EDITED BY
FRANCESCO
MENOTTI
AIDAN
O'SULLIVAN

The Oxford Handbook *of* WETLAND ARCHAEOLOGY

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Edited by

FRANCESCO MENOTTI

&

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FM & AO'S

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Abbreviations

~	approximately
AMS	Accelerated Mass Spectometry
a.s.l.	above sea level
BP	Before Present (or BP = 1950 AD)
ENSO	El Niño Southern Oscillation
GIS	Geographic Information Systems
GPR	Ground-Penetrating Radar
GPS	Global Positioning Systems
ha	hectare(s)
ICOM	International Council on Museums
IND	Inland Niger Delta
kya	1,000 years ago
LIDAR	Light Detection And Ranging
MIS	Marine Isotope Stage
mya	million years ago
OSL	Optically Stimulated Luminescence
PCR	Polymerase Chain Reaction
SGC	Single Grave Culture
SIP	Spectral Induced Polarization
UNESCO	United Nations Economic, Social and Cultural Organization
USDA	US Department of Agriculture
WMD	Wiggle-Match Dating

CHAPTER 1

GENERAL INTRODUCTION TO THE HANDBOOK

FRANCESCO MENOTTI AND AIDAN O'SULLIVAN

Wetland archaeology is difficult to define: as mutable and slippery a concept as the watery environments it seeks to explore. What is it? Is it simply the recognition of the enormous potential of waterlogged, anaerobic environments and the due application of a range of multidisciplinary scientific methods and techniques to harvest the data about the past they can provide? Is it the archaeological and environmental investigation of past and present wetland landscapes and wet sites—in coastal marshes, bogs, lakes, and rivers—to reconstruct their role in local, regional, and national long-term histories? Or does wetland archaeology simply seek to explore how people in the past interacted with the wetlands, revealing how societies and cultures make their own worlds through their social, ideological, economic, and above all material engagement with dynamic, ever-changing, and bountiful environments? It is in a sense all of these things and more. Because there is no doubt that wetland archaeology, despite the criticisms that might be made of it, has been responsible for some of the most spectacular archaeological discoveries in the world. It also provides us with the potential to tell more nuanced stories about the past—creating both an opportunity and a challenge for this fascinating branch of archaeology.

What are wetlands? Wetlands can be defined as being those environments whose soils are covered by water, or where water is present at or near the surface—either all year or at different seasons. Wetlands vary widely in their location, topography, climate, water regimes, water chemistry, vegetation, and wildlife, and are found across the world, from the tundra regions to the tropics, and on every continent on earth (except for Antarctica), with notable wetlands in Europe, the Americas, Africa, the Middle East, Asia, and Oceania. They include coastal wetlands, such as estuaries, with saltmarshes, mudflats, and lagoons where brackish water creates fluctuating, difficult environments within which only a range of salt-tolerant plants, fish, wildfowl, and animals can thrive—and indeed, they do thrive. Freshwater wetlands situated further inland also include an almost bewildering range of environments, including rivers, lakes and ponds, marshes and wet meadows, and wetland woodlands. Fens and bogs form where encroaching vegetation chokes water bodies.

As is well known, wetlands are amongst the most productive and bountiful environments on earth, only comparable to rainforests and ocean coral reefs for the range and diversity of fish, amphibians, shellfish, insects, birds, and mammals that can inhabit them, migrate to them, or breed there. Wetlands, as is also increasingly understood, are ecologically of critical importance in terms of the globe's water cycles, for long-term carbon storage and for the moderating effects that they can have on climate and weather change. Wetlands also clean and filter out impurities from water, protect against floods and coastal erosion, and provide a home for threatened wildlife across the planet, while they are also often landscapes that have both an aesthetic beauty and an ecological richness. Since earliest times, as we shall see in this book, people have also lived in, moved through, and used wetlands environments in a wide range of different ways; for food, shelter, safety, and raw materials. In some parts of the world, indeed, they have long been a key location for people's settlements and daily lives and practices (see e.g. the Niger River Delta, McIntosh 1999; or the Amazon River floodplains, Harris 2000 and Chapter 44 this volume).

For all that, humanity finds itself at a crossroads—or, more appropriately, has walked out along the wrong road—when it comes to the world's wetlands. For many centuries, particularly in the western world but elsewhere as well, we have long had an ambivalent relationship with them: fearing their cold, dark, and vegetation-clouded waters, and seeing them as useless, disease-ridden marginal spaces and oftentimes too the abodes of spirits, monsters, and 'the other'. Thus, fearful and scornful of them at the same time, many generations of human ingenuity and labour has been spent draining them, filling them in, and otherwise destroying them, to replace them with landscapes more suitable for agriculture, industrial extraction, and settlement. Soon, much of the world's wetlands—those not already destroyed—will be lost. It is estimated for example, that since European colonists arrived in North America four centuries ago, more than half the forest wetlands native to that land are gone (Nicholas 2001). Most of Europe's boglands are already gone—and in Ireland, it is estimated that all unprotected raised bogs will be extinct within the next few decades (Coles 1995; O'Sullivan 2007). On the other hand, wetlands do survive in both continents—and elsewhere across the world—in incredible richness.

In seeking authors for the *Oxford Handbook of Wetland Archaeology*, we tried to ensure that the various chapters would cover as many parts of the world as possible. Although it is apparent from the opening section—and from the papers in subsequent sections—that Europe has long played a central role in the antiquarian and modern development of wetland archaeology, papers from the United States, Canada, Central and South America, Africa, Asia, and Oceania clearly show that wet/wetland archaeological sites from these areas are certainly of no less importance than their counterparts in Europe. We have then sought to define what it is that wetland archaeological evidence represents. There are chapters on wetland landscapes, settlements, and buildings, and the material culture that are found within them or in other contexts. Wetlands have long been seen as routeways through landscapes—or as obstructions to routeways—and these are also discussed. Wetlands, as is well known, are also places for the deposition of objects (Bradley 1990). Bog bodies, which are amongst the most evocative of all finds from wetlands—and which provide unique glimpses of people from the past (van der Sanden 1996)—are also detailed.

Wetland archaeology has also often been seen as a set of methods and techniques, a mindset or mentality in approaching archaeological investigations that will then enable maximum use of all the data available. There are chapters here on remote sensing methods, on survey

and excavation, stressing the fact that different waterlogged contexts require different approaches. Many of the multidisciplinary approaches that are then brought to bear on wetland survey and excavation data do not owe their origin to wetland archaeology *per se*, but it is probably fair to argue that almost nowhere else do these methods and approaches work so well. The potential of wetland archaeology can be discerned by a reading of the list of scientific approaches: archaeobotany, insect analysis, palaeoecological reconstruction, geoarchaeology and soil micromorphology, ancient DNA, palaeoclimatology, radiocarbon dating, dendrochronology and lacustrine varve dating. However, in preserving such an extraordinary range of evidence, wetlands are also fragile and prone to destruction. Various chapters also provide a discussion of international, national, and local responses to the destruction of, and damage to, wetland and wet archaeological sites—and as several authors mention, how wetland archaeology as a discipline needs to engage both with local indigenous communities and wider conservation organizations. As it happens, at about the time this book's papers were being edited (2011), UNESCO announced that a selection of the prehistoric lake-dwellings of the Circum-Alpine region were to be inscribed on the World Heritage List. In fact, after a long and demanding application process (Suter and Schlichtherle 2009), Switzerland (as the leading country), France, Germany, Austria, Italy, and Slovenia succeeded in having 111 of the most relevant lacustrine settlements designated as World Heritage sites. It is hoped that the UNESCO label will not only make the sites known to a wider public, but will also promote new archaeological research, as well as more effective initiatives to protect that invaluable (and fast-disappearing) cultural heritage.

For many reasons, wetlands have been amongst the most important landscapes explored by archaeologists, and, as archives of past environmental and cultural change, they are almost unparalleled in the quality of evidence they can produce. As John Coles (1984: 12–15) has suggested, on a well-preserved dryland settlement site one would hope to excavate the complete plan of a building, and identify the post-holes of its walls and roof supports, as well as its hearth—and potentially the various scientific and archaeological methods map out at least some of its zones of cultural and household activity. Finds might include stone, pottery, metal objects, animal bone, and charred materials, but the majority of organic materials (arguably providing the bulk of a household's material culture) would usually be missing, destroyed by time. On a wetland settlement site, under optimum conditions, one would recover the same house plan, but the individual wooden posts and roof supports and the interwoven wattle of the surrounding walls would also survive, with the toolmarks demonstrating the tools and techniques used to modify them, while the range of tree species used, the tree-rings and beetle decay could help reveal aspects of the surrounding woodland environment, the selection of raw materials, and the conditions of the site. Dendrochronological studies of the often-found large quantities of wood can not only reveal very precise chronological insights—often within surprisingly short time-scales—into a building's construction, use, repair, and abandonment, but also woodland management of the settlements' surroundings (Billamboz 2005; 2010). Even where Bayesian statistical analysis of radiocarbon dates is done, archaeologists can only identify long-term (e.g. one generation or longer) patterns of dwelling/settlement occupation. On the other hand, high-resolution dendrochronological dating argues for much shorter phases of occupation limited to one or two decades, and in some cases even less (Bleicher 2009).

In and around the building, in a wetland archaeological excavation one might find a wide range of organic (wood, leather, basketry, textiles, and hair) and inorganic objects that reveal

the sheer extent of how people lived with—and understood the properties of—raw materials in the past. We will also hope to find evidence of the animals that shared their living space with humans. In some cases, such as the Iron Age buildings found at Goldcliff, in the Severn Estuary, Wales, we might even find the hoofprints of cattle that gathered around a marshland building (Bell et al. 2000). It is also possible to identify evidence that reveals how people created, used, repaired, and abandoned artefacts—revealing the potential cultural biography of the small things that are often forgotten, or more accurately no longer present, on dryland sites (Thomasson 2004). Finally, the contexts of both structure and finds on a wetland site will also potentially be full of a range of palaeoecological data—and when soil micromorphology, insect analysis, plant macrofossil, and a multitude of other studies are done, we can get a sense of the house floors, the activities within dwellings, as well as the buzzing flies, hopping fleas, and noisome floor matting of houses and dwellings. This is the 'muck of life', the dirt under the fingernails of the past that wetland archaeology provides—not merely an evocation of lifeways, but direct engagement with the reality of people's lives. In investigating such evidence, we can more fully and completely attend to the relationships that people had with places, buildings, objects, animals, time, and change, and thus with the materiality of their social lives, as their identities of status, gender, and kinship were enacted and negotiated in the 'real world' (soggy as it was).

