a quarry, or rather, what comprises lithic procurement practices. The final stage of examination in the operational chain was therefore to investigate where the quarried rock ended up, including identifying the range of the quarried rocks' distribution (for elaboration on method see Nyland 2016a, 2017c).

Identifying the norm to distinguish the extraordinary

Identifying the norm is imperative in order to identify any extraordinary use of sites. One way to achieve this is to compare contemporary sites and procurement practices. I will therefore commence by briefly outlining how variations in procurement practices can be detected.

Throughout the Mesolithic, between 8000 and 4000 cal BC, rock appears to have been quarried moderately, pragmatically and sometimes opportunistically and spontaneously from a wide range of sources. This included collecting so-called beach flint, an apparently preferred material for blade and flake tools along the coast. In Norway, flint cannot be mined as there is no naturally occurring flint. However, flint had been left by drifting sea-ice at the end of the last Ice Age, arriving from the closest flint deposits in Scania and Denmark. Flint was therefore collectable as small nodules along seashores throughout the Stone Age in Norway (e.g. Johansen 1956). In addition, at numerous Middle and Late Mesolithic sites along the coast, inland and in the mountain regions, lithic assemblages display great diversity in the exploitation of local rock types.

This demonstrates that there is a huge misrepresentation between the number of archaeologically known quarries or lithic procurement sites and the 'true' number of former procurement sites. However, through studying and comparing the exploitation of known quarry sites, together with the lithic assemblages from settlement sites, varying procurement practices, preferences of rock types and sometimes even the scale of extraction of a deposit can be identified.

In the aforementioned PhD study, 18 of the 21 sites examined were dated to the Mesolithic. Persistent quarrying of specific deposits can be interpreted as an appreciation of predictable sources of high-quality rock. However, in some situations, a combination of the scale and duration of exploitation and the range of distribution of rock into areas of equally suitable rock deposits, implies that there was more to it than that. Knowing that the coastal landscape changed continuously, and that the settlement pattern displays high mobility, the practice of continuous exploitation of a particular site and subsequent long-scale distribution of the quarried rock, is not easy to understand. A fundamental element in understanding the varying character of quarrying and lithic procurement is therefore to attempt to contextualize the sites. Establishing their timeframe of activity and thereby relating the quarries to contemporaneous sites and societies is thus essential.

To date quarries is challenging (e.g. Nyland 2016a, 2016b, 2017c). A combination of different methods is necessary. Possibilities for radiocarbon dating quarries may be limited due to either the lack of charcoal because of acidic soil conditions in southern Norway or simply because fire-aided quarrying was not undertaken at the source in question. Radiocarbon dates exist from only four quarries within my study area (Olsen 1981; Alsaker 1982; Mikkelsen 1984; Olsen & Alsaker 1984; Alsaker 1987; Sjurseike 1994). Instead, in Norwegian Stone Age archaeology, it is common to relate assumed shore-bound coastal sites to dated ancient sea-level curves, as shown in Figure 14.2; e.g. Fægri 1944; Kleppe 1985; Bjerck 1986). Shoreline dating can be appropriate for sites close to ancient seashores. However, due to the location of the quarries investigated in the aforementioned study, seashore dating proved irrelevant. Instead, most of the quarries were indirectly dated through typology, that is, what had been made from the quarried rock. Hence, chronologically significant adze types, certain signs of specific lithic technologies or quarried material found at radiocarbon-dated sites in the immediate vicinity of the quarries, pointed to the time period of activity at the different quarries.

Examining lithic assemblages at related sites is not only vital for dating purposes; determining the frequency of various types and the composition of the assemblages can also indicate the position held by various rock types in the contemporary society, or indeed, the place of procurement. To identify the provenance of rock, one may examine its geochemistry and mineralogical composition. However, in situations where settlement sites are located close to a known exploited quarry, quarried materials may be visually recognized with relative certainty, too. In the area surrounding Bømlo (see Figure 14.1), five quarries were in use simultaneously during a short period around 4000 cal BC, including a monumental greenstone quarry, Hespriholmen; there are also two jasper quarries, another greenstone quarry and one rhyolite quarry. Estimates of the scale of extraction vary significantly between the quarries. In the vicinity of these quarries, within an area of less than approximately 20 km in diameter, lithic assemblages at a number of contemporary sites have been quantified, showing varying frequency of use of the different rock types from the quarries. This demonstrates that the variation is not a result of the quarries' varying time-depth. Furthermore, at the sites, there was also extensive use of beach flint, quartz, quartzite and slate. Indeed, despite easy access to jasper and efforts made to quarry it, jasper was outnumbered by the other rock types. From a modern, rational perspective, it appears that jasper was quarried without any apparent practical purpose.

Furthermore, the range of distribution also varies considerably. Whereas jasper was only used locally, greenstone from Hespriholmen was distributed throughout the region comprising what are now the counties of Hordaland and Rogaland (Olsen & Alsaker 1984; see also Figure 14.1). Hespriholmen is a quarry on an islet far out to sea, which was quarried from the Middle Mesolithic to the Middle Neolithic. At the onset of the Neolithic, around 4000 cal BC, a rhyolite quarry atop Mt. Siggjo was established. This rock was soon found at sites along most of the coast of western Norway, distributed further than the greenstone had ever been, even into the mountainous region (Alsaker 1987; Indrelid 1994; Bergsvik 2006; Nyland 2016b). That is, both Hespriholmen-greenstone and Siggjo-rhyolite were distributed into areas where raw materials of similar quality were just as available. Was the desire to possess these particular rock types linked to their place of origin? Their wide distribution suggests that the place of procurement, or known associations, made rock from certain places desirable. How then should one understand the minute jasper quarrying?

Long-term exploitation of coastal adze quarries

The continuous exploitation of one particular quarry, coupled with the subsequent and persistent wide regional distribution of rock for adze production, was not unique to Bømlo; located more than 200 km further north along the western coast, the diabase quarry at Stakalleneset in the county of Sogn og Fjordane shares similarities. Both quarries were in use from about 8000 to 2400 cal BC and provided quality rock for partially overlapping regions throughout this considerable period of use (Fægri 1944; Olsen 1981; Alsaker 1982; Olsen & Alsaker 1984; Alsaker 1987; Bergsvik & Olsen 2003). It is estimated that the extracted rock from both quarries amounts to about 400 m^3 each. Although exploitation of these quarries might have been episodic or fluctuating, the amount of rock quarried per year was not necessarily a lot. Furthermore, Hespriholmen and Stakalleneset were not the sole rock sources with suitable, even similar rock, within their districts. Indeed, surrounding Stakalleneset, there are several other recorded diabase dykes that were not exploited (Olsen 1981). Some of them are located closer to the Stone Age settlements than the Stakalleneset quarry, but none appears to have been exploited. The Stegahaugen greenstone quarry is located on the mainland of Bømlo, safely accessible in all kinds of weather, but this site remained small and was exploited only to a limited degree (Alsaker 1982; Nyland 2012). The insistence on exploiting these two particular sites, Hespriholmen and Stakalleneset, therefore seems to have been a very conscious choice and rock from them a specific preference. Hence, their continuous exploitation attests to the sites being imbued with significance beyond pragmatics.

The physical properties of certain rock types make some rocks very well suited for specific tool production. Thus, the repeated exploitation of certain high-quality rock deposits is not surprising. Various physical properties of rock types can be examined using geo-archaeological methods, examining aspects such as density, hardness, toughness, resilience and elasticity. An example of such is to test the tensile stress in rock used for adzes. This was attempted in the UK and demonstrated how it is not necessarily the superiority of the rock that matters. As it turned out, distribution studies showed how high-quality stone types (according to our modern understanding) were locally distributed, while axes made of poorer material were carried from England across the Irish Sea (e.g. Bradley et al. 1992). Such tests demonstrate that, in some situations, the choice of rock type had value beyond our modern rationale. It also indicates that prehistoric people did not always optimize cost-benefits. Indeed, in several regions, it appears that the specific rock type mattered less than its place of origin (Bradley et al. 1992; Bradley & Edmonds 1993; Edmonds 1999; Nyland 2016a, 2016b). Be it greenstone, diabase, hornfels, ignimbrite or any other rock type, as long as it was suitable for ground adze production, the geological type of rock did not necessarily matter, but the place of procurement did. It is therefore of particular interest when one can identify that rock from selected sites was distributed into areas with an abundance of equally or better suited rocks. It supports the argument that sentimental value or symbolic aspects associated with certain places were sometimes just as important to lithic raw material procurement as rock quality.

Another indication of the embedded social significance of the Hespriholmen and Stakalleneset quarries is the apparent reluctance to abandon these sites. As the sea-level curves in Figure 14.2 illustrate, by the end of the Middle Mesolithic in western Norway, the sea had caught up with the land. Slowly, the lowest part of both quarry sites became submerged, but the sites were still not abandoned. Despite other accessible deposits in less challenging locations, quarrying continued in elevated parts of both deposits (Figure 14.3). This insistent practice of quarrying at these apparently ‘drowning’ sites is contrasted by lithic procurement practices for adze materials at the southernmost coast and in eastern Norway. For example, parts of the diabase dyke exploited at the headland Rivenes, in Vest-Agder County, were also transgressed by the sea at the end of the Middle Mesolithic. Even though the diabase dyke was still accessible higher up in the terrain, this deposit was abandoned. Further east,

Figure 14.3 The islet Hespriholmen with its marked scars from continuous quarrying. As the sea rose, quarrying continued on top of the islet. Photo: A.J. Nyland.

at the head of the Oslo fjord, the diabase quarry at Ekeberg was exploited in the Middle to Late Mesolithic. This site never developed into a large quarry similar to those on the west coast, but appears to have been relatively modestly exploited and then abandoned. Certain rock types such as ignimbrite, basalts and hornfels were repeatedly exploited in various districts (see examples in Jaksland 2005; Eigeland & Fossum 2014). However, aside from an inland jasper quarry providing rock for blade and flake tools, no single rock source for adze production displays a similar character of large-scale use as those identified in the west. Furthermore, during the Late Mesolithic so-called 'classical Nøstvet' phase (about 5500–4500 cal BC), rock types for adze production were procured from any nearby deposits, moraines and beaches (Jaksland 2005). That no selected rock or particular quarries were exploited to the same degree as the western quarries at Hespriholmen or Stakalleneset does not mean that lithic procurement was not a significant or planned task in the east. 'Opportunistic procurement' of rock, that is, collecting either from moraines or in a small or modest manner from multiple local outcrops, just represents a *different kind* of engagement with rock and place of procurement (Nyland 2016a). Building on this, another question emerges, why is there a regional difference?

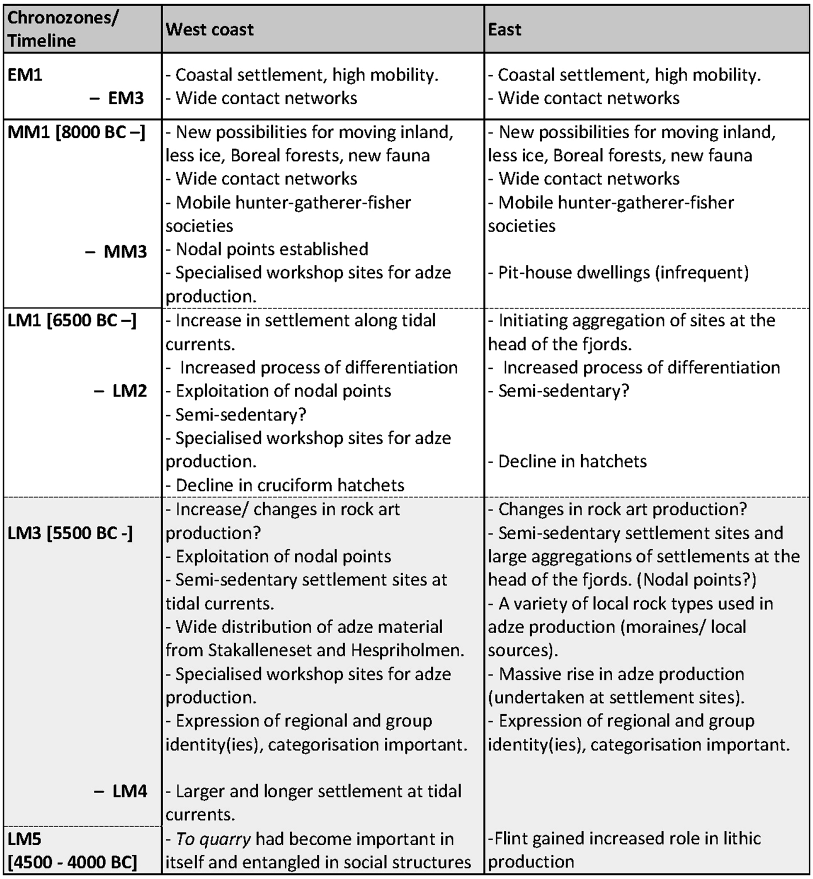
The unstable coast

Throughout the Mesolithic, the population of southern Norway appears to have been predominantly coastally oriented. The forested interior and mountainous regions were inhabited too, but probably on a more seasonal basis (e.g. Boaz 1998; Stene 2010). Thus, fluctuating sea levels along the coast influenced the lives of the majority of the population. Because sea-level fluctuations differ between regions, this would in turn have influenced the lives of the inhabitants in the various regions of Norway differently. Perhaps this, by extension, influenced groups' myths or tales of ancestry? This interpretation presumes that knowledge of practices and traditions was transmitted between generations in mobile hunter-gatherer societies familiar from ethnographic and historic records. Hence, people would have recognized the gradual changes due to the transgressing sea and found strategies to cope with the unstable nature. Shared social practices and traditions, and knowledge of a group's myths or ancestry, create social ties and bind a group together (cf. Berger & Luckmann 1967; De Certeau 1984; Taçon 1991). During the final half of the Mesolithic, parallel with the landscape changes, there is a developing regional variation in material culture.

In general, settlement pattern, tool types and lithic technology are similar between the two regions: western and eastern Norway. However, this does not necessarily mean that people's relationship to the sea, the coast or significant places in the landscape is compatible. In eastern Norway, despite some irregularities, the sea level declined steadily, the pace slowing somewhat after the Mesolithic (see Figure 14.2). Meanwhile, in western Norway, during the end of the Middle Mesolithic, the sea level rose quicker than the land, causing a period of transgression of older sites and coastline. Reaching *tapes maximum* in the Late Mesolithic, the sea level on the western coast stabilized for almost 2000 years before gradually sinking again (Figure 14.2). Along the southernmost coast, there was also a transgression, but this area displays another transgression/regression trajectory, where some sites are still submerged. Hence, even if the Mesolithic people in the various regions of Norway seem to share a marine-oriented way of life in general, the social memories and histories of the inhabiting populations of these coastal landscapes were not the same. The coastline itself was not a stable and predictable element, behaving differently between regions. Indeed, one autumn about 8200 years ago, in the Late Mesolithic, the western coast experienced a devastating tsunami, the Storegga tsunami, creating a wave several metres high that washed over the coast of western Norway, including the east coasts of the Shetland Islands and Scotland (e.g. Bondevik et al. 2003). Considering the location of the majority of the Mesolithic sites close to the shores, the effect of a 10-m-high tsunami would have been tremendous, flooding whole landscapes and destroying sites and lives (Figure 14.4). There is no trace of this event at the coast of eastern Norway (Romundset in print).

The many small Early Mesolithic sites with a limited number of finds that indicate a lifestyle of short-term stays and frequent moves. In the Middle Mesolithic, despite more invested settlements such as pit dwellings, the archaeological record still indicates a dominance of short-term occupation and a high level of mobility, including long-distance travel (Figure 14.5). In a mobile and changing Mesolithic coastal world, I believe people needed some form of predictability, to anchor their sense of identity and belonging to a defined group with a common history and shared traditions. Similar practices can be a sign of a chosen social strategy for establishing and maintaining a platform for social stability. Bringing order to one's experience and interaction with the landscape through, for example, naming places and conceptualizing them through revisiting and reuse, is a known practice in mobile, nomadic societies (e.g. Taçon

Figure 14.4 Southern Bømlo, a coastal landscape vulnerable to the unstable sea. Hespriholmen is among the archipelago in the far right corner (southwest) of the picture. Photo: A.J. Nyland.



Chronozones/ Timeline	**West coast**	**East**
EM1 **– EM3**	- Coastal settlement, high mobility. - Wide contact networks	- Coastal settlement, high mobility. - Wide contact networks
MM1 [8000 BC –] **– MM3**	- New possibilities for moving inland, less ice, Boreal forests, new fauna - Wide contact networks - Mobile hunter-gatherer-fisher societies - Nodal points established - Specialised workshop sites for adze production.	- New possibilities for moving inland, less ice, Boreal forests, new fauna - Wide contact networks - Mobile hunter-gatherer-fisher societies - Pit-house dwellings (infrequent)
LM1 [6500 BC –] **– LM2**	- Increase in settlement along tidal currents. - Increased process of differentiation - Exploitation of nodal points - Semi-sedentary? - Specialised workshop sites for adze production. - Decline in cruciform hatchets	- Initiating aggregation of sites at the head of the fjords. - Increased process of differentiation - Semi-sedentary? - Decline in hatchets
LM3 [5500 BC -] **– LM4**	- Increase/ changes in rock art production? - Exploitation of nodal points - Semi-sedentary settlement sites at tidal currents. - Wide distribution of adze material from Stakalleneset and Hespriholmen. - Specialised workshop sites for adze production. - Expression of regional and group identity(ies), categorisation important. - Larger and longer settlement at tidal currents.	- Changes in rock art production? - Semi-sedentary settlement sites and large aggregations of settlements at the head of the fjords. (Nodal points?) - A variety of local rock types used in adze production (moraines/ local sources). - Massive rise in adze production (undertaken at settlement sites). - Expression of regional and group identity(ies), categorisation important.
LM5 **[4500 - 4000 BC]**	- *To quarry* had become important in itself and entangled in social structures	-Flint gained increased role in lithic production

Figure 14.5 Compiled Mesolithic developments in the western and eastern regions of south Norway. *Source*: from Nyland (2016a).