Indeed, as many authors also argue here, as archaeologists we should not stop there: we cannot just uncover such spectacularly preserved archaeological evidence and hope to simply read it as we would a book (Van de Noort and O'Sullivan 2006). In adopting interpretive or theoretical archaeological approaches—whatever they might be—we would hope to fully exploit our evidence further to at least attempt to reconstruct the cultural biography of that building; its origins, construction, use, shifting functions, and cultural meanings across time—and ultimately its abandonment and fate (Arnoldussen 2008). We would also hope through multidisciplinary studies to place that building and its objects within its particular regional cultural context, to investigate how its inhabitants dwelt in local and regional landscapes, possibly linking their economies to trade networks, which stretch for exceedingly long distances (Bellintani 2002). It can also be understood how people used material culture and their environment to create social worlds that were distinctive, contingent to time and place with stories that are revelatory to some extent of diversity of the human past. Cultural sensitivity of some artefacts, such as basketry, can even identify cultural and social differences, as a number of studies on basketry remains of the northwestern coast of North America have demonstrated (Bernick 1998; Croes 1995; 2003).

Our challenge as archaeologists is to make the most of our evidence, recognizing that sometimes it can be about the most evidence that one would ever hope to get—and also to ensure that such evidence contributes to wider debates (Menotti 2012). It is one thing to find a spectacularly well-preserved dwelling in a wetland environment; it is another thing to have that evidence contribute to our understanding of the long-term histories of particular societies. Perhaps it is the case that the general archaeological discipline can ignore the evidence provided by a wetland habitation like the 6th-century crannog at Buiston, in Scotland (occupied for mere decades, from AD 589 to about 650) (Crone 2000), or the medieval fortified lake settlement at Charavines-Colletière France (AD 1003–40) (Colardelle and Verdel 1999), because they can be portrayed as unusual, wetland-specific discoveries that, while fascinating in themselves, do not have to be seen as typical. In fact, as argued throughout the Handbook, such sites are fairly common within the entire Circum-Alpine region, from the Neolithic to the Bronze

Age, and they have been providing more and more insights that uncomfortably challenge normative models of settlement continuities and dynamics. Many of the chapters in this book attempt to do just this, to use the evidence from wetlands environments to contribute to wider archaeological debates and also to place the social, ideological, and economic role of wetlands within wider landscapes and thus create a better understanding of past lives in many different contexts, whether they be the wetlands of the Dutch river delta or the peoples of the Amazon River Basin.

Finally, at a time of global economic and climate change concerns, it has become more and more evident that wetland archaeologists need to engage with the general public in a more holistic way. It is in fact crucial that people are aware, not only of the results achieved by wetland archaeology, but also of the numerous problems that the discipline and indeed the entire archaeological evidence face. Open-air museums, living-history television programmes, and a numerous 'open days' on wetland archaeological excavations do provide people with useful information on wetland archaeological research. This is however not enough if we (as both general public and academia) are not prepared to compromise and sacrifice our different expectations. Wetlands, and with them our cultural heritage, are disappearing at a hasty pace, and only synergetic efforts towards the development of systematic protection policies will be able to prevent the loss of what nature has preserved for millennia.

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PART 1

WETLAND OCCUPATIONS

A GEOGRAPHICAL AND CHRONOLOGICAL PERSPECTIVE

Introduction

Where there is water there is life! People's interaction with the wetlands is a global phenomenon, which is not restricted to specific periods. Archaeological evidence of this interaction spans from the dawn of human kind to the present, and it can be found in the most unthinkable places. Part 1 of the Handbook attempts to show how different people from different places of the planet interacted (and in some cases still do) with the wetlands. As discussed in Parts 3 and 4, what we find as archaeological evidence today is certainly not a full picture of what really happened in the past. The overwhelmingly-high archaeological remains from central and northern Europe (Chapters 2 and 3) do contrast with the paucity of evidence found in Africa, but that does not mean that there people–wetland interaction was more limited. In fact, in some cases people's relationship to wet environments was richer and more complex than in other parts of the world, as explained by Mitchell in Chapter 7. A similar situation is also found in the Middle East (see Wilkinson, Chapter 8).

An interesting array of human behaviour within and between the wetland is also offered by the Americas; from intensive and subsistence-oriented prehistoric coastal occupation in north-western North America (e.g. Chapter 5), to a more sacred one, linked to mortuary

practices in Florida (Chapter 4). People's incredible adaptability to wetland environments, especially form subsistence and economic point of view, is shown by the pre-Columbian wetland sites of central and South America, described by Beach and Luzzadder-Beach in Chapter 6. Indigenous American wetland agricultural systems are particularly well known in the Basin of Mexico, the Maya Lowlands, the Andean Highlands, and Amazon Lowlands, where, in some areas, they are still very much in use (see also Harris, Part 6, Chapter 44).

The Asian continent too, retains valuable evidence of our ancestors' skills of adapting to the wetlands; from the long (Mesolithic to Bronze Age) people–wetland relationship in the Middle Urals, describe by Kuzmin in Chapter 9, to the initial development of rice cultivation for large-scale food production in the Yangtze River region of China, discussed by Zheng in Chapter 10. This remarkable way of 'colonising' the wetlands, resulting in significant advances in rice cultivation technology within periodically-flooded fields is also shown in Matsui and Inoue's Chapter (11), as a crucial part of Japan's prehistory.

Part 1 concludes with the less numerous, but, by no means less important wetland occupations in Oceania. The extraordinary early agricultural activity in the Highlands of New Guinea (Chapter 14), the critical part that the Australian wetlands played in the first colonisation of the continent (Chapter 13), and the crucial information about sacred sites, settlement, economy, trade and social hierarchy of the Maori provided by Chapter 12, offer but few examples of the importance of wetland environments in our past and present ways of living.

EUROPE

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CHAPTER 2

WETLAND OCCUPATIONS IN PREHISTORIC EUROPE

FRANCESCO MENOTTI

Introduction

Although the archaeological evidence for wetland occupation in Europe becomes more evident from the Mesolithic onwards, it is well understood that people's interactions with these environments started and developed much earlier. Throughout most of the Mesolithic, people lived close to and exploited wetlands mainly for food procurement (i.e. hunting-fishing-gathering), but they preferred to settle in drier environments. As time passed, these people–wetland relationships became more and more complex, including a combination of sacred and profane activities. As early as the Neolithic, and in some cases even in the Late Mesolithic (Larsson 2007), people's involvement with wetlands reached far beyond sheer subsistence purposes—with offerings and sacrifices gradually integrated into the enculturation process of these landscapes (e.g. Van de Noort and O'Sullivan 2006: 43–55). However, it was during the Neolithic that wetlands started to be inhabited and used systematically. Neolithic wooden causeways and trackways started to be built in the northern parts of Europe, while in the Mediterranean and Circum-Alpine regions, for example, properly self-sufficient settlements were established. By the beginning of the Bronze Age, wetland occupations had become more complex. The tendency towards the fortification of terrestrial settlements (e.g. hillforts) is sometimes also reflected in later prehistoric wetland settlements (see e.g. Wasserburg-Buchau, in Germany, Biskupin in Poland, and in some cases even some Scottish Late Bronze Age and Iron Age crannogs)—although this does not imply an exclusive defensively nature for such wetland occupations. As we approach historic times, wetland settlements began to fall out of fashion in some areas (e.g. Circum-Alpine region and even earlier in the Mediterranean), while they appeared or continued to develop in others (e.g. the Baltic Sea regions and in Britain and Ireland).

Early wetland occupation activity in Europe was often dictated by environmental factors, especially in northern latitudes. One of the best examples of this can be seen in the Baltic Sea area, where complex and dynamic environmental evolution and change from the Last Glacial Maximum onwards, influenced the location of people's settlements and their relationships with wetlands across millennia. Sea level fluctuations, as well as isostatic land uplift, forced

Mesolithic and Neolithic people to relocate their settlements constantly. Interestingly enough, it is by following those spatial/temporal shifts that the palaeoclimatic and hydrological history of the Baltic Sea can be better understood. But most importantly, wetland sites retain crucial archaeological evidence enabling the identification of key processes of cultural change. For instance, in northern Europe and Scandinavia they are central in shedding light on the still fairly obscure transitional period between the Mesolithic and Neolithic. At the same time, wetland sites can also be crucial to the study of the so-called Neolithization process in the Baltic Sea regions, and they have also contributed to the long-debated issue on the difference between the introduction of pottery and the adoption of agriculture as starting points for the Neolithic. In ideal conditions of preservation, Neolithic, Bronze, and Iron Age wet and/or wetland sites could even help archaeologists identify social groups at the scale of settlements, houses, and households (e.g. within the lake-dwelling tradition in the Circum-Alpine region). The ultimate goal is the integration of all of these outstanding results into mainstream archaeology (see in particular Part 6 of this volume).

People–wetland interactions in the Mesolithic: living on the edge

The Baltic Sea and Scandinavia are two of the richest areas in Europe in terms of Mesolithic waterlogged archaeological evidence. A combination of isostatic rebound in the north and eustatic rise of the sea level in the south helped shape the entire coastal regions of the Baltic Sea throughout the Holocene. As a result, coastal Mesolithic sites are today either situated inland (central and northern Sweden) or are underwater (southern Denmark and the German coast of the Baltic) (Hartz and Lübke 2006; Larsson 2001). A particularly fruitful area is the Wismar Bay (Mecklenburg-Vorpommern, Germany), where more than twenty submerged sites have been identified recently, spanning the period from the Late Kongemose Culture to the Early Funnel Beaker Culture. Five of them, namely Jäckleberg-Huk, Jäckleberg-Orth, Jäckleberg-Nord, Timmendorf-Nordmole I, and Timmendorf-Nordmole II stand out for their remarkable material culture, which has helped archaeologists shed more light on the still unclear transition to agriculture in the region (Lübke 2006; 2005).

Submerged Mesolithic sites are also found on the Baltic Sea coast of Denmark. Amongst them though, only a few show traces of dwelling floors. One of the best studied is the Møllegabet II (dated to 5500–5000 cal BC) settlement, situated in the narrow Møllegabet channel near the island of Dejrø, where the remains of a fireplace and a rectangular area made of a layer of bark resting on cross-laid branches have been identified. Near the site there was a log boat with human bones in it (possibly a boat grave) (Rieck 2003). The most famous and best-studied submerged Mesolithic site in Denmark, however, still remains that of Tybrind Vig on the Lillebælt coast of western Fyn. The site chronology there covers the entire period of the Ertebølle Culture (*c.*5500–4000 cal BC), and indicates that it was only abandoned in the very late Mesolithic when agriculture and animal husbandry were first introduced into Denmark. Along with the large amount of beautifully preserved artefacts, the site yielded the remains of at least three log boats (dugouts) and about fifteen wooden paddles; four of which were beautifully carved and decorated (Andersen 1985; Engen and Spikins 2007).

In contrast, on the North Sea coasts of Scandinavia and in the British Isles, underwater sites of this era are not very numerous, and they are also extremely difficult to find. Due to the post-Glacial Maximum rise of the sea levels, the land mass, then joining the regions located in present-day southwestern Scandinavia and the northwest European coastline to the British Isles, started to be flooded, and consequently Late Palaeolithic-Mesolithic sites are now potentially located several metres underwater (Shennan and Andrews 2000). An area of particular interest—crucial for a better understanding of the 'delayed Neolithization' of Britain following its separation from mainland Europe—is the so-called Doggerland (Coles 1998).

The patterns of coastal, intertidal and subtidal archaeological evidence of Mesolithic occupation in Britain itself are also closely related to the processes of geomorphological and sea-level change. The northern parts of the British Isles underwent isostatic coastal uplifting, as opposed to downwarping, while coastal inundations and erosion occurred in the south (Young 2007: 16). Consequently, the majority of coastal Mesolithic sites are now underwater in the south (e.g. Bouldnor Cliff in the western Solent, north of the Isle of Wight) (Momber 2007), and on land in the north (especially in Scotland) (Mithen 2000; Finlayson 1995). Particularly striking evidence from the western coast of Britain includes the remarkably well-preserved human footprint tracks found at Goldcliff (*c.*5600–4800 cal BC) in the Severn Estuary (Scales 2007; Bell 2007), which offer an extraordinary and evocative insight into people's lives in coastal wetlands (e.g. in terms of social group composition and ratio of adults to children) and, if found with animal footprint tracks, they can even shed some light on economy and seasonality.

However, waterlogged sites are rare in Mesolithic Britain and Ireland. One of them, Star Carr (dated to the first half of the ninth millennium cal BC), located in the Vale of Pickering, has however managed to become the milestone of British Mesolithic research. The site is famous for its remarkable artefacts (e.g. the famous perforated skull and antler of a deer) and in particular its large wooden platform interpreted as a landing place on the edge of the lake (Mellars and Dark 1998; Clark 1954). A similar wooden platform, although subsequently reinterpreted as the product of naturally decayed woodland, is that of Eskmeals in the Williamson's Moss, the English Lake District, Cumbria (Clare et al. 2001: 103). Mesolithic waterlogged sites in Ireland include a platform at Lough Kinale, Co. Longford, occupied several times, from *c.*7000 to 4000 cal BC (Fredengren 2009) and a Mesolithic lake-shore occupation site with mounds at Moynagh Lough, Co. Meath (O'Sullivan 1998: 52–3). Further evidence of Mesolithic people interaction with other lacustrine areas has also been found from Ireland's Early Mesolithic period at Lough Boora, Co. Offaly, and from the Late Mesolithic sites at Clonava and Coralanna at Lough Derravaragh, Co. Westmeath, although neither of these sites have yet yielded remains of actual habitations (O'Sullivan 1998).

Waterlogged Mesolithic sites are more numerous on the mainland of Europe, and the vast majority are located at northern latitudes. Two of the best known are Friesack (9700 to 6700 BP) in Germany (Gramsch 1992; 2000) and Noyen-Sur-Seine (8000–6500 BP), France (Mordant and Mordant 1992). Some wetlands have revealed a particular potential for the study of cultural and environmental change. For instance, the Holmegårds Bog in south Zealand (Denmark) has proved helpful in identifying change in settlement patterns. It has, for instance, been possible to study the transformation from small and clustered sites in the first phase of the Maglemose Culture (8750–7900 cal BC) to larger settlements with an intensification in the exploitation of the bog, during the next three phases (7900–6400 cal BC).

A similar examples is the Åmose area, where $\delta^{13}C$ analyses of human and dog bones have proved contact and mobility between inland and coastal communities; people leaving inland were also exploiting marine resources (Fischer 2003: 406).

In the eastern Baltic Sea regions, wetland occupations are more common in the Neolithic. There are nevertheless some Mesolithic sites located on present-day Estonian islands, which are central for the understanding of the initial colonization of the area after the Last Glacial Maximum (Kriiska 2003). On the mainland, the best known and probably the oldest site in Estonia is Pulli (*c.*9000–7200 cal BC) (Veski et al. 2005). Another site crucial for our understanding of initial colonization processes in the far northeastern part of Europe is Ristola, in southern Finland. In fact, not only does the site have comparable material culture to that of Pulli, but further links to other Pre-Boreal settlements in the Baltic regions, and even to the Butovo Culture in the Upper Volga area (Russia), can be identified (Jussila and Matiskainen 2003: 664).

Northwestern Russian, and in particular the Upper Volga River region, has also yielded remarkable evidence of wetland occupation in the Mesolithic, with some of the best-studied sites being Butovo (eponymous site that gives the name to the Butovo Culture); Stanovoje 4; Ivanovskoje 7; Ozerki 5, 16, and 17; Okajomovo 5; Nushpoli 11; Sakhtysh 14; Zamostje 2; and, further north in the Vichegda basin, the site of Vis I (Zhilin 2007; Zaretskaya et al. 2005).

Inside the Neolithic wetlands

Although the introduction of pottery is sometimes seen as a key indicator of early farming societies, it does not actually reflect an immediate adoption of agriculture in many places (a good example being the Late Mesolithic ceramic Ertebølle culture of the northwest European coastal regions). Typical examples of sites where there was an early introduction of pottery but the transition to agriculture took place much later, are found in western Russia, the eastern region of the Baltic Sea, and northern Scandinavia (Dolukhanov 1992; Zhilin 2007). In southern Finland, for instance, pottery appeared at *c.*6000 BP, whereas the boundary of agricultural activity is set to *c.*4000 BP (Vuorela 1998: 175). Similarly, in the Upper Volga region (Russia), pottery is first seen at *c.*7000 BP, but agriculture does not begin until the very end of the Neolithic, and in some areas not even until the Bronze Age.

Neolithic sites with pottery, but no or little evidence of agricultural activity, are found in Belarus, Estonia, Latvia, and Lithuania. In Belarus, for instance, sites are found in the Paazerje Lake region. Three of the best-studied sites of this area are Zacennie, Asaviec 2, and Asaviec 7 in the Kryvina peatbog (Charniauski 2007). While a few Estonian Neolithic wetland occupations, such as Kääpa, Akali, and Villa 1, started in the Mesolithic, others were exclusively from the Neolithic. Two of the best examples are Tamula 1, dating from the late Combed Ware period to the Corded Ware period (*c.*4600–2000 cal BC) (Kriiska et al. 2007) and Koorküla (*c.*3300–3200 cal BC) (Virtanen 2006). Latvia and Lithuania also hold evidence of Neolithic wetland occupations. Two of the best-studied areas in Latvia are Lake Lubana (Loze 2001) and the famous coastal peatbog of Sarnate, whereas in Lithuania, Neolithic wetland sites are found on Lake Kretuonas (Girininkas 1980), Lake Biržulis (Butrimas 1998), and Šventoji. Only three out of 40 sites of Šventoji (e.g. Šventoji 3B, 23

and 6) retain early evidence of agriculture (*c.*3000–2600 cal BC) on the eastern Baltic Sea coast (Rimantienė 1998: 213). A succinct example of people's adaptation to cultural and environmental change is the multi-phase occupation of Dudka (Poland). Here, climate change combined with the advancing process of Neolithization shaped particular adaptation patterns. The introduction of pottery changed both the ways people interacted with the surrounding woodlands and how they hunted game (the disappearance of long-lasting food procurement strategies such as hazelnut cultivation is an example) (Gumiński and Michniewicz 2003).

Different cultural groups reacted in different ways to the Neolithization influx in southern Scandinavia. In Denmark, for instance, a major change occurred from the Single Grave Culture (SGC) to the Late Neolithic period, when the SGC groups expanded onto more fertile soils in eastern Jutland, increasing the overall economic importance of cereals (Siemen 2008). In the marshes along the estuary of the Rhine and Meuse, on the other hand, Neolithic settlements seem to have been more integrated within the wetlands. Hunting, fowling, and fishing were still important activities at Swifterbant, Bergschenhoek, and Hazendonk (early/middle Neolithic), as much as they were at Schipluiden in the middle Neolithic, or at Hekelingen III and Vlaardingen in the late Neolithic (Louwe Kooijmans 1987; Bakels and Zeiler 2005; Van Gijn 1990; Verhart 2010).