1991; Nuttall 1992:38). The ever-growing marks at selected rock sources and the associated waste piles must have made a monumental impression and transformed the quarries. The quarries became places with long-lasting evidence of human endeavour and presence along coastal western Norway. In a time and region where human-made, enduring structures were almost non-existent, these large quarries represented tangible traces of past human activity and engagement, thus materializing time and history; the distributed rock being mementoes of this (Nyland 2017b).

Embodied taskscapes, socially entangled practices and nodal points

By the Late Mesolithic, quarrying from specific sites had become socially required routines, traditions or ritual practices, expressing a developing idea of the importance of establishing and returning to socially significant places. Collaterally, through maintaining traditions and practices, people turned the landscape and entangled known places and locations into webs of histories.

T. Ingold (1993:162) introduced the term *taskscape* to direct attention to the importance of the dynamic between places, acts/tasks and movements. The term was supposed to embody the rhythm of activities and movements that bring someone into contact with new experiences, the 'going on of life'. Later, Ingold abandoned his term, having, as he phrases it himself, 'introduced the concept of "taskscape", in short, only to show why in the end, we do not need it' (Ingold 2017:23). Ingold's (e.g. 2007, 2013, 2017) point was, and still is, to emphasize the importance of understanding lived lives as in a constant state of becoming; our lives are always under construction, since we always respond to our surroundings. From Ingold's perspective, societies are like organic rhizomes, like histories made up of never-ending story lines, or meshworks of entangled 'lines', paths, practices, preferences and choices. A key point is to acknowledge the dynamics of being, the shaping and creating of worlds through practices, while practices are affected at the same time by the world we meet. The world is made up of meetings, meetings between humans, between humans and places and between humans and material culture. To paraphrase I. Fuglestvedt (1999:35): meetings make history.

Fuglestvedt (1999, 2008) discussed the dynamics and results of long-distance contact in relation to rock art, persisting practices concerned with inscribing figures in rock. In this chapter, it is the enduring scars made in rock outcrops through continual quarrying, which that is the shared practice. It is perhaps not coincidental that there is a simultaneous intensification of both rock art production and quarrying in coastal western Norway[1] from around 5500 cal BC (Olsen 1981; Gjerde 2010; Nyland 2016a, 2017b; Fuglestvedt 2017). Both quarries and rock art sites may have functioned as nodes or nodal points in landscapes, both types created enduring scars on the rock surfaces. Rock was an essential element in the lives of Mesolithic people, in both a practical and social or symbolic perspective. Some of the places of procurement were visited and revisited for generations. This would slowly embed these sites into the social memories of the exploiting communities. To visit a quarry could have been part of an everyday or annual routine. It might also have been an episodic event undertaken in order to highlight the past in the minds of people. Being places still in use, quarries were not mere memories or parts of stories, but tangible places where myths of an ancestral past came to life. A quarry would then perpetuate into the future as places people included in living practices; they were sites one moved towards or planned to visit. Thus, quarries and the involved lithic procurement practices inhabit temporal qualities (e.g. Edmonds 1999). Furthermore, quarries tied lines of movement, time, people and districts together. Continual activity endorsed the quarry sites' significance and contributed in making these places into mnemonic pegs. Lithic raw material procurement sites and involved procurement practices were then gradually and continually becoming deeply entangled in the social lives of people, making quarrying a required practice. To share certain ideas, for example the idea of possessing rock from significant places, and by distributing rock from these sites, peoples' sense of belonging to an area or a landscape was reified (e.g. Gould 1978; Taçon 1991; Thomas 1991).

By extension, access to a significant place or significant rocks can also be related to territorial claims. Claiming a place as one's own, to objectify or define a place, to transform places into something to be managed by someone claiming rights to them, is a known tactical or strategic mechanism (De Certeau 1984:35–36). Having access to a significant site, such as a quarry, to manage or control it, could have made quarries into *social arenas* for the people to whom they mattered (cf. Nyland 2016c). Not only myths and links to past generations or ancestors were upheld at a quarry, but access could also validate or anchor social status. In turn, this may have affected social organization and mobility patterns, setting limits on the accepted distance between rock sources and settlement sites. Demonstrations of access by displaying rock from a socially or strategically important site, confirmed relations among people belonging to the same group. In this sense, these quarries were nodal points, bundles in webs of relations, created and maintained through shared practices of engaging with land and rock.

The persistent exploitation of the large quarries in the Middle and Late Mesolithic seems to reflect an ongoing, but increasingly intertwined and dynamic relationship between people and places. If selected quarries represented ideas linked to origin and ancestry, to the *essence* of the people living within an area, the, for us, 'odd' distribution patterns and exploitation of certain rocks and sites can be explained. To obtain a piece of rock from a known nodal point in the landscape was an acknowledgement of kinship, and the display of such confirmed its possessor's belonging to an area.

Final remarks

The character of exploitation indicates that certain quarries had come to represent something beyond being sources of high-quality rock. Continual and repeated quarrying resulted in the sites' gradual entanglement in social systems, traditions and structures. By the Late Mesolithic, an idea of returning to places of particular social and symbolic significance had been established across southern Norway, but this idea was expressed differently between the western and eastern regions. In this chapter, this variation is interpreted as triggered by the varying geological processes and history. In the east, the rock sources did not gain similar significance as in the west. In the east, large aggregation sites were established with invested settlement sites, pit-house dwellings, at the heads of the fjords. These have been interpreted as some kind of nodal points too, expressing stability and rootedness for the people in this region (Glørstad 2010:155). However, the character of these sites, their location and not least their lithic inventory vary from those found in the west. For example, lithic assemblages demonstrate large-scale adze production (Jaksland 2005), in a number ten times what is common at contemporary sites in the western part of the country. Still, no one single rock source of the same time-depth or scale of extraction, nor consistent distribution, has been identified. Instead, geologists have agreed that the rock in these adzes was obtained from numerous sources and deposits. Indeed, most blanks were probably collected from the moraines in the region (Jaksland 2005). It seems that there is the same sentiment and desire for stability, yet in eastern Norway, the nodal points lack the quality of temporal persistence or indeed visibility that linked people to their past in western Norway. A procurement practice is prominent and reflects common ideas and cultural traditions within a society; it is both culturally expressive and conceptual. The beaches and moraines that had provided rock for generations may have been just as intertwined in the narratives of spiritual sentience, ancestors and group identity. Nevertheless, the practice and the sites differ significantly from the western practice.

To look beyond availability and rock properties, insight into the questions of why the Mesolithic coastal inhabitants quarried can be gained. Why certain rocks were distributed into areas where rock was locally available becomes more understandable. In my view, the exploitation of specific sites expresses ideas of significance or association added to a specific place or area. As anchor points in an otherwise mobile world, the distribution of rock from sources seen as nodal points can reveal the range of a group's mobility. However, one may also deduce that during the Middle Mesolithic, the significance of specific places to which people would return was established in southern Norway. Still, be it quarries, rock art sites or pit dwellings, certain significant sites – nodal points representing time, social relations and stability in the changing Mesolithic coastal world – seem to have been important to the mobile hunter-gatherer-fisher societies inhabiting the coast.

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Note

1 The large rock art sites of Vingen (more than 2000 figures) and Ausevik (over 300 figures) are both located along the coast of western Norway.

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15 First visit or revisit?

Motivations of mobility and the use and reuse of sites in the changing coastal areas of Mesolithic southeastern Norway

Almut Schülke

Introduction

Mesolithic people's attachment to the coast, reflected in traces of site occupation and settlement in this borderland between land and sea, has primarily been explained from an economic perspective. In Norway, thousands of Mesolithic sites, placed directly at the contemporary shoreline and close to excellent fishing grounds, attest to the significance of easy access to marine and terrestrial resources (Bjerck 1994; Bergsvik 2001; Jaksland 2001:116–120; Glørstad 2010:82; Solheim/Persson 2018), the boat being the main means of transportation (Bjerck 2008). This general shore boundedness of occupational sites throughout all of the period is interpreted in terms of people's historic attachment to the economically important resources of the coastal zone (Glørstad 2010:97–102). Ritual or cosmological meanings are seldom discussed for coastal settlement sites (but see Bergsvik 2009; Mansrud 2017); however, they play an important role when interpreting Mesolithic people's marking, exploiting and altering of shore-based places composed of durable rocky material, such as rock art sites (Helskog 1999; Gjerde 2016) or quarries (Nyland 2016).

This chapter investigates how traces of occupation and settlement sites in the coastal zone might give insight into Mesolithic people's experience of and response to past events embedded in these changing coastal landscapes, such as environmental shifts and past human activity. The case study area is southeastern Norway, with the Skagerrak coast in the south and the Oslo fjord protruding from it northwards (Figure 15.1). This area is exceptionally well suited for studies of the long-term use and settlement of the coastal zone. In other areas in northwestern Europe, Mesolithic coastal sites are submerged or destroyed due to marine transgression (Bjerck 2008; Chapter 3 [Solheim] this volume). Processes of glacial retreat, isostatic rebound and sea-level changes led to continuous land upheaval along the Oslo fjord during all of the Mesolithic period, preserving hundreds of former coastal sites in today's inland areas. At the Skagerrak coast, the land upheaval was less pronounced, with a phase of transgression, but here also many Mesolithic coastal sites are preserved. Thus,

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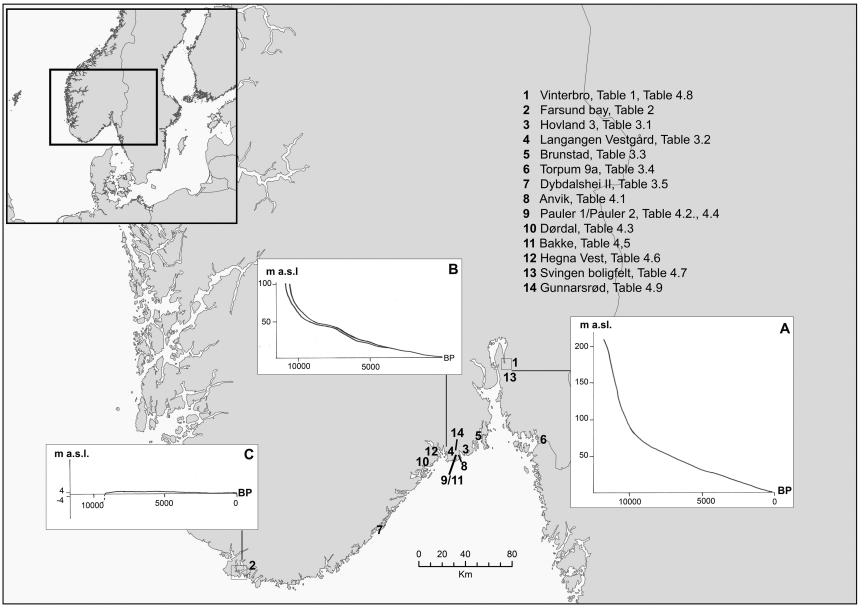


Figure 15.1 Southeastern Norway. The shoreline displacement curves illustrate the regionally different processes of land upheaval, with a marine maximum of c. 200 m in the inner Oslo fjord (A) (after Sørensen 1979), of about 100 m along the Vestfold/Telemark coast (B) (after Sørensen et al. 2014) and c. 5 m on the island of Lista at the Skagerrak coast in the south (C) (after Romundset et al. 2015). Sites discussed in the text are mapped. Illustration: A. Schülke; topographic data: Geonorge (free access).

the coastal zone in this region is versatile and in constant transition, especially in a long-term perspective, where retreating shorelines led to the constant growth of the coastal hinterland, with different surface morphologies. What was the shoreline at one time, became the hinterland at another. Here, I use the term 'coastal zone' to address the strip of land between the shoreline (which in itself is always changing) and land which has a maritime character, while (coastal) hinterland is land that is close to the coast, but has an inland character.

In this chapter, aspects of the spatial placement of the Mesolithic use of the coastal zone in southeastern Norway are discussed in a long-term perspective, with special focus on the Middle Mesolithic and the Late Mesolithic periods (c. 8200–3800 cal BC). The study does not provide a complete analysis of the region, but is based on well-excavated areas and single locations, which illustrate well the variety in spatial placement that hitherto has attracted little attention from archaeologists. Elements such as the topographic surroundings of the sites' locations, the sites' distance to the coast and their relation to earlier settlements sites are studied. They reveal nuances in how people settled and resettled in the coastal zone, and which locations they preferred. Roughly, four situations can be addressed: (1) Sites are very often shore based, which is especially observable in areas with continuous land upheaval. (2) In areas with little land upheaval, sites occur that lie further from the shoreline. (3) Quite a few shore-based sites show long-term use and reuse. (4) The reuse of originally shore-based occupational sites after they had become hinterland locations can be documented. Comparing and contextualizing these observations prompt questions about people's relation to their surroundings, which go beyond the mere economic importance of the coastal zone. Understanding the sites as traces of chains of activities and movement through time allows for the discussion of possible motivations for the mobility of the people who chose to visit, use or settle at specific places. As an analytical tool, the conceptual pair of 'first visit' and 'revisit' is introduced. Whether people settled at a place because they were attracted to its location or because they frequented previously used and thus well-known places, implies different relations between people and their surroundings, motivated by different traditions, conceptions of time, depths of and 'historic' perspectives on their surroundings and, not least, different scales or types of long-term mobility, either with a linear or a cyclical character. Looking at the long-term changes in the coastal environment also illustrates the significance of the growing coastal hinterland, an aspect that has been previously neglected.

The background: the significance of the coast in Mesolithic southeastern Norway

The Mesolithic record of southeastern Norway is strongly linked to the history of glacial retreat, isostatic rebound and sea-level changes in the course of the melting of the Weichselian ice shield (Påsse & Andersson 2005; Hughes et al. 2016). The constant land upheaval which characterizes most of the region led to an enlargement of landmasses, changing the character and course of the coastlines and the biotopes of the coastal ecotone/ecozone over time, both underwater and on land (Sørensen 1979; Jaksland 2001, 2014; Sørensen et al. 2014; Wieckowska-Lüth et al. 2018). Significant local and regional variations with different marine maximums and sea-level developments can be observed (Persson 2008), occurring at different speeds in different areas (Figure 15.1).

In the last two decades, archaeological excavations in connection with linear development projects have yielded hundreds of Mesolithic coastal sites in the study area, dating from the Early to the Late Mesolithic periods. These comprise of lithic scatters, sometimes accompanied by human-made structures (Jaksland 2001; Glørstad 2004; Solheim/Damlien 2013; Melvold/Persson 2014; Solheim et al. 2017). Due to acid soils, little organic material is preserved. Combinations of shoreline displacement curves and radiocarbon dating from Mesolithic sites substantiate that these were often placed directly at or just some metres above the shoreline at their time of use (Solheim/Persson 2018). The high numbers of coastal sites might, however, be biased by the placement of modern infrastructure projects in rocky and wooded hillsides that were once Stone Age coastal zones, which often line lower-lying areas with precious arable land, and which are more densely populated. These wooded hillsides are in focus when surveying Mesolithic sites. One of the preferred methods of surveying involves test-pitting in topographic situations, which favourably represent locations of shore-based sites, such as sheltered terraces, sometimes underestimating other types of topographic features (Berg-Hansen 2009:69–71). Mesolithic people also frequented the interior lowland and the mountainous regions, and sites placed along rivers and former fjords indicate the importance of these waterways as communication routes into these areas, away from the sea (Fuglestvedt 2004; Stene 2010; Chapter 11 [Mjærum/Mansrud]). However, their significance and use are not fully agreed upon. While some researchers argue that inland areas and mountains were used seasonally by people who lived by the coast most of the year (Lindblom 1984; Mikkelsen 1989; Bang-Andersen 1996; Glørstad 2010; Mjærum 2016), others see disparities in the archaeological material as evidence for different social groups inhabiting the coastal zone and the interior, respectively (Boaz 1999; Fuglestvedt 2004; Damlien 2016:405–412; Damlien/Solheim 2018). The use of the land that connects coast and interior, the coastal hinterland, is hardly discussed, also due to the apparently strong shore boundedness of Mesolithic sites.

According to evidence that suggests short occupations, the people who first visited southeastern Norway, around 9400–9300 cal BC, were highly mobile sea mammal and elk hunters, for which the boat was a vital means of transport and an essential part of their identity (Bjerck 1994; Fuglestvedt 2009; Glørstad 2013; Breivik 2014; Berg-Hansen 2017). From the Middle Mesolithic (c. 8200 cal BC) and into the Late Mesolithic period (c. 6300 cal BC), structures such as hearths, floors of sunken huts and tent rings indicate a less mobile way of life (Glørstad 2010:103–160; Solheim & Olsen 2013; Fretheim 2017). The composition of the find material suggests different functions of and activities at the sites, reflecting visits of different lengths (Solheim 2013; Mansrud/Eymundsson 2016). Late Mesolithic sites with large find inventories and many structures are interpreted as important anchor points for relatively stable groups, with a semi-sedentary lifestyle and an economy driven by coastal resources, which gave structure to people's lives and caused these groups to return repeatedly to the same coastal areas and sites (Glørstad 2010:64–71).

'First visit' or 'revisit': motivations of mobility

Archaeological sites are traces of dynamic interactions over time, and of people moving in different situations, with different motivations and at different speeds. Thus, sites, represented by archaeological finds and their spatial placement, not only have economic functions and meanings, but they also witness one or several stays at a place at a certain time, with a temporal depth and with overlapping meanings (David et al. 2014). On the basis of T. Ingold's (1993) work on the temporality of tasks and their relatedness to certain social contexts and places (the 'taskscape'), and on A. Gell's (1992) study on time, C. Conneller (2006) has pointed out that the *chaîne opératoire* of tasks and activities has different temporal dimensions: Linear sequences through time, in the sense of past–present–future, on the one hand, and circular, e.g. seasonally conditioned, actions on the other. Both of these are intertwined: 'The multiple connections between different technologies and different places in the landscape, some fleeting, others more permanent, structured the temporalities which functioned to produce places' (Conneller 2006:46).

Social mechanisms – following linear and/or circular conceptions of time – of establishing, maintaining and abandoning places, lie behind the find distribution patterns of sites. Unravelling such mechanisms entails questioning what the people who frequented, stayed and moved in the area might have known about the time depth and past dimensions of their surroundings, and how they reacted to them. To study these questions, I would like to introduce the conceptual pair of 'first visit' and 'revisit', which can serve as an analytical tool to illustrate different motivations for using or choosing certain places for shorter or longer stays.

The term 'first visit' denotes a 'pioneer' perspective, implying that people, alone or in groups, were moving in unfamiliar areas, and were in search of sites which fulfilled certain requirements, in the sense of the right type of place. This can apply not only to colonizing a hitherto unsettled area, but also more generally to a specific group or person for which an area was unknown, even though it was used by others before (Meltzer 2003; Littleton 2007). The important point is that these areas were not specifically part of these people's history (Fuglestvedt 2009:266–269).

A 'revisit', on the other hand, denotes a situation in which people had an idea of or knowledge about an area or a place, its topographic characteristics and earlier events that happened there (Kelly 2003; Nyland 2016:310–312). Revisiting implies a targeted *return*.

The motivations for people's movement are connected to the traditions of a group, among them the social and cosmological attachment to surroundings, and the method of organizing space (Grøn/Kuznetsov 2003). People carry ideas of the right places and landscapes with them, expressed by both physical conditions as well as social action and reaction (Gosden 1994:80–81). This pertains to being at home in a specific territory, or being on the search for suitable new places.

The above lifts the understanding of archaeological data from the frame of absolute chronology and general overviews to the level or perspective of the experiencing human being – the individual – and contrasts both. Even though the temporal resolution of the archaeological data can hardly grasp this individual level of experience, the consideration of possible motivations behind the placement of sites, in this case, is necessary for a better understanding of Mesolithic people.

Untangling different situations of long-term use and reuse of coastal areas in southeastern Norway

Examples of well-excavated minor areas or locations from different parts of Mesolithic coastal southeastern Norway allow the identification of the different situations of diachronic spatiotemporal use of the coastal zone. Most of them are published, others treated in reports (see Tables 15.1–15.4).

Shore-based sites in areas with land upheaval

In areas with distinct shoreline displacement, as in the inner Oslo fjord, Mesolithic people's inclination to occupy locations directly on the contemporary shoreline can be observed in the diachronic distribution of sites. Seen in a long-term perspective, the shore-based sites 'follow' the retreating shorelines, with the result that the older sites are located further in and higher up in the terrain than the younger sites. This can be seen from both artefact typology and technology, and radiocarbon dates. This is well documented in some minor areas with many excavated sites, as on the island of Svinesund, Østfold (Glørstad 2010:fig. 9.9) or in the areas of Langgangen Vestgård and Gunnarsrød, Telemark (Melvold & Persson 2014; Reitan & Persson 2014). The reconstruction of Mesolithic site locations by modelling the contemporary sea level according to shoreline displacement curves shows that people preferred to occupy shore-based terraces in these areas, which were easily accessible by boat, placed some metres from the shoreline and slightly elevated (not more than a few metres) above sea level.

The area of Vinterbro, Akershus, in the inner Oslo fjord, for example, underwent dramatic postglacial shoreline displacement (compare Figure 15.1). The excavated Mesolithic sites cover a time span of four millennia, and illustrate that people preferably occupied shore-based places, following the retreating seashore (Figure 15.2 and Table 15.1). In this area, due to a relatively deep seabed lined by steep slopes, the rapidly falling sea level only gradually changed the size of the coastal zone and islands during the Middle Mesolithic period (Figure 15.2). A strait with a productive ecosystem developed (Jaksland 2001:15), and initially in the Late Mesolithic period the rapid emergence of a flat seabed changed the character of the landscape significantly. The earlier sound, as an important communication road and marine habitat, was closed and turned into a shallow wetland.

The Vinterbro example illustrates that the extent of topographic change as a result of land upheaval is dependent on a combination of factors, including the velocity of land upheaval and surface morphology above sea level, as much as that of the emerging seabed. Due to locally different surface morphologies and speeds of land uplift, topographic changes were perceivable within a lifetime in certain places, and at times where and when this combination occurred resulted in obvious changes: for example, when a flat seabed began to dry out in an area with rather fast land upheaval.

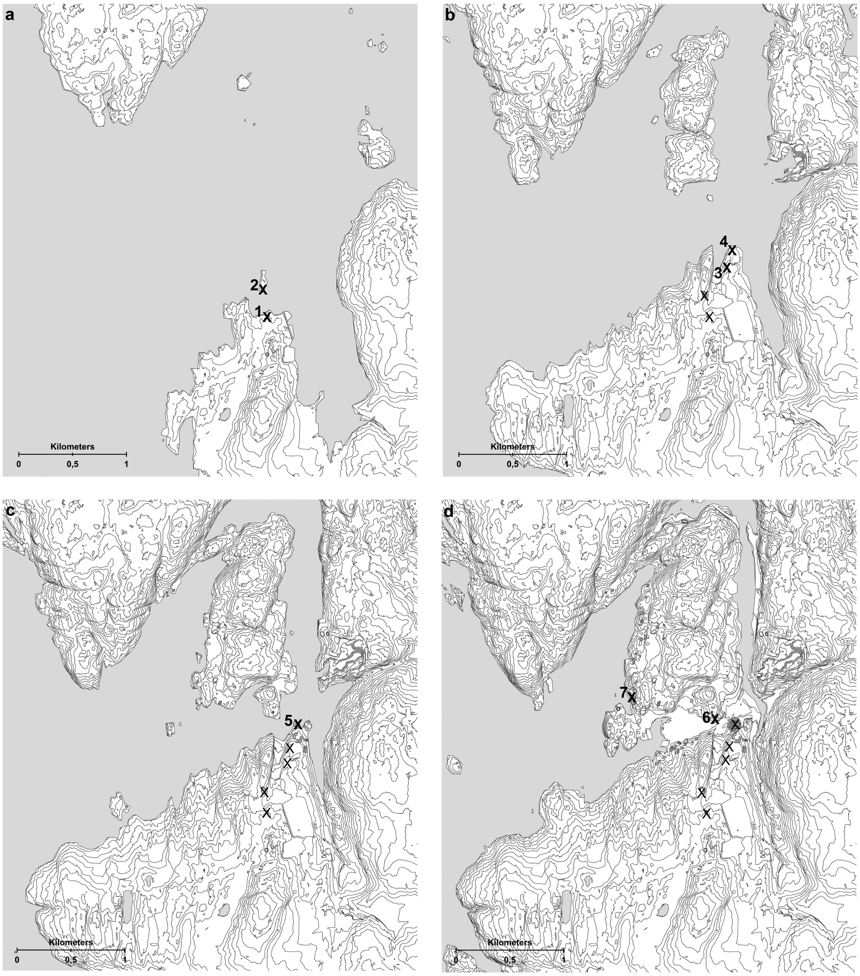


Figure 15.2 Vinterbro area, Akershus: Excavated sites (X) substantiate that Mesolithic people in this area preferred to occupy locations on shore-based terraces. The diachronic picture suggests that the sites "followed" the coast (compare Table 15.1.1–7). a) Shoreline modelled to 120 m a.s.l., c. 8200 cal BC. b) Shoreline modelled to 90 m a.s.l., c. 7600 cal BC. c) Shoreline modelled to 70 m a.s.l., c. 6400 cal BC, d) Shoreline modelled to 50 m a.s.l., c. 5100 cal BC. No. 6 dates to around c. 5500 cal BC and was shore-bound at its time of use with a sea level at 57 m a.s.l. (Eymundsson 2012). The grey circle marks a later revisit of the then inland site (see discussion below, Table 15.1 No. 5 and Table 15.4 No. 8). Illustration: A. Schülke based on Sørensen's (1979) shoreline displacement curve and digital elevation model (G. Steinskog, MCH, UiO).

Table 15.1 Excavated coastal sites around Vinterbro, Akershus

	Topography	*Height m a.s.l.*	*Distance to contemporary coast in metres*	*Number artefacts*	*Museum number*	*Dating*	*Site use*	*References*
				Middle Mesolithic				
1 Vinterbro næringspark lok. 2	Terrace, sloping towards north	124	10–20	121	C60376	Typology/ technology; sea-level curve: c. 8100 BC	–	Mjærum (2018)
2 Vinterbro næringspark lok. 1	Southern tip of a little island	120-118	10–20	4245	C60375	Typology/ technology; sea-level curve: c. 8000 BC	–	Mjærum (2018)
3 Vinterbro lok. 12	Terrace	100	10–20	1053	C51440	Typology/ technology; sea-level curve: c. 8700/8600 BP	One visit	Jaksland (2001:45–70)
4 Vinterbro lok. 9	Terrace, with steep slope to the north	90-92	10	879	C51438	Typology/ technology; sea-level curve: c. 8500 BP	One visit	Jaksland (2001:71–85)

					Late Mesolithic				
5	Vinterbro lok. 3	Terrace, with small rocky outcrops and a steep slope to the north	75-73	10–20	6744	C51436	Typology/technology; sea-level curve: ca. 7500 BP; one later radiocarbon date (see Table 15.4.8)	One/several visits	Jaksland (2001:86–104)
6	Vinterbrokrysset	Terrace, sloping towards southwest	63	10–20	3289	C57934	Typology/technology, sea-level curve; one radiocarbon date, ca. 5500 cal BC	Different activities	Eymundsson (2012)
7	Nøstvet 1	Terrace, sloping steep towards southwest	50–60	10–20	11 716	See Jaksland (2005:App. 1–7)	Typology/technology, sea-level curve, one radiocarbon date; 6500–6100 BP	Many visits	Jaksland (2005); Brøgger (1905)

Shore-based sites and sites located further from the sea in areas with little land upheaval

In areas with comparably little shoreline displacement, as on the southern – Skagerrak – coast of Norway, Middle and Late Mesolithic sites are distributed in clusters along the coast, such as the sites on the northern side of the shallow Farsund Bay, Island of Lista (Ballin/Jensen 1995). Four Middle Mesolithic and three Late Mesolithic sites lie adjacent to each other on the same types of protrusions at around 8 m a.s.l. (Figure 15.3 and Table 15.2).

The sea-level curve indicates that the Tapes transgression started at around 8600 cal BP – in the first part of the Middle Mesolithic period, when the sea level, originally lower than today's, began to rise. The transgression reached a maximum of 5 m a.s.l. at around 7000 cal BP in the Late Mesolithic (between c. 7500 and 5500 cal BP), in a period with a relatively constant sea level of little under 5 m (Romundset et al. 2015; see also Prøsch-Danielsen 2006; Ryen et al 2009).

The Middle Mesolithic sites were placed more inland from the contemporary shoreline, as the lower sea level in this period suggests (Ballin/Jensen 1995:34–35, 118): Three sites were located between 20 and 40 m away from

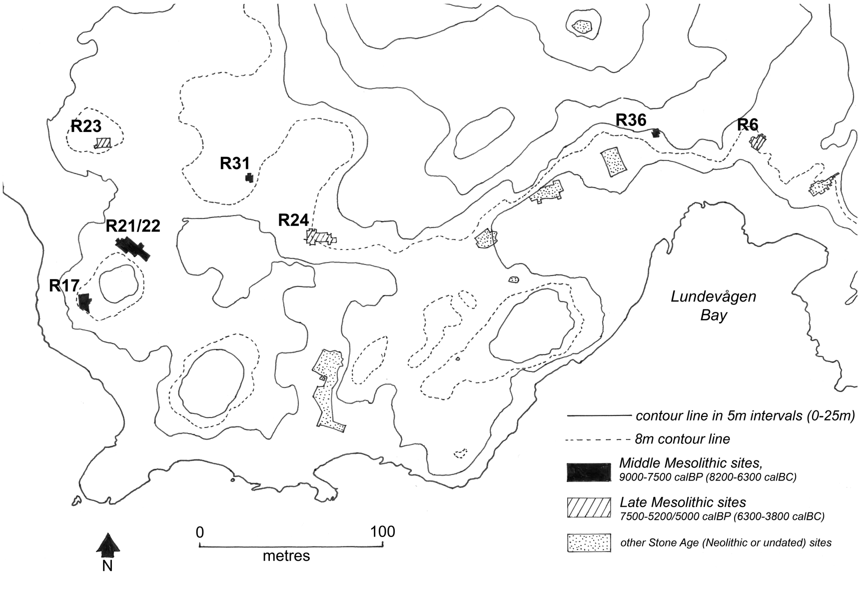


Figure 15.3 Stone Age sites excavated along the northern side of the Lundevågen Bay, which is a part of the Farsund Bay, Lista, Vest-Agder. Middle and Late Mesolithic sites are marked (see legend). Throughout the Late Mesolithic period, the sea level was just under 5 m asl., with a marine maximum of 5 m asl. around 7000 cal BP (Romundset et al. 2015; see also Figure 15.1). Elevation lines at 5-metre intervals. Illustration: A. Schülke, modified after Ballin/Jensen (1995, fig. 2).

Table 15.2 Excavated sites for north of the Farsund bay, Lista, Vest-Agder, which can be chronologically classified

	Topography	*Today's height m a.s.l.*	*Distance to contemporary coast in metres (according to Høeg 1995)*	*Number artefacts*	*Museum number*	*Dating*	*Site use*	*References*
Middle Mesolithic								
Lundevågen R17	Terrace	7–9	20–25	6080	C38017	Typology/technology, one Middle Mesolithic radiocarbon date	Various activities, several short visits	Ballin/Jensen (1995:36–65)
Lundevågen R21/22	Plane, dropping towards northeast, a rocky outcrop to the south	7.5–8	40	87 326	C38021	Typology/technology	Various activities, many visits	Ballin/Jensen (1995:66–89)
Lundevågen R31	Terrace	9	100	2765	C38029	Typology/technology	Different activities, two short visits	Ballin/Jensen (1995:90–103)
Lundevågen R36	Terrace, steep slope to the north	9.5–12	30	853	C38034	Typology/technology	Short visit	Ballin/Jensen 1995:104–118)

(*Continued*)

Table 15.2 Continued

	Topography	*Today's height m a.s.l.*	*Distance to contemporary coast in metres (according to Høeg 1995)*	*Number artefacts*	*Museum number*	*Dating*	*Site use*	*References*
				Late Mesolithic				
Lundevågen R23	South side of a marked rocky outcrop	7–9	10	11 491	C38022	Typology/ technology, two radiocarbon dates	Short visit	Ballin/Jensen (1995:119–131)
Lundevågen R24	Southwestern side of a marked hill	8–9	10	22 7761 (includes neolithic material)	C38023	Typology/ technology, one Late Mesolithic radiocarbon date	Many short visits	Ballin/Jensen (1995:132–150)
Lundevågen R6	Terrace	7.5	<10	104 063 (includes neolithic material)	C38009	Typology/ technology	Many shorter visits	Ballin/Jensen (1995:151–160)

the contemporary shoreline, and another c. 100 m away behind a small hill (Table 15.2; Figure 15.3). In contrast, with a sea level of around 5 m a.s.l., three Late Mesolithic sites were located closer to the shoreline, at distances of 10 and 20 m, on elevations ca. 3 m above sea level, protected from the waves (Table 15.2). This might indicate different patterns of site placement in the coastal zone in the two periods. However, possible shore-based Middle Mesolithic sites might be submerged today due to transgression (Høeg 1995), and therefore not visible. The Farsund case, however, substantiates site placement that is further back from the shoreline. That the coastal hinterland was frequented at the time is affirmed by targeted surveys in the coastal hinterland of Lista. Targeted surveys up to 1 km from the shore have yielded traces of many Stone Age hinterland sites, at least one of them dating to the Mesolithic period (Berg-Hansen 2009; ibid. nr. 27).

The long-term use and reuse of the same coastal places

A number of larger shore-based sites in southeastern Norway are interpreted as more stable settlements, or base camps. In comparison to smaller sites, they often exhibit special features such as a high number of artefacts, many structures (hearths, pits, pit houses) and, in one case, an inhumation (Table 15.3). On the basis of the find material alone, it is, however, difficult to assess whether the sites represent many short visits or more extensive stays (Jaksland 2001:116–120; Glørstad 2010; Solheim 2013). A number of sites have yielded sequences of radiocarbon dates that support the hypothesis of their use throughout centuries (Table 15.3). However, it is unclear if the sites were used repeatedly or continuously. Firstly, the series of radiocarbon dates need not represent the entire time span of the actual occupation of the site. And secondly, overlapping ranges of dates for calibrated radiocarbon dates do not guarantee that the real events which they represent were overlapping in time (Table 15.3, no. 1, no. 4) (Solheim 2013). In other cases, the calibrated radiocarbon date ranges exhibit lacunae (Table 15.3, no. 3, no. 5), which might bear witness to longer periods of abandonment of these sites.