In Britain and Ireland people did actively exploit wetland environments, but the scale and impact of this activity varied from place to place. Wetland resources were, for instance, not essential, but complementary to the daily practices of people living close to the Humber wetlands, in northeast England (Van de Noort 2004). Similarly, in the Fenland region's fens (East Anglia in eastern England) as well as along the marshy areas of the Severn Estuary, wetlands were used seasonally for animal grazing, while settlements were typically built on higher ground (Bell 2001; Coles and Hall 1998). Further inland, marshes and peatbogs were extensively criss-crossed by a myriad of wooden trackways. One of the best-known areas is the Somerset Levels, with its rich archaeological evidence for Neolithic trackway construction, such as the famous Sweet Track (the oldest trackway in Britain, dendrochronologically dated to 3806 BC), or the sites known as Bisgrove, Chilton, Honeygore, Garvin, Jones, Honeygore Complex, Baker, Blakeway, Walton/Rowland, Bell, and Abbot's Way, all dating to between 3700 and 2500 cal BC (Coles and Coles 1986). Neolithic trackways were as numerous in Ireland (see e.g. the Neolithic trackways at Corlea 8, 9, 10, and 11, and Cloonbony—all built between 3600 and 2500 cal BC), but there, they became much more common in the Middle and Later Bronze Age (Raftery 1996: 284).

Lake settlements seem not to have been popular on Irish lakes during the Neolithic period. According to O'Sullivan (1998), the scarcity could be the result of a 'biased' orientation of Irish archaeological research, which has tended to ignore lakeshore occupation generally. There are in fact some lakes, such as Lough Enagh (Northern Ireland) and, to some extent, places like Rathjordan and Lough Gur, where Neolithic archaeological assemblages have not been properly considered in terms of their wetland associations (O'Sullivan 1998: 61–9). Nonetheless, it does seem the case that people in Neolithic Ireland did turn away from wetlands in their landscapes, in contrast to other social groups across Europe. A similar situation could be seen in Scotland, where, apart from a few known (and key) lacustrine occupations—one of them being a Neolithic island settlement at Eilean Domhnuill, Loch Olabhat (Ashmore 1996)—the majority of lake settlements (mostly known as crannogs) are from the Late Bronze Age and Iron Age (Henderson 1998; Henderson et al. 2003).

In fact, for typical lacustrine sites' archaeological evidence in the Neolithic we must turn to the rich archaeological assemblages of central Europe, particularly the Circum-Alpine region, where, from the end of the fifth millennium cal BC onwards, we have the development of the so-called lake-dwelling phenomenon. Although believed to have had its origins in the Mediterranean region (Schlichtherle 1997), it is in the northern parts of the Alps that the lake-dwelling tradition reached its apex. These Neolithic lake villages include the sites of Egolzwil 3 (Wauwiler Moor) (Vogt 1951), Hornstaad-Hörnle 1A (Lake Constance) (Dieckmann et al. 2006), and Aichbühl (Lake Feder) (Schlichtherle 2002), as well as the more established ones in the fourth millennium BC (see Chapter 15 by Pétrequin and Chapter 17 by Ebersbach in Part 2 this volume). Neolithic lacustrine and marshland settlements are also found in the southern slopes of the Alps, mainly in northern Italy and Slovenia (Ljubljana Marsh) (Velušček 2009). Outside the Alpine area, proper lacustrine Neolithic settlements are those of Hunte 1 (*c.*3250–2550 cal BC) (Kossian 2007) and Hüde 1 (*c.*4200–2700 cal BC) (Kampffmeyer 1983), both located on Lake Dümmer, northern Germany.

Prior to the development of the lake-dwelling tradition in the Alpine region, lakeside settlements were mainly located in the Mediterranean area. Some of the best examples are those of Sovjan (*c.*7000 cal BC), former Lake Maliq in Albania (Touchais et al. 2005), Dispilio (*c.*5300–3500 cal BC) on Lake Kastoria, Greece (Hourmouziades 1996), La Marmotta (*c.*5500–5200 cal BC) on Lake Bracciano, Italy (Fugazzola Delpino and Pessina 1999; Fugazzola Delpino 1995), La Draga (5400–5000 cal BC) on Lake Banyoles, Spain (Bosch et al. 2006), and Isolino Virginia (Lake Varese) (Baioni et al. 2005).

Bronze Age and Iron Age: more complex social interactions with wetlands

Bronze Age

People's relationship with wetlands in the Bronze Age involved both the sacred and profane, although in some places the more highly ritualized perceptions and uses of these environments prevailed. In Sweden, for instance, the Neolithic tradition of offerings and depositions in inland peatbogs continued throughout the Bronze Age. This is shown by discoveries at the Fröslunda Bog, near Lake Vättern, including a large collection of bronze shields (sixteen shields of the Herzsprung type—*c.*950 cal BC) (Hagberg 1988). Whatever the motivation might have been to go into the wetlands, they were never considered to be indefeasible barriers, and this is proven by the number of wooden trackways found in northern Germany (e.g. the corduroy road of Ockenhausen/Oltmannsfehn in the Lengener Moor) (Fansa and Schneider 1993), in Ireland (the various trackways of Corlea and Derryoghil) (Raftery 1996), and the English trackways of Eclipse, Meare Heath, Tinney, and Westhay (Somerset Levels) and Flag Fen in the Fenlands (Coles and Coles 1986; Pryor 2005). Permanent settlements were also integrated in the surrounding wetland landscape, as shown by the various occupations in the Bjerre area in northern Jutland (Denmark), between 1500 and 500 cal BC (Bech 1997: 5).

In Britain and Ireland, Bronze Age inhabitations within the wetlands and people's exploitation of wet environments were not the same everywhere. In the Humber wetlands, for

example, farming activities were more focused on limited stockbreeding (Van de Noort 2004: 54), whereas sites such as St James and Newark Road (in the Fenlands) show permanent occupation and use of extensive field systems in the southern parts of the fens (Pryor 2005; Coles and Hall 1998). In Ireland, evidence of fairly intensive Bronze Age (in particular Middle and Late Bronze Age—1700–700 cal BC) people–wetland interaction is shown by the plentiful *toghers* built within peatbogs and marshlands, as well as by the number of seasonal and/or permanent settlements found around the loughs. Although generally called crannogs and regarded as small residential units, these wetland occupations had different functions. Some of them (e.g. Cullyhanna Lough and Clonfinlough) might have been agricultural farmsteads, while others, such as Rathtinaun (Crannog 61) on Lough Gara, Ballinderry Lough (Ballinderry Crannog no. 2), and Moynagh Lough, might suggest high-status residences, or special gathering places associated with wetland votive deposition (O'Sullivan 1998; Bradley 1991).

In the northern part of the Circum-Alpine region, the lake-dwellings began to appear in the Neolithic, continued throughout the Bronze Age, and came to a sudden end just before the beginning of the Iron Age (Schlichtherle 1997; Menotti 2004a). South of the Alps, in northern Italy, the chronology was slightly different. Here, the lake-dwelling tradition ended much earlier (*c.*13th–12th century cal BC). Just before the last lake-dwellings disappeared, though, we have the development of a distinct contemporaneous (to those last lake-dwellings) wetland settlement tradition known as the *terramare*. Interestingly enough, both traditions faded away at the same time. However, the end of the lacustrine settlements in northern Italy did not stop people from interacting with the wetlands in other parts of the peninsula. In fact, the 12th–11th century marshland occupation discovered near Stagno in Tuscany (Giachi et al. 2010), and the riverine settlement of Poggiomarino on the River Sarno near Pompeii (Albore-Livadie et al. 2005; Menotti 2004b; Pruneti 2002) are the undeniable proofs. Bronze Age wetland settlements are not found anywhere else in the Mediterranean except on Lake Ohrid on the border between Albania and Macedonia, where (especially on the Macedonian shores of the lake) pile dwelling communities became established and thrived throughout this period (Kuzman 2009). A Bronze Age anthropogenic layer, dating to the end of the third millennium cal BC, is also found at Sovjan (former Lake Maliq, Albania, not far from Lake Ohrid), a site already occupied in the Early Neolithic (Touchais et al. 2005; Touchais and Fouache 2007).

In the Baltic Sea regions, Bronze Age wetland settlements were not very numerous. In fact, after a few Neolithic occupations, they almost completely disappeared until the very end of the Bronze Age/beginning of the Iron Age, when people–wetlands interaction intensified again (see below) (Menotti et al. 2005: 383; Pydyn 2007: 323; Gackowski 2000). Conversely, in Belarus, northwestern Russia, and Upper Volga region, major wetland sites such as Kuzmichy 1, Aziarnoye 2B and Kamen 8 were only settled in the first part of the Bronze Age, after a long occupation throughout the Neolithic.

Iron Age

The Iron Age in Europe varies in length, depending on the region (e.g. Scandinavia and the Baltic Sea regions, where it extends well up into the first millennium AD) and, to some extent, on its location in relation to the Roman empire. While in some areas of Europe a sharp decrease in wetland settlements is registered during the Iron Age, in others the number

increased significantly. As mentioned above, the 3,500-year-long lake-dwelling tradition in the northern Circum-Alpine region ended fairly abruptly with the settlement of Ürschausen-Horn (*c.*850–635 cal BC) on Lake Nussbaum, Switzerland (Gollnisch-Moos 1999). A sharp decrease in wetland occupation is also noticed in other parts of central Europe. For example, on Lake Feder, which had been fairly well populated throughout the Neolithic and Bronze Age, the only trace of people–wetlands interaction in the Iron Age consists of evidence for fishing weirs (but no settlement) at Oggelshausen-Bruckgraben (*c.*620 cal BC) (Köninger 2002). The only evidence of Iron Age lakeside occupation in the surroundings of the Alpine region is the Roseninsel site (*c.*392 cal BC) on Lake Starnberg, southern Germany (Schlitzer 2009). The further away from the Alps we go, the more Iron Age wetland settlements we find, such as those of Poggiomarino (Albore-Livadie et al. 2005), Put Blanc (7th–4th century cal BC), and L'Estey du Large (3rd–1st century cal BC) on Lake Sanguinet, France (Maurin 2006), Biskupin (Piotrowski 1998), and the various sites of the Masurian Lakes, in Poland.