Here, two aspects are important:

Firstly, the comparison of the absolute time spans of use of these sites shows that the phenomenon of continuously or repeatedly visited places variably spans different archaeological periods (Table 15.3). Some date solely to the Middle Mesolithic period (no. 1, no. 2), some to the Late Mesolithic period (no. 3, no. 4) and one over both of these periods (no. 5).

Secondly, the topographic changes of these sites' location within their time span of use can contribute to a discussion on the motivation for the abandonment of the respective places. For this purpose, the earliest and latest radiocarbon dates of the respective site – as terminal points of its use – are combined with the valid shoreline displacement curve and the local

Table 15.3 Examples of larger coastal sites with radiocarbon dates that indicate continuous or repeated use over longer time periods. For a complete overview of the radiocarbon dates see references

	Site (municipality, county)	*Number of artefacts*	*Number of hearths*	*Number of pit houses/huts*	*Today's height in m a.s.l.*	*Topography at earliest time of use*	*Number of Mesolithic radiocarbon dates*	*Number of lacunae with non-overlapping Mesolithic radiocarbon dates*	*Oldest ^{14}C-date*	*Youngest ^{14}C-date*	*Topography at the latest time of use*	*Reference*
1	Hovland 3 (Larvik, Vestfold)	21 381	3	1	58	At the southern tip of a rocky peninsula, on the northern shore of a shallow sound in a sheltered pocket – an island to the south	18	0	8609 ± 54 BP (Ua-45507), 7676–7579 cal BC	8291 ± 48 BP (Ua-45518) 7459–7200 cal BC	Drying out of the sound, emergence of land bridge between peninsula and island to the south	Solheim/Olsen (2013)
2	Langangen Vestgård (Porsgrunn, Telemark)	15 515	4	–	47–49	Small, elongated valley connecting a peninsula with the mainland, with direct access to the sea in the north and in the south	13	0	8030 ± 55 BP (TRa-4117), 7130–6702 cal BC	7740 ± 45 BP (TRa-4115), 6645–6476 cal BC	Small, elongated valley connecting a peninsula with the mainland, direct access to the sea in the north and in the south	Melvold/Eigeland (2014)
3	Brunstad lok. 24 and lok. 25 (Stokke, Vestfold)	c. 16 000	41	–	51–54	Northeastern side of an island (c. 1 km long), at the shore of a shallow bay	15	1	7439 ± 39 BP (UBA-28736), 6398–6233 cal BC (95%)	6850 ± 35 BP (Ua-48381), 5833–5661 cal BC (95%)	In the northeastern part of an island (c. 2 km long), approximately some hundred metres from the shore	Schülke et al. (2019); Schülke/Hegdal (2015)

4	Torpum 9b (Halden, Østfold)	38 539	7	3	48–50	On the western side of an island, at the shore of a little bay at a little fjord	13	0/1	6530 ± 70 BP (TUa-3279), 5520–5345 cal BC	6205 ± 85 BP (TUa-3920), 5525–5065 cal BC/5270 ± 45 BP (TUa-3921), 4220–3995 cal BC	At the shore on the west side of an island, at a little bay	Tørhaug (2003); Glørstad (2010:106–110)
5	Dybdalshei II, lok. 1 (Arendal, Aust-Agder)	52 (soil removed by excavator)	9	–	26–30	Depression on southern sheltered side of a marked rocky offset on a peninsula on an inner skerry island	8	3	8566 ± 36 BP (Ua-53022), 7610–7530 cal BC (95.4%)	5262 ± 31 BP (Ua-53024), 4180–3980 cal BC (82.1%)	Depression on southern sheltered side of a marked rocky offset on a peninsula on an inner skerry island	Granum/Schülke (2018); see also Figure 15.5

elevation model to assess possible changes to the shoreline in the respective time span. This exercise led to the following results:

- In the Bommestad area, the hut site Hovland 3 (Table 15.3, no. 1), used between c. 7620 and 7440 cal BC, and two smaller contemporary sites (Hovland 1 and Torstvet) were placed on terraces at the shoreline of a sound (Olsen 2013; Solheim/Olsen 2013). This sound separated the southern tip of a larger peninsula and an island to the south (Figure 15.4). A reconstruction of the local sea-level change shows that the sound must have dried out rather quickly, some time between 7500 and 7200 cal BC. Between peninsula and island, a land bridge emerged that obstructed direct access to the sites by boat (Figure 15.4). Hovland 1 and Hovland 3 were abandoned between c. 7500 and 7450 (Solheim/Olsen 2013:fig.15.37), at a time when the drying up of the sound was in progress.
- The settlement area at Brunstad (Table 15.3, no. 3) was visited between c. 6400 and 5700 cal BC, when it was placed some metres from the shore of a shallow bay. It was abandoned at a time when the seabed started drying out, leading to the shore retreating by several hundred metres and enlarging the island.
- The site of Torpum 9b, used between 5500 and 5200 cal BC (Table 15.3, no. 4 with one later use around 4200 cal BC), was placed on the shore

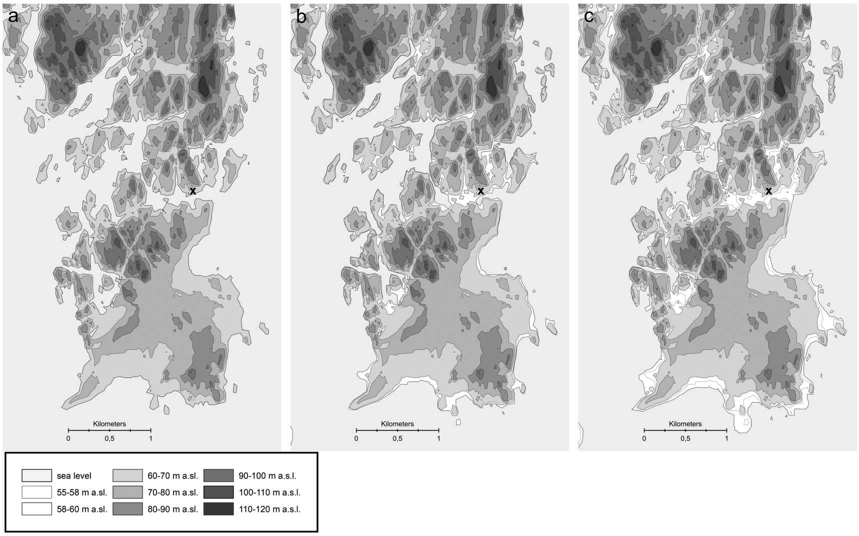
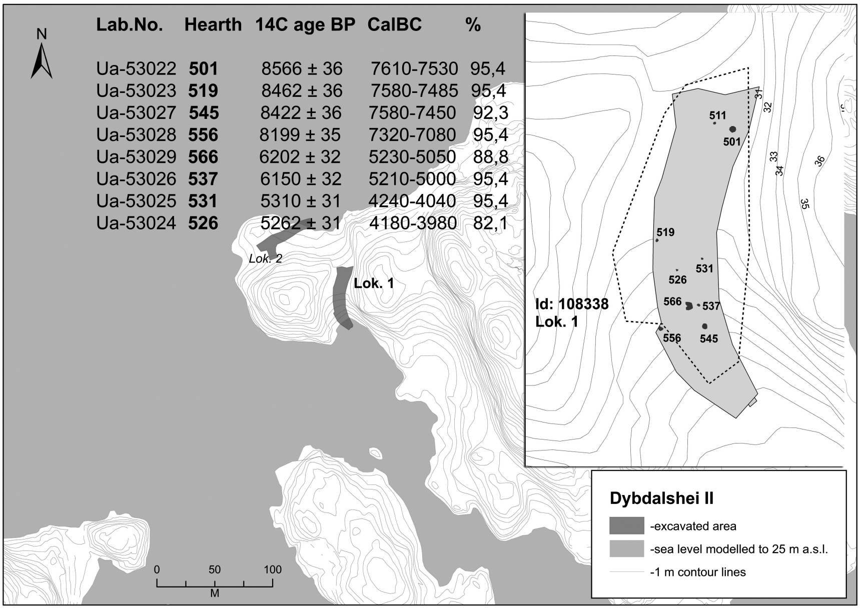


Figure 15.4 Model of the stages of land uplift around the Hovland 3 site (marked with X). (a) Sea level at 60 m a.s.l. (c. 7500 cal BC), (b) sea level at 58 m a.s.l. (7400 cal BC), (c) sea level at 55 m a.s.l. (c. 7200 cal BC). Modelled on the basis of the shore displacement curve (Sørensen et al. 2014) and a digital elevation model by G. Steinskog (MCH, UiO). Illustration: A. Schülke.

of a small bay on the west side of an island, only some metres to the east of the structures at site Torpum 9a, which are c. 300–400 years older (Rønne 2003). The spatiotemporal sequence of Torpum 9a and Torpum 9b indicates that shore-based activities were dislocated, following the retreating shoreline (Glørstad 2010:fig. 4.3). However, at the time of Torpum 9b, the older activity area at Torpum 9a, now further from the shoreline, was reused. Torpum 9b was abandoned when the adjacent beach and landing place started to dry out, while the surrounding topography of the island did not change significantly.

- Langangen Vestgård 1 (Table 15.3, no. 2) shows a different situation. The radiocarbon dates substantiate use throughout c. 600 years between c. 7130 and 6476 cal BC. The site's topography, an elongated valley with direct access to the sea to its north and south, and a peninsula connecting the mainland, remained more or less unchanged. According to the radiocarbon dates, the site was abandoned some time *before* the location no longer had direct access to the sea.
- The Dybdalshei II site (Table 15.3, no. 5) was repeatedly used during large parts of the Mesolithic period. Eight radiocarbon-dated hearths indicate *at least* four visits, twice in the Middle Mesolithic period and twice in the Late Mesolithic period (Figure 15.5). The site was located between two steep rocky heights in a depression, on the west side of an



Lab.No.	Hearth	14C age BP	CalBC	%
Ua-53022	**501**	8566 ± 36	7610-7530	95,4
Ua-53023	**519**	8462 ± 36	7580-7485	95,4
Ua-53027	**545**	8422 ± 36	7580-7450	92,3
Ua-53028	**556**	8199 ± 35	7320-7080	95,4
Ua-53029	**566**	6202 ± 32	5230-5050	88,8
Ua-53026	**537**	6150 ± 32	5210-5000	95,4
Ua-53025	**531**	5310 ± 31	4240-4040	95,4
Ua-53024	**526**	5262 ± 31	4180-3980	82,1

Figure 15.5 The site Lok. 1 at Dybdalshei II was used repeatedly according to eight radiocarbon dates from eight hearths. The sea-level is modelled to 25 m a.s.l. (after Romundset 2013). Illustration: A. Schülke, based on maps by M. Samdal, MCH, UiO.

inner skerry island. It kept its topographic character in this period, due to the rather insignificant local shore displacement (Romundset 2018).

The relation between the time span of these sites' use and the local topographic development in these periods shows that most of the sites kept their general topographic character during their time of use. But they also indicate different relations between time of abandonment and the topographic changes in the surroundings.

The reuse of former coastal sites as hinterland sites

Finally, a number of sites dated to the Early or Middle Mesolithic periods based on artefact typology and technology, which were shore-based at these times, have yielded radiocarbon dates that signal use in later phases of the Mesolithic period, at times when, due to land upheaval, the sites' locations would have turned into hinterland sites (Table 15.4; Figure 15.6). These late dates, on charcoal or hazelnut shells from hearths, have hitherto been questioned as indicators of human activity, and instead have been interpreted as indications of natural forest fires. It is argued that the late dates are not supported by the chronology of the artefact material as there are no indications of later artefact types, that they do not support the 'normal' picture of a shore-based site and that the hearth(s) in some cases are spatially related to the earlier find assemblages (Jaksland 2001:103–104; Nyland 2012; Schaller Åhrberg 2012; Jaksland 2014:28–32; Solheim et al. 2017). Nevertheless, radiocarbon dates that support the shore-based location of a site at its time of use are usually not considered as anomalies or traces of natural events, not least because they 'fit' with other evidence, even though they in principle also could represent traces of later events. As a logical consequence, the late dates should at least be considered as possible chronological indications of human activity, under the caveat that they – as with all other radiocarbon dates – might contain sources of error, or be traces of natural fires.

Eight of nine sites exhibit interesting similarities (with the exception of Table 15.4, no. 6):

- The topographic situation of their location changes from being shore bound when initially visited in the Early Mesolithic or Middle Mesolithic periods to being a high-lying site with good views, at the time of the later radiocarbon date(s) in the Middle or Late Mesolithic periods. At the time of the later date(s), these locations are placed between 120 and 4000 m away from the nearest contemporary seashore, on a naturally delimited pocket or plain on top of a rather steep hillside, on or directly beside a spot that either overlooked a valley (Table 15.4, no. 2, 3, 5, 9; Figure 15.6) or a junction of several valleys (Table 15.4, no. 4, 8; Figure 15.2), and

Table 15.4 Former coastal sites that were reused after having become hinterland sites

	Site (municipality, county)	*Today's height in m a.s.l.*	*Dating of earlier visit/s when coastal site*	*Radiocarbon date/s that indicate reuse of site*	*Context of date/s for reuse*	*Approximate height of shoreline (in m a.s.l.) at the time of reuse, based on regional shoreline curve*	*Approximate distance from the shore at time of reuse in metres*	*Topography at time of reuse*	*Reference*
1	Anvik (Larvik, Vestfold)	77–80	Early Mesolithic (technology), shoreline dated to between 8550 and 8250 cal BC	Four dates: (1) 7875 ± 52 BP (Ua-46951) 7030–6930 cal BC (95.4%) (2) 7818 ± 49 BP (Ua-46950) 6820–6500 cal BC (95.4%) (3) 7744 ± 49 BP (Ua-46952) 6650–6470 cal BC (95.4%) (4) 7678 ± 49 BP (Ua-46953) 6610–6430 cal BC (95.4%) → Minimum two visits	Hearth (S10520), oval, 0.78 × 0.9 m, 0.19 m deep, burnt stones	37–39	120	Little plateau on west-oriented steep slope, c. 25–30 m above the shore of a sound	Eymundsson (2014)
2	Pauler 1	127–130	Technology and typology: Early Mesolithic, shoreline dating: 9200–8900 cal BC	7245 ± 45 BP (Tua-7847), 6120–5995 cal BC	Hearth A15: 1 × 0.6 m, burnt stones	38–40	3200	Elongated depression, on a south-oriented steep slope, good views into a valley from the rocky outcrops directly to the south of the site	Schaller Åhrberg (2012)

(*Continued*)

Table 15.4 Continued

	Site (municipality, county)	*Today's height in m a.s.l.*	*Dating of earlier visit/s when coastal site*	*Radiocarbon date/s that indicate reuse of site*	*Context of date/s for reuse*	*Approximate height of shoreline (in m a.s.l.) at the time of reuse, based on regional shoreline curve*	*Approximate distance from the shore at time of reuse in metres*	*Topography at time of reuse*	*Reference*
3	Dørdal (Bamble, Telemark)	100–101	Early Mesolithic (technology), shoreline dated to between 8600 and 8400 cal BC	Two dates from each hearth: A792: (1) 7070 ± 30 BP (Beta-417122) 6010–5895 cal BC (95.4%) (2) 6956 ± 31 BP (Ua-53184) 5970–5740 cal BC (95.4%) A1134: (1) 7120 ± 30 BP (Beta-417123) 6045–5925 cal BC (95.4%) (2) 7050 ± 31 BP (Ua-53183) 6010–5875 cal BC (95.4%)	Two hearths. A792: elongated form, 1.35 × 0.75 m, several layers, minimum 0.5 m deep, top-layer (10–20 cm) with burnt stones and charcoal. A1134: pear-shaped, c. 1.6 m long, several layers, up to 0.5 m deep, top-layer (20–30 cm) with burnt stones, in the middle packing with burnt stones and layers with traces of charcoal	35–37	1500	Offset with very good views into an east–west oriented valley and to the opposing hillsides	Solheim et al. (2017)

4	Pauler 2 (Larvik, Vestfold)	123–124	Early Mesolithic (technology), shoreline dated to 9150–8850 cal BC	Two datings: (1) 6910 ± 40 BP (Beta-234403) 5880–5720 cal BC (2) 6990 ± 40 BP (Beta-234404) 5980–5760 cal BC	Hearth, circular, 1.3 × 1.1 m, only a few centimetres deep, several layers, stone packing with kerbstones	35–40	2000	Hearth placed rather hidden in a little 'pocket', from the rocky outcrop south of the site excellent views into two valleys (with lakes?)	Nyland (2012)
5	Bakke (Larvik, Vestfold)	98–103	Early Mesolithic (technology), shoreline dated to between 8900 and 8550 cal BC	6915 ± 40 BP (Tua-7852) 5770–5700 cal BC	Hearth, oval, 4 × 2 m, minimum 0.5 m deep, several layers, stone packing with kerbstones	35–40	4000	Very good views into a valley to the west and to the opposing hillside	Nyland/ Amundsen (2012)
6	Hegna Vest 1 (Bamble, Telemark)	60–61	Technology and typology: Middle Mesolithic, two radiocarbon dates from hearths: just after c. 8000 cal BC, shoreline-dated to 8000–7800 cal BC	6816 ± 36 BP (Ua-51466) 5750–5640 cal BC	Pit 100079	34–35	700	Col between two heights to the southeast and northwest, slopes towards northeast and southwest	Fossum (2017)
7	Svingen boligfelt/ Sundby Søndre (Vestby, Akershus)	84–87	Technology: Middle Mesolithic, shoreline dated to between 7700 and 7500 cal BC	6336 ± 39 BP (Ua-45463) 5465–5218 cal BC	Hearth (S312), oval, 0.74 × 0.68 m, c. 0.2 m deep, burnt stones	34–37	300	Little plateau on the eastern slope of a north–south going mountain ridge, 30–40 m above a valley with a little fjord arm, excellent views to the west	Eymundsson (2013)

(*Continued*)

Table 15.4 Continued

	Site (municipality, county)	*Today's height in m a.s.l.*	*Dating of earlier visit/s when coastal site*	*Radiocarbon date/s that indicate reuse of site*	*Context of date/s for reuse*	*Approximate height of shoreline (in m a.s.l.) at the time of reuse, based on regional shoreline curve*	*Approximate distance from the shore at time of reuse in metres*	*Topography at time of reuse*	*Reference*
8	Vinterbro 3 (Ås, Akershus)	73–75	Technology and aspects of typology: early Late Mesolithic, around 7500 BP	5905 ± 105 BP (T-13136)	Hearth, centrally placed on the location. Not documented further.	25–28	300	At the northern end of a mountain chain, where a rocky slope drops towards a valley, excellent views to the north. A little saltwater fjord c. 300 m distance to the north, more open sea c. 650 m towards the west	Jaksland (2001:86–104)
9	Gunnarsrød 7 (Porsgrunn, Telemark)	57–59	Technology and typology: Middle Mesolithic: four concentrations of finds interpreted as several visits; shoreline dating: c. 7800–7300 cal BC	5563 ± 30 BP (UBA-19129), 4454-4350 cal BC	Eroded hearth	24–26	300	Small plateaus on a northwest oriented steep slope, overlooking a little valley/ plane to the northwest	Fossum (2014)

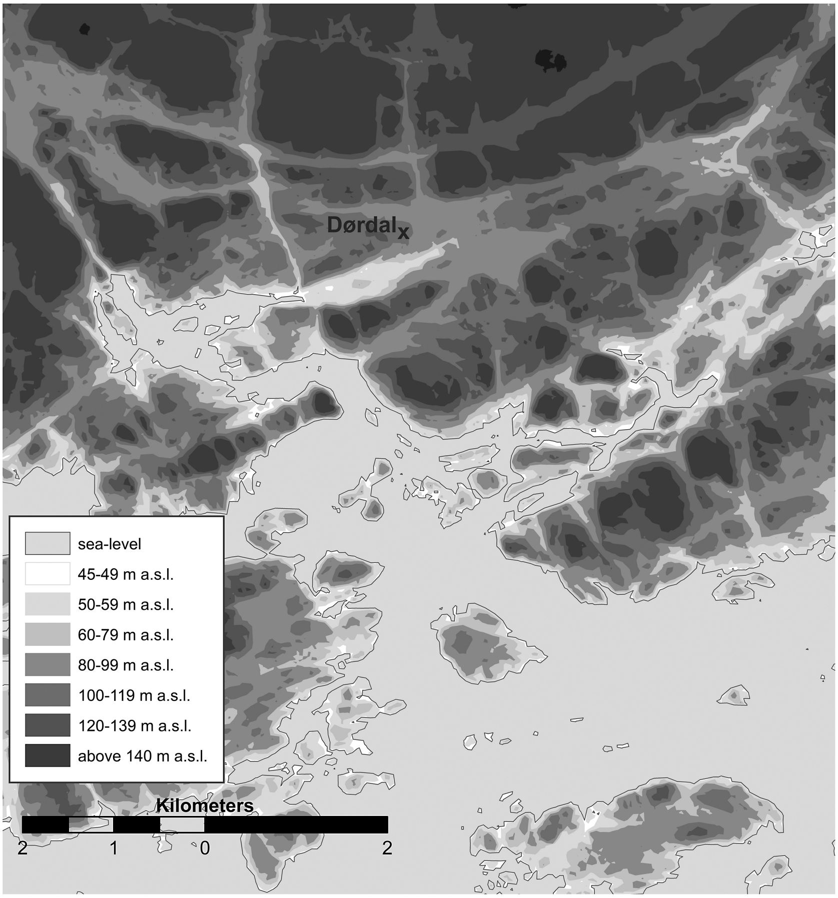


Figure 15.6 Dørdal (Solheim et al. 2017) is one example of a former Early Mesolithic coastal site that most likely was reused in the Late Mesolithic period after having become a hinterland site with very good views, in this case overlooking a several valleys. The shoreline for this Late Mesolithic scenario is modelled to 44 m a.s.l. Illustration: A. Schülke on the basis of Sørensen et al. (2015) and digital elevation model by G. Steinskog (MCH, UiO).

sometimes with a fjord (Table 15.4, no. 1, 7). From one site (Table 15.4, no. 1), a cross-over point between two peninsulas could be observed (Figure 15.6).

- One site is radiocarbon dated to the Late Middle Mesolithic period (Table 15.4, no. 1), all others to the Late Mesolithic (Table 15.4, no. 2–9). Four sites, all located in southern Vestfold/Telemark (Table 15.4, no. 2–5), show signs of reuse in the early Late Mesolithic period, between

c. 6000 and 5700 cal BC, and were then, due to drastic local land upheaval since their first use, placed between 1500 and 4000 m from the nearest seashore.

- In seven cases, the late dates stem from one hearth (Table 15.4, no. 1, 2, 4, 5, 7–9), in one case from two hearths (Table 15.4, no. 2) and in one from a pit (Table 15.4, no. 6). Three Late Mesolithic hearths from the southern Vestfold/Telemark area (Table 15.4, no. 3–5) are relatively big and thoroughly constructed. Two of the more monumental fireplaces (Table 15.4, no. 4, 5) exhibited some even younger dates and suggest use through time. At Dørdal (Table 15.4, no. 3), two big, oval formed hearths have each yielded two dates from overlapping periods in the early Late Mesolithic period.

This similarity in archaeological evidence – charcoal in hearths – and in topographic traits suggests that the late dates might reflect a pattern of – primarily – Late Mesolithic use of the coastal hinterland. These are places that in the Early Mesolithic period when they were first frequented, were often placed directly at narrow sounds at a precipitous underwater cliff, which provided immediate access to deeper waters. In later Mesolithic times, in the course of land upheaval, they were turned into exposed terraces over valleys with steep flanks, which would have provided an overview and shelter at the same time. From such viewpoints, the movement of animals and humans could have been monitored – on land and on water, connected to friendly or unfriendly events. At Svingen (Table 15.4, no. 7), a recent elk track across the site might go back to Mesolithic times (Eymundsson 2013). Fires lighting in the hearths could have been sources of warmth, but they could also, for example, have been used to send light or smoke signals (Selsing 2018). The bigger hearths seem to be constructed for rather big fires, which could imply their more permanent or repeated use. The lack of artefacts relating to the later hinterland use of these sites might be due to activities that did not involve the deposition of artefacts, or to artefacts with rather unspecific chronological traits, which might be 'hidden' in the find material.

Mobility in a changing coastal world: shoreline, coastal hinterland and the use of places

Mesolithic people in southeastern Norway lived in coastal landscapes that underwent different types of environmental changes – with marked long-term shoreline displacement in the inner part of the Oslo fjord, and relatively little shoreline displacement at the Skagerrak coast. Most likely, they would have had a general knowledge about the long-term instability of the shoreline in these different regions (Chapter 14 [Nyland] this volume). Changes in coastal topography occurred at different times in different areas. They were especially perceivable at a local level by people familiar with the respective area, at times when the combination of the velocity of land upheaval and the surface morphology of the emerging seabed would have resulted in a swift topographic change.

The above review of long-term trends of settlement and occupational sites shows, not surprisingly, but hitherto not in focus, that different types of places were used in the coastal zone:

- In areas with continuous land upheaval, as in the inner Oslo fjord area, from a long-term perspective, the archaeological pattern of coastal sites 'following' the retreating shorelines through time can be seen.
- Examples from Lista show that sites were placed further from the shoreline – at least in the Middle Mesolithic period.
- Specific coastal places were used – continuously or repeatedly – over longer periods, throughout hundreds or even thousands of years, in both the Middle and Late Mesolithic periods. Often, but not always, they were abandoned around the time when the adjacent seabed began to dry out.
- A number of earlier coastal sites were visited in later Mesolithic periods, primarily in the Late Mesolithic, after they had become hinterland sites and were placed several hundred metres or several kilometres away from the shore, in many cases at locations with very good views of the surroundings.

With reference to the theoretical starting point, I will, in the following, discuss how these observations can contribute to the understanding of movement, motivations and possible scales of mobility in the Mesolithic coastal zone.

General trends of mobility

Both Middle and Late Mesolithic artefacts and lithic technological traditions suggest that the groups that settled in southeastern Norway shared the same material culture (Glørstad 2010; Damlien 2016). From the Middle Mesolithic onwards, a lifestyle attached to specific areas and places is observed (Damlien 2016), but still with a mobile settlement organization (Mansrud/Eymundsson 2016). The Late Mesolithic period has, as a kind of processual development from earlier phases, been understood as a period with semi-sedentary societies living in more defined territories (Jaksland 2005:110–111; Glørstad 2010:100–102). The quality and character of such a 'semi-sedentariness', with a high degree of recurrent, cyclical movements, including patterns, rhythms and distance of movement of these groups, are, however, only partly understood. While analysis of lithic raw material distribution can give hints on the attachment to certain regions (Eigeland/Fossum 2014), there is a significant lack of representative data on seasonal resources such as large-scale faunal material (age, killing season, seasonal appearance) or macrofossils, which might give representative hints on seasonal exploitation and potential task group mobility (cf. Bergsvik 2001).

For a better understanding of Mesolithic people, besides repetitive seasonal activities, which follow a more circular, recurrent concept of time (the seasonal round), aspects of linear developments and of one-time events and movement – in the sense of history unfolding through time – should be considered. Archaeologists often look at linear development in connection with phases of transition, reflected in changes and discontinuities of material culture – such as the introduction of the micro-blade technology in the Middle Mesolithic period (Damlien 2016) – or material changes between Late Mesolithic subphases (Reitan 2016). However, one-time events, and thus linear development, also apply for the time within one phase. The relocation of a site, even if it might be part of a seasonal pattern of movement, is always also linear human movement, either of whole groups, of task groups, or of individuals. Movements or relocations might have had different social, economic or cosmological causes. They could have led to the periodic desolation of certain areas, for example, due to social preferences or even conflicts – indicating historic and possibly even social and political development, a topic which is rather under-communicated in Mesolithic studies (Conneller 2010). While general trends in numbers of radiocarbon dates point to a rather constant use of the inner Oslo fjord area in this period (Solheim/Persson 2018), there might have been differences in the actual intensity of use of certain areas at certain times.

Cyclical and linear movements: targeted returns or the search for the right place

The Mesolithic sites placed in the coastal zone, especially those that were continuously or repeatedly occupied throughout centuries (see Table 15.3), are the result of diverse intertwined chains of activities, of complex histories of 'first visits' and 'revisits', expressing the relation between specific people and specific places.

This relation starts with people's monitoring of places. When a place was considered adequate for a stay, it was either continuously or repeatedly used over longer periods, the length of the stay possibly anticipated (Mansrud/Eymundsson 2016 with reference to S. Kent). Uniform archaeological material found on – according to the radiocarbon dates – repeatedly used sites could be the output of different human relations to a location:

(a) People could have revisited the site deliberately. This would imply that they were acquainted with the site, which at least one group member had visited before, or that the site as an ancestral place was part of the collective memory of the group, with a narrative about its location being passed on between generations (Pollard 2000; Kelly 2003; Littleton 2007). Such *targeted returns* to earlier used sites would have been part of an overall social and cosmological way of being. People would engage with specific places; their 'economic' aspect represented by the closeness to the seashore and the resources of the coastal zone being part – but not necessarily the most important part – of it (Bergsvik 2009). Remembrance of such places needed to be kept alive constantly, especially at times and in areas with significant topographic changes of shorelines and coastal landscape.

(b) People could have visited a site for the first time, not having been there before and without any experiential or historic connection to it, even if it had been frequented by others who used the same types of artefacts.

> Such a coincidental reoccupation could be due to people following the same idea of the right place, with a similar understanding of what a good place was, than the earlier users had (Littleton 2007), but not as much tied to specific places to which people had an experiential or ancestral relation. Being excellent readers of traces, these people might have recognized remains of old fireplaces, (lithic) artefacts or vegetation that were intentionally or unintentionally altered by humans (Knutsson 2005). Older structures might have served as 'space attractors' (Fretheim et al. 2016). Furthermore, special animals or trees, as spiritual beings, could have (repeatedly) attracted people to stay at these places (Driscoll 2017).

In both cases, people would, in different ways, establish or re-establish a historic relation to the place. A targeted revisiting (a) would express a more reinforcing relation to specific places important for the group, while a coincidental visit ('first visit') of an earlier used site would express the importance of the location and not its earlier use (b).

An important moment in the relation between people and a site is the motivation for its abandonment. The practice of abandonment of the larger sites stretches chronologically throughout the Middle and Late Mesolithic period (Table 15.3), indicating a long-term phenomenon. The repeatedly visited sites are commonly thought to be abandoned at times when the drying out of the adjacent seabed cut off direct access from the site to the sea (see above), not being directly accessible by boat as the most important means of transportation. However, merely from a practical perspective, a well-established site would also be accessible by boat if the landing place were placed a bit apart from the site and reachable on foot. Thus, giving up a site might perhaps also have to do with the general changes in the site's surroundings, concurrent with the drying up of the beach, resulting in new types of vegetation and animals, which would have felt 'wrong', and which would have required new daily routines – beyond the mere economic importance of the coast. Furthermore, as the examples Langangen Vestgård 1 and the lacunae of occupation at Dybdalshei II (Table 15.3, no. 2 and 5) show, also good coastal sites were abandoned. This could have been part of a more circular system of movement between sites, connected to different tasks, but it could also have been related to more linear ways of moving in the coastal zone, including events, which might have made the place uninhabitable. Mansrud and Eymundsson (2016) argue that the deposition of flint flakes in Middle Mesolithic hearths might indicate the abandonment of these places for cosmological reasons, with the flakes signalling to potential later users to avoid this same – dangerous – spot, the abandoned sites being important parts of people's long-term memory of a landscape. Other examples might be places with burials which, as described in ethnological sources, were abandoned and avoided (Knutsson 1995:66), and which in the case study area might be seen at Brunstad (Table 15.3, no. 3; Schülke et al. 2019).

To understand the degree of and motivations for mobility in the Middle and Late Mesolithic period, less on a general level, for example, denoting a 'culture' or 'society' as semi-sedentary, and more on the level of a specific group living together, it is crucial to ask where the group moved to after giving up a site. A discussion of these topics must be linked to a better understanding of these groups' social and economic organization, for example with regard to task group movement or movements of the whole group (Binford 1980), as well as the distances they travelled, and thus the size of the area that they traversed (Kelly 1983). The latter, namely length of distance and thus size of 'territory', and the degree of topographic variability of these environments facilitating or complicating the remembering of places also play an important role (Kelly 2003). The analysis of depositional practices of lithic artefacts with regard to their stage of production will in future help to study such aspects.

Finally, site distribution might also contain lack of revisiting, or failures, in the sense that formerly used sites were not found again – for several reasons. One of them could be a changed coastal environment, with a former coastal location changing its character due to land upheaval.

Stepping beyond: Coastal hinterlands and diverse possibilities of movement

The long-term topographic changes due to land uplift brought about challenges at different times and in different areas, such as the alteration of coastal biotopes, the drying up of good fishing places and the closing of waterways. But the growing landmasses also provided new possibilities – with the emergence of new locations with excellent conditions for fishing (Mjærum in prep.) and hinterland areas with new kinds of resources, allowing for movement of humans and animals, blocking old and opening new waterways. Metaphorically speaking, these processes resembled a symphony of different speeds and expansions – in different areas at different times. With their dichotomous character, these changes were most likely part of people's knowledge and stories.

The use of the direct coastal hinterland is documented in the case studies from Lista and the Oslo fjord region with the reuse of former coastal sites after becoming inland sites. At least for the Skagerrak area, sites might have been placed further from the shore to be protected from wind and heavy storms (see Romundset et al. 2015). All in all, a number of recent finds bear witness to the fact that the forested inland was more frequented in the Mesolithic period than hitherto assumed (Mjærum 2019; Chapter 11 [Mjærum/Mansrud]), not least with activities around inland lakes (Gundersen 2013). At any rate the lighting of fire seems to be graspable at the reused coastal sites. A future review of the archaeological find material on the basis of these new insights might indicate activities conducted contemporaneously with reuse. Activities at these strategically placed locations with good views substantiate that the coastal hinterland, beyond the large river systems, was used and that it was frequented on foot (compare Tables 15.3 and 15.4). Through their excellent views, these hinterland sites encompassed the surrounding landscape, with vegetation and human and animal movement. On the other hand, possible light or smoke signals from these sites would have been visible from afar. Even though a targeted revisiting of ancient coastal places cannot be substantiated, it is very likely that the ancient use of these sites, possibly due to the remains of older hearths, was recognized. At such places, the ancestors' world – in the form of traces of earlier occupations – and the practical benefit of good overview, came together. Here, the depth of time, the historicity and the poetics of the changing coastal world could be experienced.