With only a few exceptions, Iron Age wetland settlements are more numerous at northern latitudes. While there are areas, such as the Masurian Lakes (northeastern Poland), where the number of lacustrine settlements increased significantly during this period, in other areas, such as Lithuania and Estonia, the number of lake settlements was considerably lower. Two of the best-known Iron Age lacustrine settlements are those of Lake Luokesas (Menotti et al. 2005) and the earliest occupation on Lake Valgjärv in Estonia (Roio 2007: 28). Conversely, the number of 'terrestrial' sites (so-called hillforts) was fairly high (Valk 2008). Similarly, the Scottish crannog tradition reaches its peak indeed during this period. In contrast, in Ireland, Iron Age wetland settlements are rare, and wooden trackways (apart from the spectacular example of Corlea 1) are also less common (Raftery 1996); there are, however, some places, such as the sites of Edercloon, where a persistence of trackway building and object deposition is still discernible in the Iron Age (Moore 2008).

A similar decrease in human activity (especially during the early Iron Age) within the English wetlands seems to be related to environmental change, but people's response was not the same everywhere. For example, while people's contact with the wetlands in the Fenland continued regularly, with even an increase in Iron Age settlements around the fen-edge, on islands, and on the siltland deposits (see e.g. Cat's Water: Pryor 2005: 127–28; Coles and Hall 1998), less activity is noticed in the Somerset Levels (in particular *c.*700–400 cal BC). In northern England, for instance, in the Humber wetlands, settlements were not particularly numerous either; one of the very few examples is the 4th-century BC 'marsh fort' at Sutton Common in South Yorkshire (Parker Pearson and Sydes 1997; Van de Noort et al. 2007). Abundant waterlogged remains of Iron Age wetland villages in England are only found in the Somerset Levels, more precisely at Glastonbury and Meare East and West (two sites). Glastonbury was occupied from about 250 to 50 cal BC (Coles and Minnitt 1995), whereas Meare was probably established earlier and occupied only seasonally (Coles and Coles 1996). Not far from the Somerset Levels, seasonal exploitation of estuaries continued throughout the Iron Age, as is shown by the short trackways and the rectangular house structures of Goldcliff on the Welsh shore of the Severn Estuary (Bell 1999; Bell et al. 2000).

With the exception of northern Scandinavia, intensive agriculture had been adopted almost everywhere in Europe by the beginning of the Iron Age. Consequently, the exploitation of land was accentuated even within wetland contexts. For instance, the Bronze

Age field systems of Bjerre (northern Jutland) became more sophisticated, and this method of land exploitation spread throughout Denmark. Similarly, saltmarsh and pasture ground were also used extensively, as is the case in the Assendelver Polder, the Netherlands (Brandt and Van Der Leeuw 1987), and in northern Germany, for example Feddersen Wierde (Schmid 2002; Schmid and Schuster 1999), whose first occupation was almost synchronous with the last phase of Glastonbury village. As more dry tillable land was used around the wetlands, marshes and peatbogs became more and more linked to sacred activities. Offerings (objects, animals, humans) and depositions already performed in the Neolithic and Bronze Age continued, and even intensified. One of the best examples of bog sacrifices, including weaponry, animals, and humans, is that of Skedemosse (island of Öland, Denmark) (Hagberg 1967). Although human remains in wetland contexts are found throughout prehistory, it is indeed in the Iron Age and pre-Roman/Roman period that the highest number of so-called bog bodies are found (see van der Sanden, Chapter 23 this volume).

Conclusions

People's relationship with wetlands in prehistoric Europe varies significantly across time, and from place to place. In the Mesolithic, for instance, wetlands were exploited mainly for subsistence; hunting, fishing, and gathering activities were carried out within wetland environments, but people preferred to live in drier environments at their margins. The construction of artificial platforms, such as those of Star Carr, Moynagh Lough, and Lough Kinale, though, demonstrates people's willingness to explore the interface between the two environments on a more sustained basis. With the Neolithic, the relationship with the wetlands became more intimate and permanent. Not only did social groups choose to inhabit and exploit the wetlands economically, living on lakeshores all year round (as in the Neolithic Circum-Alpine lake villages), but they started regarding them as sacred places as well, where ritual and offerings could be performed periodically. With the advent of agriculture, and later on the spread of metals (copper, bronze, and iron), people's interactions with the wetlands became more complex. In continental Europe, fortified settlements appear also within wetland environments (e.g. Biskupin and Wasserburg-Buchau), denoting a widespread socioeconomic change. In Scotland and Ireland, this increased socioeconomic complexity is reflected by the construction of isolated, well-protected and/or high-status residences known as crannogs in the Late Bronze Age and Iron Age. This is of course not to say that all crannogs had a similar function; most of them were in fact single-household farmsteads or workshops, while others may have been associated with depositional or ritual activities. A sharp decrease in wetland occupation took place in central Europe from the last phase of the Bronze Age, signalling the end of a 3,500-year-long lake-dwelling tradition in the Circum-Alpine region. At the same time, however, wetlands started or continued to be settled, and even increased in number in other parts of Europe (e.g. the Masurian Lakes in Poland, the eastern Baltic Sea regions, Scotland, and later on Ireland). The more we find out about wetland occupations in European prehistory, the more we realize that they were not isolated social entities, but were fully integrated into widespread interregional socioeconomic networks. Their development and decline depended mostly on direct and/or indirect 'external' influences; in other words, it

was the result of a series of events and factors occurring outside the single settlements, and in most cases spanning long distances. Rather than seeing wetland occupations as liminal or isolated time capsules, we need to study them in relation to wider social, cultural, and economic networks within wider regional contexts.

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CHAPTER 3

EUROPE'S WETLANDS FROM THE MIGRATION PERIOD TO THE MIDDLE AGES

Settlement, Exploitation, and Transformation, AD 400–1500

AIDAN O'SULLIVAN

Introduction

In the Middle Ages, wetland environments in Europe were often portrayed (particularly by clerics) as remote and dangerous wastes, inhabited by monsters, demons, and outlaws and governed by forces beyond human ken. Thus, in the 8th-century *Vita Sancti Guthlaci*, St Guthlac is reputed by his hagiographer, Felix, to have ventured into the fens of East Anglia in southeast England in AD 699, seeking there a place of retreat; there he found, as is traditionally translated, 'a hideous fen of huge bigness, oft times clouded with moist and dark vapours' inhabited by demons (Colgrave 1956). On the other hand, medieval monks were also well aware of the abundant resources of wetlands, so that writing about the same fenland in the 12th-century *Liber Eliensis* (Book of Ely), a monk in the Abbey of Ely mentions 'innumerable eels, large pike, even pickerel, perch, roach, burbots and lampreys, which we call water-snakes' (Fairweather 2005; Hall and Coles 1994: 1). Archaeological evidence from Ely has revealed the rich harvest of the wetlands (Barrowclough 2010: 31–42), while the annual render of Wisbech in 1086 was 33,000 eels, all variously caught with boats, fish-weirs, and wicker traps (Hall and Coles 1994: 1).

Medieval scholars often portrayed wetlands as liminal places at the edge of the world, fluid boundaries between this world and the supernatural. It was a view that probably endured from later prehistory: indeed, in some regions such as Anglo-Saxon England (Lund 2010), Viking Age Scandinavia (e.g. Lund 2005; 2008), and perhaps early medieval Ireland (Fredengren 2002; O'Sullivan 2007), the essentially pagan practice of placing votive offerings of objects into wetland contexts continued well into the early medieval period. On the other

hand, medieval scholars depicted wetlands as wild, dangerous spaces and marginal wastelands—and the people who lived there as eking out a miserable existence—for a reason; they provided a useful backdrop for the actions of heroic saints (or indeed pagan ancestral heroes such as the one described in the Anglo-Saxon *Beowulf*, who fights the monster Grendel and his mother in their wetlands fastnesses), while also creating a moral argument for the physical reclamation and managed exploitation—by the Church—of these landscapes. We should also be aware that these are the views of the educated church elite; missing are the perspectives and voices of the ordinary people—fishermen, herders, farmers—who actually inhabited and worked in wetlands every day. To some extent their lives emerge through archaeology.

It is interesting, however, that most wetland archaeological projects in Europe have tended to focus on prehistory. The proceedings of the various Wetland Archaeology Research Project (WARP) and associated conferences tended to focus on prehistoric archaeological sites, surveys and excavations (e.g. Coles and Lawson 1987; Coles 1992; Bernick 1998; Raftery and Hickey 2001; Coles et al. 1999). Similarly, most wetland archaeology in central Europe has been focused on prehistoric topics, such as Neolithic and Bronze Age lake villages of the Circum-Alpine zone (e.g. Menotti 2004), or the prehistoric trackways or bog bodies of northwest Europe (e.g. Coles and Coles 1986; Raftery 1996). However, there is abundant archaeological and historical evidence that the peoples of medieval Europe inhabited, exploited, and managed wetland environments in various ways as part of their daily lives, practices and economies—and that wetlands were encultured rather than wilderness spaces within the wider settled landscape. From Ireland to Russia and from Scandinavia to the Mediterranean, people inhabited watery landscapes and recognized and exploited the rich and diverse wetland economic resources of coastal marshes, rivers, bogs, and lakes, often also reflecting enduring continuities with the prehistoric past.

Settlement and occupation of wetland environments

Late Roman Iron Age, Migration Period, and early medieval settlement in the coastland marshlands of northwest Europe

The coastal wetland regions of the Netherlands (i.e. North Holland, Groningen, and Friesland), northwest Germany (Niedersachsen and Schleswig-Holstein), and southwest Denmark saw extensive settlement and exploitation in the historical period. The distinctive coastal wetland landscapes of these regions were created by sea-level rise and quaternary environmental changes since the Weichselien glacial period, leading to the creation of nearshore barrier islands and sedimentation over extensive saltmarshes. Further inland, freshwater drainage was impeded by these coastal barriers and progressively larger areas of peatland were formed. Since prehistory, these have been landscapes dominated by water, both marine and freshwater, through sea-level changes, tidal cycles, and dynamic environmental changes. In the late Roman Iron Age and Migration periods (i.e. *c.* AD 400–600), landscapes that had been previously exploited from the Mesolithic to the Iron Age, often by

people inhabiting the dryland Pleistocene sandy districts, were largely inundated during a period of marine transgression and the erosion of coastal barriers, transforming vast areas into inaccessible coastal saltmarshes.