The coastal hinterland was most likely much more important for the groups frequenting the coastal areas of southeastern Norway than hitherto assumed. Paths and trails that led to activity sites or viewpoints in the wooded hinterland, maybe following animals' tracks, might have led even further, connecting inland activity sites with a mesh of trails (Zedeño/Stoffle 2003; Warren 2005:73–74). Also, the forager perspective, and practices beyond hunting, such as collecting berries, mushrooms, nuts, herbs, insects or wood, needs more attention. Studying the possibilities for using the hinterland might, in future, point to different possibilities and the potential of movement on foot, beyond communication with boats along the rivers. Crossing the woods would allow unseen movement, compared to using a boat along the open coast. The possibility of different types of movement might have had a quality that was important in various situations – not only between humans, but also between humans and animals. Also, intersecting the woods, with their different forms of vegetation, valleys, bogs and rocky and steep terrains, might have required different skills and senses of place and direction than navigating boats (Selsing 2018).

Future studies need to explore the chronologies, activities at and meanings of these hinterland sites in relation to the coastal sites. Pollen analytical studies on lake and bog sediments in the region illustrate how the vegetation in former saltwater beach zones changed after these had been isolated from the sea and became freshwater lakes (Sørensen et al. 2014). The multiproxy record of a sediment core from Lake Skogstjern, Telemark, shows how the marine environment with coniferous trees changed into a coastal hinterland. The changing woodland vegetation through time exposes different signs and times of human use and the manipulation of the forest; to attract game or to promote plants such as hazel as a food resource, as building material or as firewood (Wieckowska-Lüth et al. 2018). This evidence, too, puts the coastal hinterland on the agenda, as a venue for hunter-gatherers who frequented the coast in the region.

Conclusion

The changing coastal environment of the Mesolithic period in southeastern Norway carries with it a social and experiential aspect, which might have been at least as strong as the importance of resources. The regionally different development of the shoreline displacement is special for the area, and integrating locally different speeds and scenarios of environmental changes into the bigger picture is important. Taking together the four situations of reuse of the coastal zone in the study area suggests an intertwining of people, land and sea in different ways. We are now just beginning to understand how Mesolithic people socialized in, and with, their world. One aspect suggested here is that there is a difference between reading traces and landscapes and remembering places. A 'revisit' is a return, and thus implies a different social engagement with a place than identifying – through a 'first visit' – a coincidentally formerly used location as suitable. Untangling the scales and types of mobility of the Mesolithic groups –motivated either by linear or by more repetitive cyclical movements or both, will be an important task, and the topic of coast–inland mobility will be one of them. Understanding the character and temporality of sites will be crucial for future studies on the intertwined rhythms of people's mobility and stays in the Mesolithic coastal zone, which in the end represent the social life of Mesolithic groups.

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16 Ritual depositions in the coastal zone

A case from Syltholm, Denmark

Søren Anker Sørensen

Introduction

Museum Lolland Falster's excavations on the island of Lolland in Denmark, east of Rødbyhavn, in advance of the construction of a fixed link between Denmark and Germany, have yielded numerous Stone Age finds from the now reclaimed part of the former Syltholm fjord. These extend in date across several periods and bear witness to a diversity of activities and events. A total of 21 separate excavations have been undertaken, distributed across the 187 ha of reclaimed fjord area to the east of Rødbyhavn. Some are interpreted as being related to the subsistence economy, others are seen as being contingent on rituals. The results of only one of these excavations will, however, be examined here – Syltholm I. In this chapter, attention will be focused on what is often referred to in the literature as structured depositions of items (Richards & Thomas, 1984) such as bones, pottery and wooden artefacts in what was, in Stone Age times, a shallow shore-near area. These depositions have their closest parallels in the much better illuminated, and much more numerous, bog depositions of the interior (Becker 1948; Koch 1998). They consequently contribute new information on the significance of the coastal zone as a possible ritual deposition area. If a short preliminary account is to be given of the conditions in Syltholm fjord during the period c. 4700–3500 cal BC (all dates are given as cal BC, and in the case of exact dates as cal BC ± 2σ), it can be said that several small sites were situated directly on the coast in the first part of the period, belonging to the Ertebølle period (5400–4000 cal BC), one of which was directly associated with the area rich in finds that is dealt with here. The Ertebølle site itself has only been sporadically investigated, as most of its settlement layer had been washed away and redeposited. The excavation thus concentrated on the area directly offshore from the settlement – an area that, already in the Stone Age when the site was occupied, was covered by water. Diatom analysis has shown that the find area was covered by about 0.5 m of water at the end of the Ertebølle period. At the transition to the Early Neolithic (EN), c. 3950 cal BC, there was a gradual increase in the water level of about 0.5 m, so that at the end of EN (c. 3300 cal BC), the area rich in finds and depositions was covered by 1 m of water. It seems as if the character of the

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site changed in the Early Neolithic, from being both for dumping waste and depositions of ritual character, to only containing ritual depositions. Probably at the same time as the settlement moved to the north of the excavated area, where trial excavations have demonstrated the presence of several localities yielding Early Neolithic finds.

The now reclaimed fjord that we have chosen to call Syltholm fjord (Figure 16.1) was formed around 5000 cal BC. In the lower layers of the Holocene sediments, at a level dated to c. 5400 cal BC, waterlogging can be detected, which was caused by the rising sea level in the Baltic Sea. A relatively short time after the onset of this waterlogging, there are indications in the layer that there was open water in the lowest parts of the area. As the sea level rose, the fjord progressively grew in extent. This shows that we are dealing with a very dynamic coastal environment. Therefore, before the excavation, major emphasis was placed on the production of a topographic model for the development of the landscape, such that the archaeological finds could, period by period, be linked to a well-defined landscape type (Figure 16.2). Out towards the Baltic Sea were a number of small islands and sand banks, which protected the coast of the fjord from the heavy surf that would otherwise have disturbed and destroyed the areas containing the archaeological remains.

Even though organic preservation is excellent in the Syltholm fjord, a challenge with regard to the finds circumstances is that the sedimentation rate during the period from which most of the finds originate was very modest. Thus, finds from a relatively long time span were found within the same finds horizon. As a consequence, it has rarely been possible to distinguish finds from different periods stratigraphically in the most finds-rich areas. In partial mitigation of this lack of stratigraphic resolution of the find horizons, a large number of radiocarbon dates have been obtained. There are, in total, about 500 dates from all of the excavations in the fjord, of which approximately 300 were obtained for single artefacts – and more are forthcoming. In this chapter, I will concentrate on the finds and activities that can be assigned to the period c. 4700–3500 cal BC at the Mesolithic–Neolithic transition, and which are believed to be of relevance for a ritual interpretation.

Ritual depositions versus dump zones

Use of the term 'ritual deposition' might imply an interpretation of the archaeological evidence in a particular religious direction. To avoid such an interpretation as a starting point when confronted with some kind of pattern or structure in the archaeological material, some archaeologists have suggested the use of the more neutral term 'structured depositions' in reference to such types of find, thereby opening up the possibility for other interpretations than those solely of a ritual nature (Richards & Thomas 1984). Structured depositions are defined by the fact that they deviate from what could be considered a random distribution of finds. It should be mentioned here that the term structured deposition was predominantly used in connection with analyses of

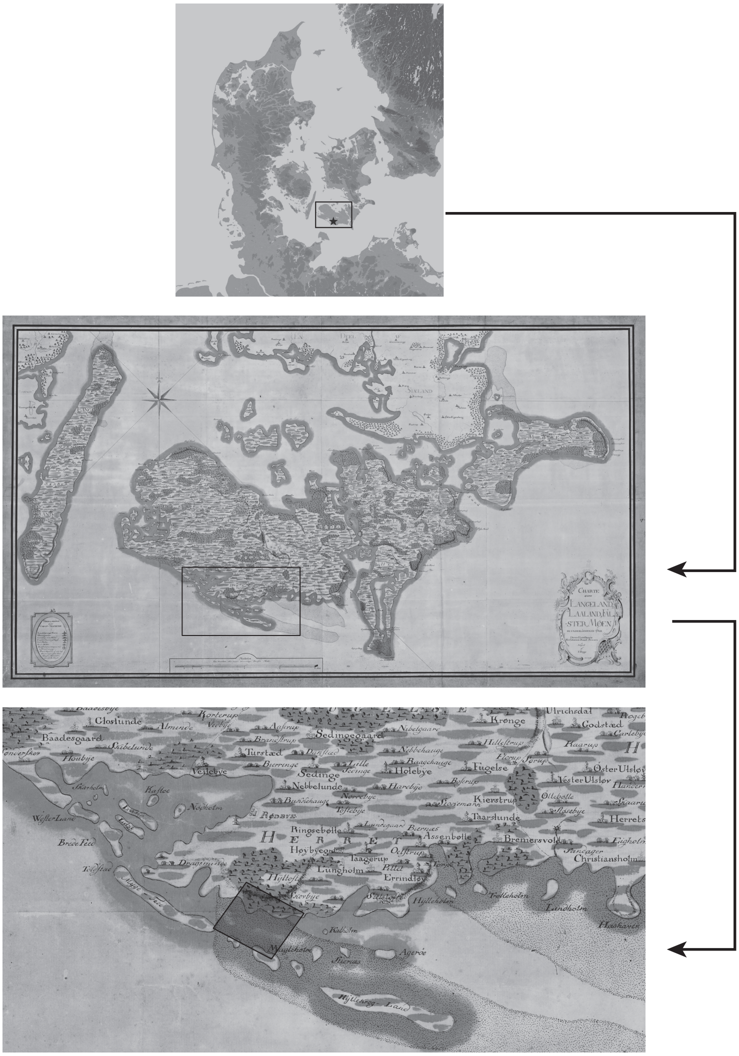


Figure 16.1 The island of Lolland in Denmark, Syltholm is marked with a rectangle (top). Bugges map from 1770 shows the south coast of the island of Lolland (middle). The excavation at Syltholm is located within the rectangle marked on the map (bottom). The area, which was a shallow fjord until the 19th century, was reclaimed in the late 19th century. Section of Bugges map over Lolland and Falster 1770: '*Charte over Langeland, Laalland, Falster, Møen og underliggende Øer. Hr. Geheime-Raad Schack tilegnet*'. *Source*: The Royal Danish Library. Reprinted with permission.

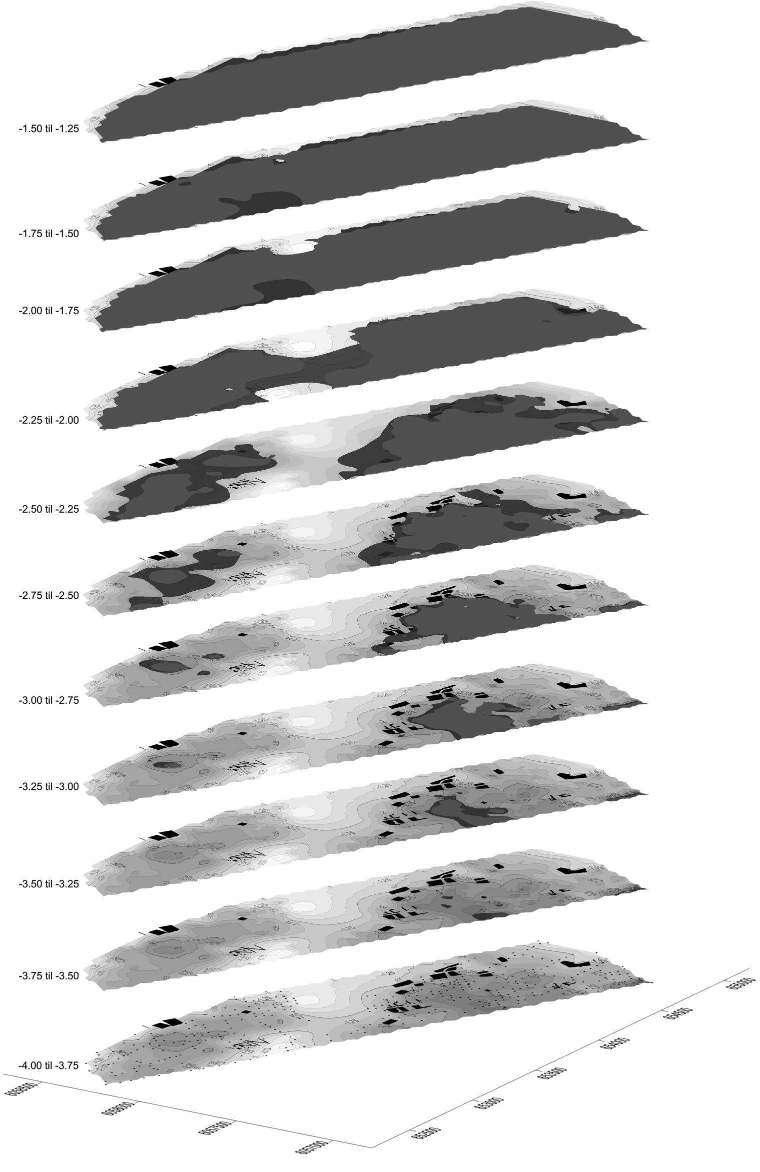


Figure 16.2 The topographic development of the Syltholm fjord at the time from c. 4750 to c. 3600 cal BC. The black squares to be seen at the lowermost level show the excavated areas. The lighter gray shades indicate the local topography, while the dark gray areas indicate the rising sea level. During the period from c. 4750 to c. 3600 cal BC, the sea level rose from approximately 4 m below present sea level to about 1.5 m above present sea level, causing dramatic changes in a landscape as flat as Lolland. Illustration: Catherine Jessen, The National Museum of Denmark.

the contents of pits and ditches, when it was introduced. They thereby differ from the analyses undertaken of the Syltholm material, which was recovered from a deposit traditionally termed a 'dump layer'. A dump layer lacks the delimiting edges of a pit, which conveniently define its context, making it even more difficult to argue the case for an intentional contextual link between the finds that are analyzed. I will return to this aspect later.

The term structured deposition has sometimes turned into an interpretation of its own, and what 'was intentionally intended as a heuristic has sometimes become an end in itself' (Thomas 2012:124). What we have found during the excavation of Syltholm I could be characterized as structured depositions but mixed in with a lot of presumably random deposited material as well. What was needed was to look at every category of find separately to be able to see some patterns and to sort out the structured depositions from the rest of the material. Doing this in an area of about 20–25 m^2 showed distinct concentrations of different find categories and a concretion of spectacular finds as well. This gave rise to the question of whether it was possible to find structured depositions of probable ritual character in an outcast layer, mixed with rubbish and waste?

Find contexts such as those excavated at Syltholm I have traditionally been interpreted as outcast layers or dump zones. This interpretation has its origins way back in the first excavations of Mesolithic settlements in Denmark, when the area directly offshore from settlements was interpreted and defined as a dump zone, composed of accumulated waste and discarded artefacts (Sarauw 1903; Thomsen & Jessen 1906; Broholm 1924). As an explanation for the formation of a 'dump zone', reference was made to the clearing out of the settlement, whereby obstructive, inconvenient and/or malodorous refuse was disposed of by dumping it in shallow water directly offshore. This interpretation has been repeated for more than a century, without significant arguments being presented either for or against it, even in the recent literature (Fischer 2003:29; Andersen 2009:42; Skriver & Borup 2012; Brinch Petersen et al. 2014:36). Historically speaking, this perception of the dump zone resulted in excavations of Mesolithic settlements often focusing on the activity areas on dry land close to the waterlogged zones. This is based on the assumption that here it was possible to find the features and structures that resulted from intentional actions and activities. With a few notable exceptions, waterlogged deposits were therefore given a lower priority with respect to analyses of the spatial distribution of the finds. One of them is the Scanian Ertebølle settlement of Bökeberg III (Karsten 2001), where the 'dump area' was analyzed in exactly the same way as the activity areas on dry land. This indicated that the dump zone also contained evidence of sorting and of structured depositions (Karsten 2001). A second exception is P. Toft's (2009) reappraisal of some of the early excavations of Maglemose settlements undertaken on Zealand, from which it is apparent that tools and bones often comply with a uniform pattern of deposition. Toft (2009:619) concludes: 'If these finds are traces of separate activities it is, however, interesting that Mesolithic people chose the same area for the deposition of socially important artefacts, such as art and pickaxes, burial rituals, and dangerous animals – the predators'.

The traditional interpretation, i.e. 'that dump zones contain refuse', should not necessarily be seen as incorrect, but it is becoming increasingly clear that it is too one-sided to perceive all the finds deposited in shallow water directly offshore from coastal settlements solely as the result of refuse disposal. Intentional and structured depositions, presumably of a ritual nature, also form part of the picture in these so-called dump layers. It is in this respect that the excavation of Syltholm I becomes relevant. Given its finds from both the Ertebølle period and the Early Neolithic, it even seems possible here to demonstrate a continuity of deposition that will be accounted for in more detail below.

The material recovered from Syltholm I raises two central questions: (a) Were ritual depositions integrated into the dump layers of the Ertebølle period? (b) Should the marine coastal area be seen as directly equivalent to inland bogs, rivers and lakes in terms of classical wetland depositions?