In the Netherlands, northwest Germany, southwest Denmark, and in the British regions adjacent to the North Sea also; such as the Humber estuary (Van de Noort 2004), the East Anglian Fenland (Hall and Coles 1994), and Romney Marsh (Eddison 2000), it seems that coastal wetlands were abandoned or only occasionally occupied at the end of prehistory. Archaeological evidence suggests a thinning out of settlement along the north Frisian coast in the 5th–7th centuries AD (Hamerow 2002: 112). In northwest Germany, the marshlands of the Ems and Weser rivers were occupied up until the 5th century and then abandoned until a period of recolonization in the 7th–8th centuries (Behre 2007; Nösler and Wolters 2009; Strahl 2000: 18; Hamerow 2002: 112). By the early medieval period, a process of recolonization of these coastal wetlands was well under way, although there is significant regional and chronological variation in this. Migration Period and early medieval settlement in the marshes involved people living in dispersed settlements of varying sizes (from the small farms and hamlets of Friesland (around Leuwarden) to both the smaller and the larger semi-planned radial settlements of Groningen, in the Netherlands and in north-western Germany.

A particularly striking aspect of these continental coastal regions was the use and construction of *terpen* mounds within the wetlands, often on sites that had previously been occupied in prehistory (it is thought that the earliest *terpen* date to the Middle Iron Age, at *c.*500–250 BC) (Schmid 1978; Boersma 2005). People lived and worked on these largely artificial island settlements deliberately raised above high tide levels that flooded the saltmarshes, tending sheep and cattle, growing crops, exploiting various wild resources to some extent, and beginning to modify and reclaim areas of wetlands. These *terpen* (also known as *wierden* in Dutch and as *Wierden*, *Wurten*, and *Warften* in German) were settlements (either single farmsteads or villages) built on natural and artificial clay platforms raised above the level of tides, often located close to navigable creeks and channels. In the earliest period, *terpen* were often located on the banks of creeks and ridges running parallel to the coast, within a very high saltmarsh environment. Many *terpen* developed across time into nucleated settlements, many hectares in size, as individual farmstead mounds were joined up through generations of dumping of clay, rubbish, and dung between them. For example, at Ezinge, a village developed across at least a millennium from the Middle Iron Age (*c.*500 BC) to the Migration Period (*c.* AD 400–600). Houses, typically rectangular longhouses with cattle stalls at one end and a smaller domestic household space at the other end, were built of turves, timber, and post-and-wattle (Hamerow 2002: 21; Waterbolk 1989: 303; 1991a: 104; 1991b). They were often laid out within fenced plots oriented radially around a central or communal open space, thus making best use of limited space on the *terpen*, while other features include craftworking areas and workshops, artificial reservoirs of rainwater (*Fething*) above the salty groundwater, granaries, internal pathways, and trackways that led down into the marshes.

Many *terpen* were abandoned in the Late Medieval period as settlement expanded out onto reclaimed land (see below), and where they are known, their houses and dwelling surfaces are less well preserved. However, archaeological excavations at Wüppels, north of Wilhelmshaven, Germany, did reveal a three-aisled long-house dated to *c.* AD 1120, with a byre of cattle stalls, a living area to the west and possibly a loft for storing grain—and this

was a building type that continued in use until early modern times (Strahl 2000: 19–20). Although many *terpen* were lost during 19th-century agricultural reclamation activities in the Netherlands (as the organic soil of the *terpen* was dug out and spread across neighbouring fields), some are still the locations of modern villages. Several *terpen* have been the subject of archaeological excavations including such as van Giffen's (1936) excavations in 1923 and 1934 of a *terp* mound at Ezinge, in the Frisian marshes, northwest of Groningen in the Netherlands; Haarnagel's (1979a; 1979b) excavations in 1955–63 of a spectacularly well-preserved *Wurt* village at Feddersen Wierde, in the marshes of the Elbe–Weser district of Lower Saxony, Germany, and most recently amongst many others, excavations in 1991–3 of a rich Roman Iron Age and early medieval *terp* at Wijnaldum, in Friesland, the Netherlands (Besteman et al. 1999).

Feddersen Wierde, dating from the Iron Age to the Migration Period, provides some insight, although it is not necessarily typical of all *terpen*, into the long-term occupation, renewal, and transformation of these coastal marshland settlements across time (Haarnagel 1979a; 1979b). The site was occupied from the 1st century BC to the 5th century AD, when it was abandoned due to flooding. It was subsequently re-occupied in the 8th century AD, but evidence for this phase is patchy because of later damage (Hamerow 2002: 77; see Fig 3.1 and Fig. 3.2). In the 3rd century AD (Horizon 5), the site consisted of 16 medium-sized and 10 smaller buildings laid out in a radial fashion over a mound that was some 4m in height and covered an area of *c.*4 hectares. Houses were aligned along radial pathways leading to a central open-area. At the east side was a possible *Herrenhof* (a 'chieftain's' farmstead)—a large enclosed complex with large longhouses, a possible meeting hall (indicated by the absence of cattle stalls), a craftworking zone (with evidence for the working of wood, bone and metals), and a storage area with granaries. In the 4th century AD (Horizon 6), there were 22 farmsteads, but now with much less evidence for cattle stalling (Hamerow 2002: 79). In the late 4th–5th century (Horizon 7–8), the village became more dispersed and irregular; fewer houses were enclosed and some houses are interpreted as craftworkers' buildings. Haarnagel (1979a) interpreted this as evidence for a shift from agriculture to craft production as farmland became increasingly marginal through increased floods and salinization.

The economy of the late Roman Iron Age and Migration Period *terpen* was largely based on pastoralism, with cattle grazed on the saltmarshes and stalled within the villages in longhouses, as at Feddersen Wierde and Elisenhof (Reichstein 1991: 73; 1994). Cattle herds were managed as dairy herds and a large proportion of male calves were slaughtered to ensure best use of fodder. By the 8th century there was a widespread shift towards crop cultivation in northwest Europe, but obviously local practices endured too. At the 8th–11th-century *Wurt* site of Elisenhof, aisled longhouses continued to be used, indicating the ongoing importance of cattle pastoralism (Strahl 2000: 19). It is possible to estimate the size of cattle herds and the land areas exploited by individual farmsteads. At Feddersen Wierde, it is suggested that settlers exploited *c.*300 hectares of wetlands for cattle grazing, with only 50 hectares available for crop cultivation (Hamerow 2002: 131; Schmid 1995: 237; 2002). In the 3rd century AD, Feddersen Wierde may have had a population of up to 300 people and 450 cattle, and on the assumption that one medieval cow would need 1.5–2 hectares of grassland, there may have been insufficient land for them all; cereal products may have been imported in exchange for dairy products and wool (Hamerow 2002: 131).

However, the *terpen* and raised areas within the marshes were also used for at least some crop cultivation, with plough irons known from some settlements, and evidence that villagers were growing barley, beans, oats, flax, turnip, and hemp. Other livestock were also