Late Mesolithic and Early Neolithic depositions off the coast at Syltholm I

During the excavation of Syltholm I, a total area of c. 5200 m^2 was uncovered, of which half was intensely investigated and the remainder more extensively examined (Figure 16.3a). One of the common features of the excavations along the fjord were poles or stakes thrust vertically or obliquely down into the bed of the fjord. A total of 1806 poles have been investigated from the 21 excavations, of which 433 definitely formed parts of fish weirs, while the function of the remaining 1373 poles could not be determined more closely. From Syltholm I, 242 oblique or vertical poles have been investigated, none of these was obviously associated with a fish weir. These 242 poles were distributed across the entire area, but 54 of them stood very close together within an area measuring c. 4 × 5 m, here referred to as Structure A (Figure 16.3b). This cluster of poles coincided with a concentration of 44 lower jaw bones from a number of animal species, which was unusual compared with the general distribution of bones and other faunal remains recovered from the remainder of the excavated area. That the zooarchaeological analysis of the bone assemblage revealed a large number of lower jaws was not the only remarkable aspect of the faunal assemblage associated with Structure A. The species distribution was also unusual, with dog being the most common, represented by a total of 93 bones (Figure 16.4). Of the 44 lower jaws, 15 have also been radiocarbon dated to either the Ertebølle period or the Early Neolithic (Figure 16.5).

Among the tools found within the confines of Structure A are several that attract particular attention by virtue of their unique character. One of these is a c. 20 cm long piece of wood, decorated with cross-hatched transverse bands. The artefact is unique in Denmark and thus cannot be dated typologically, but a radiocarbon date of 4609–4458 cal BC shows that it originates from the Ertebølle period. Another find of Ertebølle date is a so-called antler shaft,

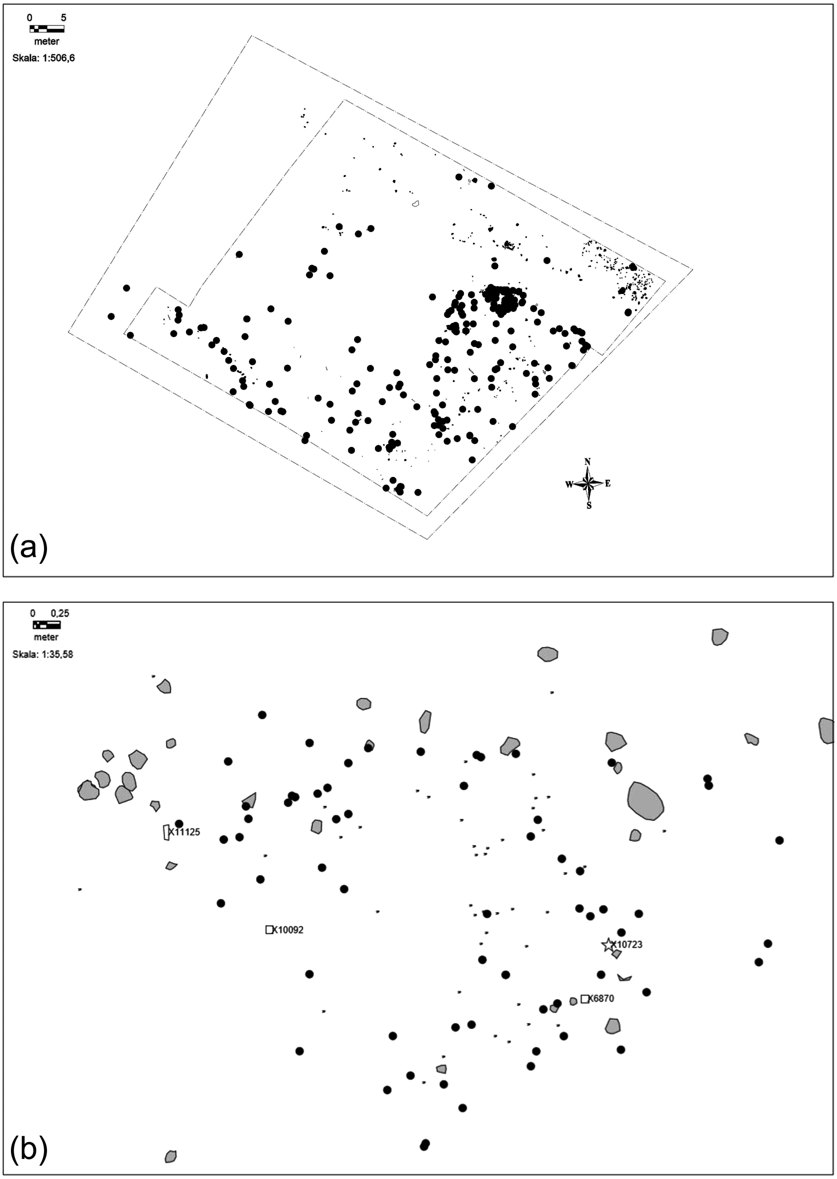
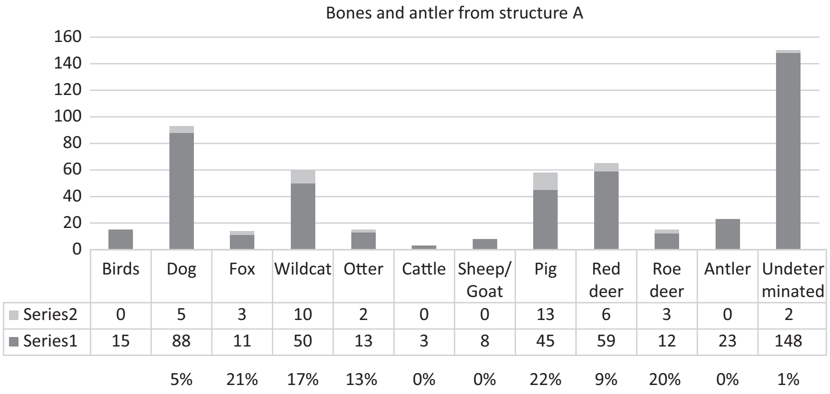


Figure 16.3 a) Syltholm 1. All vertical or oblique poles/stakes are marked with black dots; grey objects are natural stones. Structure A is located in the area with the densest cluster of black dots. b) Structure A (zoom). Legend: black dot = vertical or oblique pole/stake; small grey dot = lower jaw (mandible); square ×10092 = antler axe; square ×6870 = T-antler axe; star ×10723 = antler shaft; rectangle ×11125 = decorated wood; grey figures = stones. *Source*: Søren A. Sørensen.



Serie 1: Number of bone/antler except mandibles, found in structure A

Serie 2: Number of mandibles for each species, found in structure A

Figure 16.4 The distribution of the identified faunal remains from Structure A (the area with the concentration of mandibles). It is noteworthy that dog is the dominant species and wild cat is the third most common species, while traditional meat animals play a lesser role than is normally the case in a dump layer. Serie 1: Number of bones/antlers except mandibles, found in Structure A. Serie 2: Number of mandibles for each species, found in Structure A. *Source*: Søren A. Sørensen.

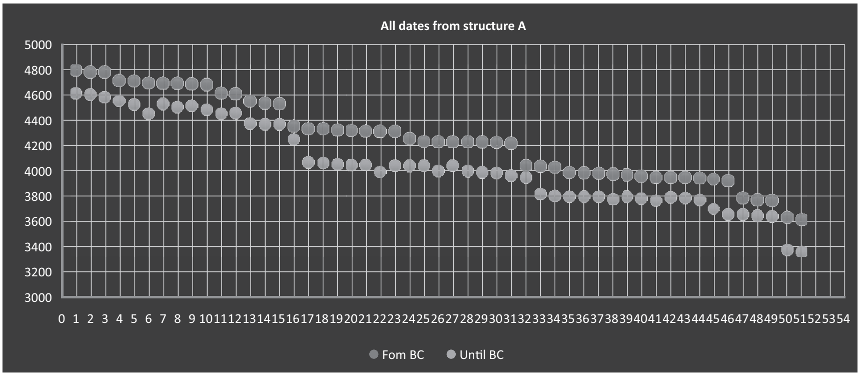


Figure 16.5 All dated items from Structure A. For individual dates see Table 16.1. *Source*: Søren A. Sørensen.

made of red deer antler. This type has also previously been referred to as a kind of pick (Mathiassen 1948:64), but in truth the original function of these characteristic tools is not known. All the tines have been removed and the surface of the shaft has been scraped smooth and polished, apart from a small section around the base of the antler. In three places, superficial ornamentation consisting of simple cross-hatching has been inscribed, and a hole has been drilled through which presumably served as a shaft hole. The piece has been radiocarbon dated to 4794–4615 cal BC. A third find from Structure A that has an absolute date in the Ertebølle period is a T-shaped antler axe. This type is a common find from the Ertebølle period in northern Germany, on Jutland and on Funen, but not to the east of the Great Belt (Petersen 1984). The axe recovered from Syltholm I is actually only the third T-axe ever recorded from the eastern Danish islands (Zealand, Lolland, Falster and Møn). What makes the axe from Syltholm I even more remarkable is the presence of a remnant of the wooden shaft preserved in the shaft hole.

In addition to these more spectacular objects, there are also some more anonymous artefacts from Structure A that have turned out to derive from the Ertebølle period. As of yet, 23 of the 54 vertical and oblique poles/stakes associated with Structure A have been radiocarbon dated, giving dates between c. 4700 and 3600 cal BC. Given these dates, the poles/stakes were not restricted to the Ertebølle period but continued into the Early Neolithic, as did the spectacular finds. Like in the form of yet another antler axe which, like the Ertebølle T-axe, still had part of its wooden shaft preserved in the shaft hole. There were also three axe shaft fragments, of the type with a knob-like expansion of the lower part of the shaft, a type that is normally assigned to the Early Neolithic (Glob 1952). This latter date was confirmed for two of the shafts from Structure A by radiocarbon dates (Figure 16.5: 45 and 49). The lower jaw bones that are so characteristic of Structure A also continue into the Early Neolithic (Figure 16.5 and Table 16.1).

An overview of the so far obtained dates from Structure A is given in Figure 16.5. This clearly indicates that depositions took place continuously over a period beginning in the middle of the Ertebølle period and terminating around the end of EN I (c. 4700–3500 cal BC).

In addition to the dated finds from Structure A, other items have been found that deserve to be mentioned, for example 18 fruiting bodies of tinder fungi (*Fomes formentarius*). These also mark out Structure A as special, because only two other fruiting bodies of tinder fungi were found in the remainder of the excavated area. A tinder fungus was also found on the excavation located just east of Syltholm I, and this is remarkable both in that it was perforated by a wooden spear and that it was decorated with cross-hatching on its lower surface. This demonstrates that the tinder fungi were not just random natural inclusions in the find horizon. Finally, the incidence of both unworked antlers and antler tools is markedly higher within Structure A than elsewhere. As radiocarbon dates have not yet been obtained for the tinder fungi and unworked antlers, these groups of finds could belong anywhere within the chronological frame established for Structure A, i.e. c. 4700–3500 cal BC.

Pottery was also found associated with Structure A, but it was not particularly abundant relative to what was found in the surrounding area. Typologically, it can be assigned to the Ertebølle period and to the Early Neolithic, but there are no intact vessels from either of these periods.

Table 16.1 Overview of all ^{14}C-dated items from Structure A

No.	*^{14}C yr* BP	*Dated item*	*Material*	*cal* BC *at 95.4%*
1	AAR-23508: 5849 ± 32 BP	Antler shaft	Red deer	4794–4615
2	AAR-27424: 5824 ± 27 BP	Antler	Red deer	4778–4601
3	AAR-26778: 5819 ± 30 BP	Stake/pole, oblique	Hazel	4778–4584
4	AAR-26774: 5789 ± 27 BP	Stake/pole, oblique	Hazel	4711–4554
5	AAR-27435: 5762 ± 36 BP	Antler	Red deer	4526–4526
6	AAR-26776: 5713 ± 52 BP	Stake/pole, oblique	Hazel	4694–4453
7	AAR-21956: 5756 ± 29 BP	Stake/pole, vertical	Hazel	4692–4529
8	AAR-22758: 5748 ± 34 BP	Mandible	Ungulate	4691–4503
9	AAR-26780: 5741 ± 26 BP	Stake/pole, oblique	Hazel	4686–4517
10	AAR-27426: 5717 ± 26 BP	Upper jaw	Red deer	4678–4486
11	AAR-26782: 5691 ± 33 BP	Stake/pole, oblique	Pome fruit tree	4615–4453
12	AAR-21932: 5697 ± 29 BP	Ornamented wood	wood	4609–4458
13	AAR-27436: 5658 ± 30 BP	Mandible	Red deer	4551–4375
14	AAR-21929: 5633 ± 28 BP	T-axe	Wood shaft	4535–4370
15	AAR-26785: 5630 ± 28 BP	Stake/pole, oblique	Hazel	4530–4369
16	AAR-22761: 5455 ± 32 BP	Mandible	Roe deer	4355–4253
17	AAR-22760: 5381 ± 34 BP	Mandible	Red deer	4334–4070
18	AAR-22755: 5378 ± 35 BP	Upper jaw	Roe deer	4333–4067
19	AAR-21953: 5360 ± 28 BP	Stake/pole, vertical	Hazel	4326–4057
20	AAR-26779: 5347 ± 35 BP	Stake/pole, oblique	Hazel	4321–4052
21	AAR-26772: 5343 ± 27 BP	Stake/pole, oblique	Hazel	4316–4053
22	AAR-26769: 5309 ± 47 BP	Stake/pole, oblique	Hazel	4315–3996

(*Continued*)

Table 16.1 Continued

No.	*^{14}C yr* BP	*Dated item*	*Material*	*cal* BC *at 95.4%*
23	AAR-26768: 5329 ± 35 BP	Stake/pole, oblique	Hazel	4313–4046
24	AAR-26771: 5316 ± 35 BP	Stake/pole, oblique	Hazel	4256–4043
25	AAR-27430: 5388 ± 29 BP	Mandible	Fox	4234–4044
26	AAR-21955: 5288 ± 28 BP	Stake/pole, vertical	Hazel	4233–4003
27	AAR-26781: 5304 ± 27 BP	Stake/pole, oblique	Hazel	4233–4047
28	AAR-26783: 5286 ± 26 BP	Stake/pole, vertical	Hazel	4232–4002
29	AAR-26770: 5270 ± 26 BP	Stake/pole, vertical	Hazel	4230–3992
30	AAR-26767: 5263 ± 29 BP	Stake/pole, vertical	Hazel	4229–3987
31	AAR-26786: 5222 ± 27 BP	Stake/pole, oblique	Hazel	4220–3966
32	AAR-22757: 5250 ± 33 BP	Mandible	Wildcat	4046–3953
33	AAR-27423: 5394 ± 27 BP	Mandible	Otter	4041–3825
34	AAR-27427: 5138 ± 26 BP	Skull with antler base	Red deer	4032–3809
35	AAR-22754: 5175 ± 31 BP	Mandible	Wildcat	3991–3803
36	AAR-26773: 5121 ± 36 BP	Stake/pole, oblique	Hassel	3987–3800
37	AAR-22763: 5259 ± 31 BP	Mandible	Dog	3986–3802
38	AAR-27422: 5092 ± 45 BP	Mandible	Pig	3976–3784
39	AAR-27425: 5103 ± 33 BP	Mandible	Pig	3971–3800
40	AAR-27429: 5070 ± 36 BP	Mandible	Pig	3961–3786
41	AAR-22756: 5190 ± 31 BP	Mandible	Fox	3954–3773
42	AAR-26775: 5068 ± 26 BP	Stake/pole, vertical	Hazel	3953–3797
43	AAR-27428: 5061 ± 28 BP	Mandible	Pig	3952–3792
44	AAR-21930: 5045 ± 27 BP	Antler axe	Wood shaft	3949–3776
45	AAR-21935: 5010 ± 27 BP	Axe shaft	Hazel	3939–3707

Table 16.1 Continued

No.	*^{14}C yr* BP	*Dated item*	*Material*	*cal* BC *at 95.4%*
46	AAR-22762: 5022 ± 34 BP	Mandible	Wildcat	3927–3661
47	AAR-26766: 4961 ± 29 BP	Stake/pole, vertical	Pome fruit tree	3792–3661
48	AAR-26784: 4933 ± 31 BP	Stake/pole, oblique	Hazel	3775–3651
49	AAR-21934: 4923 ± 32 BP	Axe shaft	Hazel	3770–3647
50	AAR-27434: 4765 ± 32 BP	Lumbar bone	Sheep/goat	3640–3384
51	AAR-27431: 4680 ± 28 BP	Tarsal bone	Cattle	3622–3370

Calibration curve: IntCal13 (Atmospheric), cal. 95.4%.

The Ertebølle finds from the area surrounding Structure A did not differ from what one would normally expect to find in a refuse layer, with flint flakes, flint tools and bones, together with a few pottery sherds. In the case of finds that can be assigned to the Early Neolithic, the situation was quite different. A number of spectacular finds were located outside Structure A: Several wooden tools were found thrust vertically down into the bed of the fjord around the structure. There were also concentrations of potsherds that are presumed to represent whole vessels placed out in the fjord. This type of find was not restricted to Syltholm I but extended eastwards where, in a neighbouring excavation (MLF906-II), several intact pottery vessels from the Early Neolithic were found.

Structure A is not the only location with finds of ritual character at Syltholm I. To the south of Structure A, four wooden spears, five axe shafts, a bow and a paddle were found, all dated to the Early Neolithic (see Figure 16.6). A conspicuous characteristic of these artefacts is that they were all found in a vertical position, which means that they were deliberately pressed down into the seabed. In addition, most of them showed traces of fire but only superficially. While the ritual depositions of Ertebølle age are restricted to Structure A, signs of ritual activity in the Early Neolithic both continue in Structure A and spread out over a much larger area than in the previous period.

Vertically thrust-down wooden tools are a rare but not entirely unknown phenomenon at other settlements from the Ertebølle period and the Early Neolithic in Denmark, but they are most often interpreted as tools that have been reused in fish weirs (Troels-Smith 1959:92; Petersen 1979:72; Price & Gebauer 2005:84; Andersen 2009:92). Seen in the light of the finds contexts for similar wooden tools at Syltholm, I consider it more likely that many, if not all, of these artefacts represent intentional depositions in shallow water, equivalent to other finds that are interpreted as ritual depositions of this kind, such as pottery vessels, flint axes, antler tools and bones (Becker 1948; Karsten 1994).

The only difference is that wooden tools cannot be deposited in shallow water unless they are fixed securely by pushing them deep down into the sediments of the fjord bed, thereby preventing them from floating away. Whether this interpretation applies to all the vertically thrust-down wooden tools and implements of this kind found in Denmark is open to question. These are, however, rarely found associated with obvious and unequivocal fish weirs, something which tends to undermine the original interpretation of these finds as wooden artefacts reused in fish weirs. The likelihood that the wooden tools recovered from Syltholm I represent ritual depositions is underlined by a unique discovery from the neighbouring locality (MLF906-II), where a hafted, thin-butted polished axe was found thrust down into the bed of the fjord (see Figure 16.6). In general terms, it is also inconceivable that such relatively short implements as axe shafts would have been used in the construction of fish weirs.

The fact that a large proportion of the vertically thrust-down wooden tools, especially those of Early Neolithic date, show superficial traces of fire, in the form of blackened or lightly charred areas, might reinforce the interpretation of these being associated with ritual depositions as fire is so often seen used in Neolithic rituals (Larsson 2011).

Based on the observations and analyses of material recovered from Syltholm fjord, and in particular from Syltholm I, it is reasonable to propose that a deposit traditionally classified as a 'dump layer' can also contain structured, and possibly ritual, depositions. As the objects recovered from Syltholm I extend over a relatively long period of time, it is necessary to examine every single type and their spatial distribution in, respectively, the Ertebølle period and the

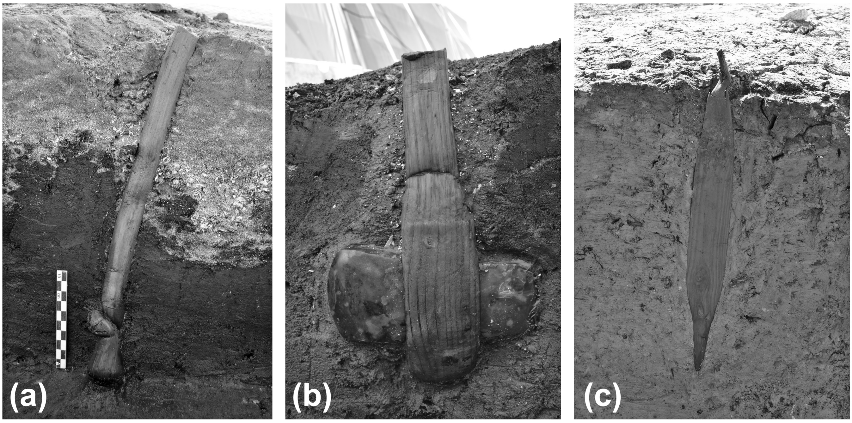


Figure 16.6 Some examples of the ritual depositions from the Early Neolithic found in the extended ritual area around Structure A: one of the many axe shafts (a), an axe with preserved shaft (b) and a paddle blade (c). Typical for these artefacts are that they have been pressed down into the fjord bed in a vertical position. Photo: Søren A. Sørensen, Museum Lolland-Falster.

Early Neolithic. The finds from the Ertebølle period come from a shore-near dump layer that has accumulated in direct association with a coastal settlement. Within this dump layer is an agglomeration of finds (Structure A), composed of a cluster of thrust-down poles/stakes, a collection of lower jaw bones from various animals, a concentration of spectacular artefacts such as an ornamented antler shaft, an ornamented piece of wood and an antler T-axe with part of the shaft preserved. Furthermore, there are some yet undated finds categories, such as red deer antlers and fruiting bodies of tinder fungi. Structure A is interpreted as a structured deposition composed of specific bone elements from selected species together with specially chosen artefacts, and it is perceived as an accumulated ritual deposition, integrated into the dump layer.

Depositions continued at Structure A in the Early Neolithic, with the involvement of some of the same elements that were evident in the Ertebølle period, i.e. lower jaw bones and an antler axe with a shaft and pointed poles/stakes in vertical or oblique position. A new type appears for the first time in the Early Neolithic, namely, the wooden axe handle of which three are found within Structure A. However, in the Early Neolithic, there was apparently no longer a settlement directly associated with Syltholm I. Consequently, the Early Neolithic depositions no longer form part of a traditional dump layer. The impression of ritual depositions in the area seems to be reinforced in this period, but not only in association with Structure A, which now only comprises a small part of a much more extensive depositional area. The Early Neolithic depositions outside Structure A are characterized by Funnel Beaker pottery, wooden tools and implements thrust vertically down into the fjord bed, broken polished flint axes and animal bones, comprising specific elements from selected species.

Locating ritual depositions from the Mesolithic

There is a long archaeological tradition of using terms such as sacrificial find, votive find and, more recently, ritual deposition – a tradition that began with J.J.A. Worsaae in 1866. These terms are, however, much more rarely used in reference to finds from the Mesolithic than those from the Neolithic and later periods. Central to Worsaae's definition of a votive find was the context in which it was found, and he mentions 'lakes, rivers, groves and large stones' as typical examples (Worsaae 1866:322). Subsequent archaeological research developed Worsaae's interpretation and it subsequently became usual to classify archaeological remains according to the following groups: settlement finds, grave finds and sacrificial/votive finds (see Berggren 2010). This classification has implicitly been of great significance for the study of Mesolithic settlements and the identification of possible votive finds/depositions, because the same spatial segregation does not exist between the three aforementioned finds categories in the Mesolithic as it does in the Neolithic and later periods. Most Mesolithic settlements lie in or on the edge of a wetland area, and in instances where burials have been found, these have also formed an integrated part of the settlement (Brinch Petersen et al. 2014).

Based on Neolithic depositional practices, several researchers have searched for traces of corresponding Mesolithic depositions in the same context, which could thereby suggest some kind of continuity back in time (Karsten 1994:166; Koch 1998:157; Berggren 2010:23). It is possible that the entire premise for demonstrating such continuity in the associated wetland finds is wrong, as the exploitation and use of the landscape were quite different in the Mesolithic and Neolithic periods. Only in the very earliest part of the Funnel Beaker culture, when the Neolithic settlement and economy had yet to distance itself markedly from that of the Mesolithic, can the two periods be directly compared.

In the Mesolithic, people used a very large economic territory, but a very small and concentrated social territory. The settlement was consequently the setting for most of the social – and possibly also the religious and ritual – activities that took place. The use of the landscape changed in the Neolithic and later periods, when several social and religious/ritual activities were practiced further away from the settlements and thus displaced. Graves, for example, were no longer found on the actual habitations; places of assembly, such as the causewayed enclosures and palisade structures, were established away from the ordinary settlements; and artefacts were deposited in bogs, lakes and watercourses, also some distance away. Against this background, it seems likely that Mesolithic depositions should be sought in close contact with the actual settlement, within the boundaries of its restricted social space. Based on the secure Mesolithic finds from Structure A at Syltholm I, I will now incorporate finds from elsewhere in Denmark and in neighbouring countries in an attempt to describe a typical deposition from the Ertebølle period.

The concept of deposition is used here as a more neutral term, in order not to anticipate the interpretation. However, the same types of deposition can appear in the literature under different labels, for example sacrificial find, votive find and ritual deposition (cf. Berggren 2010). Deposition, as understood here, means that one or more artefacts are selected and intentionally deposited in a non-random place. This should be seen in contrast to what could be referred to as waste disposal, which is defined as random waste that is deposited in an unsystematic and unstructured way.

The following artefacts/types recovered from Structure A have currently been dated to the Ertebølle period: lower jaws, decorated wooden artefact, decorated antler shaft, antler axe with remnant of shaft and vertical poles. In the following, the contexts in which these artefacts/types appear at other Mesolithic sites will be examined.

Evidently, it may seem difficult to identify lower jaws as an intentional deposition in a settlement context. However, according to J. Grünberg (2000; 2013), lower jaws of various animals have been found in graves at no less than 25 localities all over Europe. These include the graves from the Ertebølle period at Bøgebakken and Gøngehusvej in Vedbæk, as well as those from Tågerup and Skateholm I and II in Scania (Albrethsen & Petersen

1976; Larsson 1990; Grünberg 2013). The fact that lower jaws occur so frequently in Mesolithic burial contexts is a clear indication that they must also have had a symbolic, and possibly also a ritual, function. This interpretation is further reinforced by W. Gumiński's (2014) thorough investigation of all the faunal remains from the Polish burial ground of Dudka. The special significance of lower jaws in burial contexts continues into the Neolithic. Pitted Ware culture graves in Gotland provide a number of clear examples of the significance of, in particular, the lower jaw of pigs in the grave cult. Examples are the no less than 19 lower jaws of wild boar that were found in Grave 7 at Ire in Hangvar on Gotland (Bägerfeldt 1992). Another Pitted Ware culture grave at Aivide contained a total of 30 lower jaws of wild boar (Lumbye 2012). But jaw bones have also been found in other circumstances which indicate that they have played a special role. In Sludegårds Mose on Funen, a collection of lower jaws was found that, in several respects, can be equated with the situation at Syltholm. The remains were discovered in the 1940s during peat cutting and include 17 lower jaws, all of wild boar. One of these jaws has been dated to the Late Ertebølle period (K-4632: 4060 ± 90 cal BC; Noe-Nygaard & Richter 1990). The same bog has yielded pottery from the earliest and middle parts of the Funnel Beaker culture, bones of cattle, sheep and goat and a human skull, as well as a couple of wooden shafts and flint tools extending in date from the Ertebølle period to the Late Neolithic (Albrectsen 1954). Even though there is only one available radiocarbon date from Sludegårds Mose, based on the typological evidence provided by the artefacts, it is possible to conclude that the finds represent an accumulated deposition that extends over several centuries. At the Linear Pottery culture site of Herxheim in Germany, one of the pits yielded 23 jaw halves from small predators such as pine marten, wild cat and fox, together with the metapodia and phalanges of these animals; these bones also showed traces of red ochre (Orschiedt & Haidle 2006:163).

The examples outlined above are just some of the many instances where structured depositions of lower jaws have been found in various archaeological contexts that can be perceived as intentional symbolic and perhaps also ritual depositions.

Structure A also contained the only two ornamented artefacts from the Ertebølle culture found during the excavation. Earlier investigations have shown that ornamented artefacts in particular are often found either together with depositions of other 'special' artefact types (Karsten 1994; Toft 2009) or completely without context as stray finds (Brinch Petersen 1973:100). In general, ornamented artefacts from the Mesolithic are perceived as belonging to the non-functional part of the material culture and not as 'art for art's sake' (Clottes & Lewis-Williams 2007; Sørensen 2017). Then there is the T-shaped antler axe, which would not have attracted much attention had it been found on an Ertebølle settlement in Jutland or on Funen. But here, east of the Great Belt, it constitutes a rarity and must be seen as an imported object, because this type is not part of what could be termed 'the normal Ertebølle inventory' from the area. Finally, there are the vertical poles/stakes which constitute a significant part of Structure A. Not much can be said about their function, only that it is abundantly clear that they were not, or at least not all of them, parts of fish weirs or other known fishing structures. A more precise suggestion as to the function of these poles would, at present, be pure guesswork.

According to the observations made at Syltholm, it must be considered most likely that ritual depositions can be found in the dump zone. It may, however, be very difficult to identify these depositions and distinguish them from the ordinary settlement refuse by which they are surrounded. This is especially true if only a small part of the dump layer is excavated. If a large area is uncovered, as was the case at Syltholm I, there is a much better opportunity to identify structured depositions within what is traditionally considered to be a dump zone. At Syltholm I, the finds from Structure A stand out clearly from those in the surrounding dump zone. There are, in fact, indications of similar concentrations of special finds from a number of Ertebølle sites, e.g. Rosenhof in northern Germany to mention just one (Goldhammer 2008).

Water as a gateway between worlds

The second central question raised by the material from Syltholm I is whether the coastal zone can be seen as equivalent to the areas traditionally classified as wetland depositional areas (bogs, lakes and rivers) during both the Mesolithic and Neolithic, but best represented in, and described from, the latter period (Karsten, 1994).

In major publications on the finds from bogs, C.J. Becker (1948), and later E. Koch (1998), included pottery vessels found on the coast, although neither author explains why they consider these pots found in fjords to be on a par with those found in bogs, etc. Becker (1948:27) mentions some vessels discovered in the now reclaimed Sidinge fjord, but he points out that they are found in marine sediments, showing that they must have been deposited in open water. Koch (1998) supplements Becker's finds catalogue with two more localities for pots in fjords.

The fjord finds mentioned by Becker and Koch were discovered either during digging works in reclaimed fjord areas or by aggregate extraction in marine environments, which provided the opportunity for several artefacts to be recovered from within a relatively limited area. The very fact that several artefacts are found together helps to reinforce the interpretation of them as representing intentional depositions and not randomly lost objects. The impression of ritual depositions along the coast is reinforced when checking the national database of archaeological finds. The examination of the 'Sites and Monuments database' ('Fund og Fortidsminder') showed that numerous artefacts from the Stone Age found along Danish coasts are difficult to explain as anything other than intentional depositions. Flint axes, battle axes and flint daggers, in particular, have been found in abundance and, to a lesser degree, pottery, but this may possibly be due to the fact that these first categories of finds are both robust and conspicuous and thus have the greatest chance of coming to the attention of museums and ending up in the record.

One of the major fjords finds containing Neolithic artefacts, discovered in Roskilde fjord around the island of Kølholm, has been published by K. Davidsen (1983), who does not hesitate to interpret it as a votive assemblage. In addition to pottery from the Early Neolithic and the beginning of the Middle Neolithic, the Kølholm finds also include flint axes, flint halberds, a preform for a battle axe and a whetstone. As the site was discovered during commercial extraction of mollusc shells from the fjord bed, only the more conspicuous artefacts were picked out by the labourers, so possible bones and wooden artefacts have not been recorded from this locality. The same is also true of another fjord locality at Stenballesund in Horsens fjord, where numerous finds of Neolithic artefacts were discovered during shell extraction (unpublished). There is no doubt whatsoever that these finds were deposited in water and do not originate from flooded settlements or graves. The same is very probably true of the many stray finds of artefacts that have turned up randomly along Danish coasts.

Collectively, they draw a picture of the marine coastal zone functioning as a depositional area for selected artefacts on a par with bogs, lakes and rivers. It can therefore be stated that the crucial aspect of all these depositions is that they took place in water, and not so much whether the water was a lake, a bog, a river or the marine coast. Consequently, the answer to the second question is clearly 'yes' – the coastal area can be directly equated with traditional inland wetland depositional areas.

Conclusion

It is not unusual for long-term continuity to be demonstrated in the use of the areas where ritual depositions have been undertaken. This is especially clear in the case of find assemblages from bogs and other inland wetland environments (Berggren 2010:19). Consequently, the special feature of the structured depositions from Syltholm fjord is not their continuity but the fact that they extend over time from the Ertebølle period into the Early Neolithic, i.e. across the boundary between a Mesolithic hunter-gatherer society and a Neolithic agricultural society. A continuity of this nature has previously been proposed in connection with a few wetland sites in Denmark (Koch 1998) and Scania (Karsten 1994), but appears to be much better documented at Syltholm.

One of the most important conclusions resulting from the excavation of Syltholm I is that, within what has been traditionally perceived as a dump zone, there can also be structured depositions which, in the present case, are interpreted as expressions of ritual activity. The more nomadic character of the Mesolithic settlement pattern has resulted in accumulated depositions being less common for this period than for subsequent, more sedentary agrarian societies. In the Neolithic, several of the social activity areas such as burial grounds, enclosures and offering sites became displaced further away from the actual settlement.

Depositions of Neolithic artefacts have previously been demonstrated in the marine areas in Denmark. However, they have always been discovered during aggregate extraction or other commercial or industrial activities (Davidsen 1983), so the context for these finds has always been poorly illuminated. This situation has now been rectified by the excavations in Syltholm fjord, such that the marine coastal area must now be equated with freshwater wetland areas containing structured depositions, which are interpreted here as ritual depositions. The finds from Syltholm also add several wooden tools and implements to the much more common depositions of flint tools, bones and pottery. Another new aspect is the realization that many of the wooden tools were deposited in a vertical or oblique position and that, prior to deposition, several of them had suffered the effects of fire.

The finds and observations from Syltholm on Lolland are by no means unique, but their massive occurrence makes them special. This very fact makes it even more evident that we are dealing with a special form of deposition – which is interpreted here as being ritually conditioned. There are, however, several examples in the literature of finds of a similar character. Lower jaw bones have been mentioned above, but there are also several known instances of wooden tools and implements thrust down vertically in wetland areas. These have, on the other hand, almost always been interpreted as functional parts of fish weirs or the like. This predominantly functional interpretation is probably due to the fact that often only a single tool or implement is found in a vertical position; a situation that, in turn, can be explained as a consequence of the very limited areas that are normally excavated in wetland areas. Examples of wooden spears, bows and paddles thrust vertically down in Mesolithic settlements, in particular in Denmark, northern Germany and Poland, help to reinforce the interpretation of these finds as an expression of a standard depositional practice that was probably ritually determined.

Characteristics of the depositions are:

- Concentration of select skeletal elements
- Deposition of intact and usable artefacts
- Deposition of ornamented artefacts
- Traces of intensive use of fire in the depositional area
- Signs of intentionally damaged artefacts (broken-up axes)

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