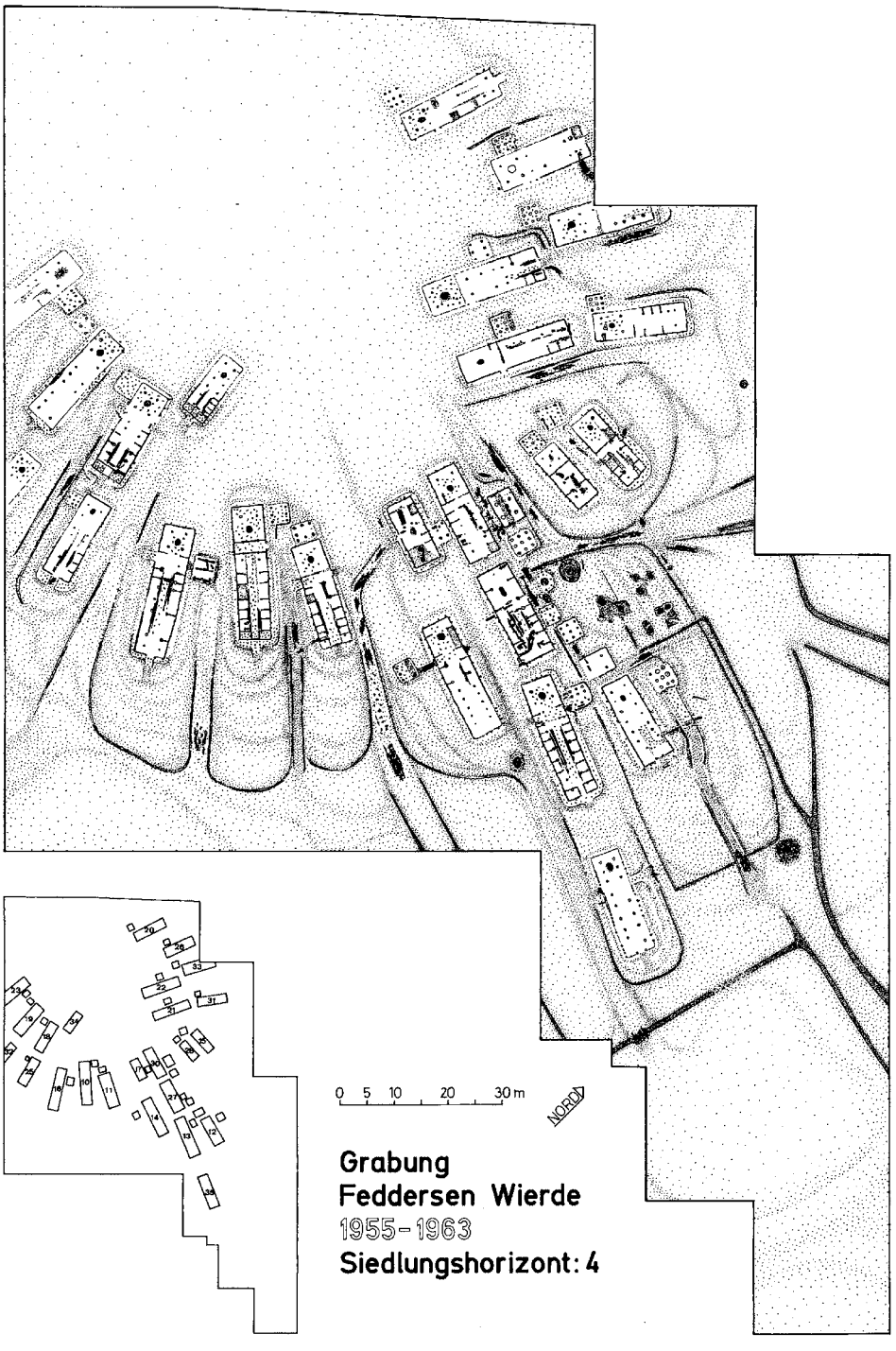

FIGURE 3.1 Feddersen Wierde, Germany, a terp mound occupied from Iron Age and after a phase of abandonment, up until the early medieval period: plan of later prehistoric phase 4 occupation levels. By the 3rd century AD (Horizon 5), the site consisted of 16 medium-sized and 10 smaller buildings laid out in a radial fashion over a mound that was some 4m high and covered an area of *c.*4ha. (Based on Haarnagel 1979a: reproduced with permission of Niedersächsisches Institut für historische Küstenforschung (NIhK), Germany.)

FIGURE 3.2 Reconstruction model of Feddersen Wierde, Germany. (Reproduced with permission of Niedersächsisches Institut für historische Küstenforschung (NIhK), Germany.)

kept, including pigs and sheep, and the latter were also very important for wool production. Some coastal *Wurten* settlements, such as Hessens and Elisenhof, may have specialized in wool production, with large flocks of sheep grazed on the saltmarshes. At the east Frisian *terp* of Hessens, located to the southwest of Wilhelmshaven, the importance of sheep is indicated by the presence of a sheep-dip in the centre of the settlement (Annette Siegmüller, pers. comm.). At Elisenhof, 80 per cent of sheep were kept to maturity, indicating their importance for fleece (Bender-Jørgensen 1992: 149). Textile production and trade may have been an important source of wealth in the region, with Frisian cloth (possibly the cloth known in historical sources as *pallium fresonicum*) in particular being well regarded in Merovingian and Carolingian times (Bender-Jørgensen 1992). At Hessens, a group of at least 4 longhouses was occupied between the 7th and the 10th centuries AD on a mound between two navigable water channels (only about 20–25 per cent of the terp was excavated, so it is likely there were actually about 15–20 longhouses at this time (Siegmüller and Bungenstock 2011; Annette Siegmüller, pers. comm.). In the 7th century, one building was extended and converted from a three-aisled longhouse and stable into a boat-house with a slipway for a small boat. The presence of numerous pieces of high quality textiles indicates that this community were probably engaged in the production and trade of cloth along the marshland waterways (Wulf 1991; Hamerow 2002: 183; Siegmüller 2010: 220; Siegmüller and Peek 2009).

Recent archaeological excavations at Wijnaldum-Tjitsma, Friesland, the Netherlands, have revealed some contexts for these trading connections (Besteman et al. 1999). Wijnaldum-Tjitsma was a *terp* that was 1st established in the 2nd century AD, flourished for a period, and then, like other *terpen* in the Westergo region, was abandoned in the 3rd–4th century AD. The site was then reoccupied, possibly by migrant peoples from northern Germany or Denmark, who used different house styles (including sunken huts), site layout, and material culture, in the later 5th century AD. At this point, settlement activities expanded and different house-*terpen* were combined to create a large *terp*. Interestingly, agriculture does not seem to have been a predominant concern. From the Migration Period onwards and up to the 8th century, daily life in the settlement was often devoted to small-scale craft

production including spinning, weaving, bone- and antler-working, gold- and silver-working, and glass- and possibly amber-working. Finds (i.e. brooches, glass vessels, horse-gear, and weaponry) indicate that although relatively prosperous, the site's inhabitants were not of the aristocratic class, but were probably the clients of a nearby royal settlement. In the 6th/7th century, this was a community that had extensive trading connections with other parts of northern and western Europe, particularly the Anglo-Scandinavian world, especially England and the Middle Rhine area.

The abandonment of many *terpen* has long been a subject of debate and linked to questions of ethnicity, migrations in the North Sea regions, and the subsequent Anglo-Saxon colonization of England. From the end of the 6th century AD, people were returning to the Frisian marshlands, often re-occupying earlier *terpen* mounds. These may not have been the descendents of their original inhabitants, but later prehistoric/late Roman Iron Age *terpen* mounds were often still a focus for settlement in the wetlands. Far from being marginalized groups eking out a miserable existence in the marshes, these were often both powerful and wealthy social groups. In the 6th and 7th centuries, the North Netherlands region became the focus of the kingdom of Frisia, the power of whose kings extended from the Schelde in Zeeland to the Weser in Germany and perhaps around and up into Jutland. The wealth of Frisia was based on the trade of prestige goods and an emerging market in commodities around the North Sea region and in the production of textiles and salt in the Frisian saltmarshes (Van de Noort 2011: 114–15). By the 10th century, as populations grew, *terp* settlements were being expanded and reclamation activities often began in earnest as embankments and drainage ditches were constructed, with some raised trackways (*dijkwegen*) between *terpen* serving as a prototype sea bank (Rippon 2000: 183–5). A Norse Icelandic Saga, *Egil's Saga*, gives an account of a Viking raid into Frisia in the 10th century AD, and describes a flat landscape of fields and meadows defined by water-filled ditches.

The peatland districts lying inland of the coastal marshlands of the Netherlands were also reclaimed and colonized in the early medieval period, reflecting in some cases cultural expansion and wealth, rather than any sense of occupation in marginal landscapes (Besteman 1988; 1990; Besteman and Guiran 1987). Besteman (1990: 117), in his study of the colonization of the peatlands of the province of North Holland, in the western coastal region, considers the early medieval sociopolitical context of patron and clients. The king, occupying the top of the feudal pyramid, would have been perceived as the landowner of any 'wilderness' such as the peatlands of North Holland. However, with the declining control of the Carolingian kings over their vassals after the middle of the 9th century, the latter usurped the peat bogs for themselves. A continuing erosion of the political structures, and an increasing geographical distance between the seats of the local elites and the reclamations in the subsequent centuries, gave rise to groups of 'free farmers'. These 'free farmers' were no longer bound by oath, obligation, or tax to their patrons, and these apparently marginal wetland landscapes had become fundamentally attractive places to live.

Viking Age and medieval lake settlements in northern and northeastern Europe

There are a number of wetland settlements dating to between the 9th and 12th century in Scandinavia and the Baltic countries, although they are certainly not as numerous as those

known from the Bronze Age and Iron Age. These sites mostly take the form of large island settlements, some of which were palisaded in the form of a military fortification. These include the prehistoric and historic pile-dwelling of Lake Valgjärv in Estonia, which was occupied some time between the 6th–9th centuries AD (Roio 2007: 31). There is also the Lake Āraiši site in Latvia (dated to the 9th–10th centuries AD), which was an island situated 50m from the shore, upon which there were at least 146 buildings, 76 of which were dwelling houses, with extensive evidence for hunting, fishing, crafts, and trade (Roio 2007: 30–31). In Poland, most lake-dwellings again appear to date to later prehistory, but there are also at least some sites that date to the medieval era. The site of Parsecko, in the Pomeranian region, was investigated in the 19th century and probably dated to the 11th to 12th century AD. It was probably an island settlement of up to 60 rectangular buildings, accessed by bridges and defended by a palisade (Pydyn 2007: 327–28). In Scandinavia, there is also the unusual and massively constructed Viking Age lake fortification known as the Bulverket, located on Lake Tingstäde Träsk on the Island of Gotland (Sweden). This was a fortified settlement of houses situated on a series of wooden platforms or caissons that formed a massive square structure, 170m long, open in the centre with a palisade enclosing it. The Bulverket has produced radiocarbon dates of AD 1000–1200 and dendrochronological dates at about the AD 1120s (Rönnby 1990; Larsson 1998; 2001). One might also mention that in the marshland regions of western Russia there are numerous settlements that are effectively wetland inhabitations. The medieval town of Novgorod (dated from the mid-10th century AD) owes its spectacular waterlogged preservation of houses and streets—and abundant assemblages of organic artefacts—to its siting in a lowlying marshy area (e.g. Brisbane and Gaimster 2001; Brisbane and Hather 2007).

Early medieval and medieval crannogs and lake-dwellings in Ireland and Scotland

Moving out to Atlantic Europe, in Ireland (O'Sullivan 1998; Fredengren 2002), Scotland (Cavers 2006; Crone et al. 2001; Dixon 2004), and Wales (Campbell and Lane 1989), there is also abundant and distinctive archaeological evidence for wetland settlements in the form of crannogs (see Chapter 16, Henderson and Sands for a detailed review of crannogs). In later prehistoric, early medieval (AD 400–1100), late medieval (AD 1350–1600), and early modern Ireland (AD 1600–1750), people often built and lived on small artificial islets of stone, earth, and wood situated out in the watery shallows of smaller lakes (e.g. O'Sullivan 1997; 1998; 2000; 2001a; 2001b; 2007; 2009; Fredengren 2002). Since the 19th century in Ireland, crannogs have been the subject of antiquarian investigations, while the archaeological excavation in the 1930s of such sites as Ballinderry Crannogs No. 1 and 2 (Hencken 1936; 1942) and Lagore (Hencken 1950) were key and formative events in the development of Irish archaeology (Hencken 1941; Lynn 1983; O'Sullivan 2003a). Modern multidisciplinary excavations of sites such as Moynagh Lough (Bradley 1991), Sroove, Co. Sligo (Fredengren 2002), Lough Kinale (Fredengren et al. 2010; O'Brien et al. 2005), and Coolure Demesne (O'Sullivan et al. 2007) have revealed good evidence for their houses, pathways, palisades, middens, and the debris of domestic activity and craft production. Recent archaeological surveys have also indicated a diversity of chronology, size, morphology, siting, and location (Fredengren 2002; Fredengren et al., 2010; O'Sullivan et al. 2007; Fig. 3.3).

FIGURE 3.3 A view of Coolure Demesne crannog, Lough Derravaragh, Co. Westmeath, in the Irish midlands. This crannog was occupied in the Late Bronze Age, Iron Age, and early medieval period—when it probably served as the royal residence of a population group known as the Uí Fíachrach Cuile Fobair—and the late medieval period. (Photograph by Aidan O'Sullivan: from O'Sullivan et al. 2007.)

Early medieval and medieval crannogs have traditionally been interpreted as defensive island refuges occupied at times of danger, or as high-status or aristocratic lake-dwellings used for lordly social display and prestige (e.g. O'Sullivan 1998; 2000). It is certainly clear that some crannogs (e.g. Lagore, Co. Meath; Hencken 1950) were aristocratic residences for kings and served as defensive strongholds, summer lodges, and symbols of power within territories (O'Sullivan 2009). Some others such as Ballinderry Crannogs No. 1 and 2 (Hencken 1936; 1942) were probably occupied by lordly classes, judging by the rich material cultural assemblages and evidence for diet and economy. Some crannogs may have been owned and used by the Church, and early medieval ecclesiastical metalwork (e.g. handbells, crosses, and book shrines) found on some midlands crannogs (if these were not votive deposits) suggests their use as storage places for relics or perhaps even as island residences for anchorites and hermits supported by a nearby monastery (O'Sullivan 2009).

Multidisciplinary approaches, combining archaeology with such historical sources as hagiographies and narrative literature, indicate that the early medieval Irish imagined crannogs to be essentially islands separate from the mainland (the word *crannóg* does not appear until the 13th century—until then they are revealingly always termed *inis* and *oilén*, both meaning 'island'; O'Sullivan 2001a; 2009). Early medieval literature, saints' lives, and the annals all portray crannogs in interesting ways; they are frequently associated with violence and depicted as places that could be built, fortified and inhabited, destroyed by fire, looted and sacked by raiders on boats, and overwhelmed by winter storms and floods. In the 9th–12th centuries AD hagiographies, saints frequently confront and defeat powerful individuals, usually kings, on their crannogs or defeat monsters on lake islands. In 9th–10th century voyage tales and adventure tales, islands are also seen as fantastic, otherworldly places, where heroes go to eat sumptuous feasts within fantastic houses, fight battles, and negotiate in various ways with

otherworldly women (O'Sullivan 2009). By inhabiting distant islands, by travelling to them by boat, or by negotiating with others upon them, the community's leaders, whether they were kings, saints, or other male figures, were thus depicted as having an ability to confront otherworldly forces to the benefit of the community. It seems likely that powerful groups used their liminality, bounded nature, and enigmatically distant architecture in discourses of power within tribal territories—and they also seem to be symbolic of Gaelic Irish traditions in the later Middle Ages and early modern period (O'Sullivan 2001a; 2001b).

Moynagh Lough crannog, Co. Meath, was in the 8th century a prosperous island settlement situated relatively close to shore, with extensive views across a lake (Bradley 1991; O'Sullivan 1998). The crannog, measuring *c.*35m in diameter, was enclosed by a post-and-wattle palisade and had at least three roundhouses, one of which measured 11.2m in diameter. There was evidence in the faunal remains—mostly cattle, with some pig and sheep—for dairy herding and high-status feasting, but little evidence for the exploitation of wetland resources. There was also extensive evidence for on-site copper-working and the production of high-status jewellery, such as copper alloy brooches, suggesting the patronage of metalworkers by a lordly class.

However, several crannogs have produced relatively modest material assemblages and could be interpreted as the island homesteads of the 'middle classes' or perhaps even the poor (Fig. 3.4). Indeed, most sites may have been like Sroove; the lakeshore dwellings, if not of the poor and unfree, certainly of groups of lower social status (Fredengren 2002). The early medieval crannog at Sroove, Co. Sligo, dated to between the 7th and 10th centuries AD, was used in diverse ways across time. It was initially a small island dwelling, with a house

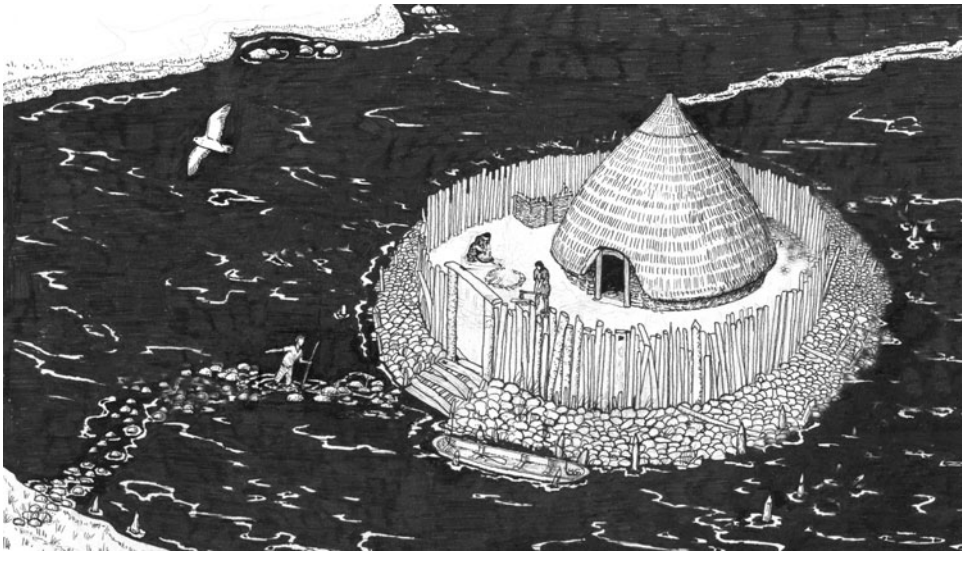

FIGURE 3.4 Reconstruction of an early medieval crannog in Ireland. Archaeological surveys suggest that while some early medieval crannogs were lordly or royal sites, most were probably relatively small islets with roundhouses surrounded by wooden fences and connected to the shore by stone causeways, and were occupied by lower social classes. (Drawing by Aidan O'Sullivan; from O'Sullivan 2009.)

enclosed within a wooden palisade. Its inhabitants left few material possessions, although they certainly had access to cattle, pig, and sheep meat, as well as cereal grain. There was almost no attempt to 'exploit' the lake's wetland resources of fish, waterfowl, or plant foods. The island was used towards the end of the early Middle Ages as an open-ai iron-working platform, seemingly not functioning as a settlement. Fredengren (2002) demonstrated how a small crannog could have functioned firstly as a domestic residence, then as an open-air platform of shattered stone used for forging iron, before it was finally abandoned. Other smaller early medieval crannogs such as Bofeenaun, on Lough More, Co. Mayo (O'Sullivan 1998: 121–3), served as seasonal or temporary occupation sites used for specialist crafts, particularly ironworking.

Early medieval crannogs and lake-dwellings in Scotland

Although most studies of crannogs in Scotland have tended to focus on their Late Bronze Age and Iron Age construction and use (e.g. Cavers 2006; 2010; Harding 2000; Crone et al. 2001; Henderson 2009), there is also excellent evidence for their role in the early medieval and late medieval periods (Morrison 1985), such as at the Buiston and Loch Glashan sites (e.g. Crone 2000; Crone and Campbell 2005). Striking evidence for the dynamic occupation of an early medieval crannog was revealed by excavations at Buiston, Ayrshire, in southwest Scotland (Barber and Crone 1993; Crone 2000). Buiston crannog, during the main phase of its occupation in the 6th–7th century AD, was probably the island stronghold of a small community of farmers, who were fairly self-sufficient and prosperous without being particularly wealthy (see Chapter 16; Figs. 16.5 and 16.6). Initially, radiocarbon dating seemed to indicate a long period of occupation at Buiston, from the 2nd to the 7th century AD. However, dendrochronology indicated that the site's history of occupation and abandonment was surprisingly dynamic and compressed into a relatively brief 80-year period, between AD 589 and 630.

The early medieval occupation at Buiston began at the end of the 6th century AD, at about AD 589, as an island dwelling on a site that had seen some activity in the Late Bronze Age and Iron Age. It may also have been the deliberate reactivation of an antique site which had associations with ancestors, a common phenomenon in both Ireland and Scotland (Henderson 1998; Cavers 2006; O'Sullivan 1998; Fredengren 2002). This Phase III crannog was built as a small 'packwerk' crannog: a mound of timber, brushwood, peat, and stone was dumped onto the earlier deposits and natural lacustrine muds. It was enclosed within a double palisade and was rebuilt and resurfaced on a number of occasions. There was at least one early medieval roundhouse (House A), possibly 5.6m in diameter, which was occupied for five years; within that time, the hearth and floor were replaced three times. Insect studies reveal that there were large amounts of fly puparia and beetles from rotting vegetation, indicating that people would have endured great swarms of house-flies that thrived in the rotting organic material lying on the floor. So plentiful were these flies that people might have suffered from maggots and fly-borne skin diseases. A period of flooding ensued, but the people returned again.

In AD 594 the entire crannog was levelled and rebuilt over a year or two, extending its surface further towards the northwest, suggesting a change in the household group. House B, a roundhouse 8m in diameter with internal partitions, and the largest house to be used on the dwelling, was constructed of a double wall of post-and-wattle and used as a dwelling for the next twenty years, during which time the hearth and floor were replaced four times, every

five years or so, the last time in 609 AD. In AD 620 the site's inhabitants decided to consolidate the site with something more substantial, and a timber ring-beam palisade was constructed, perhaps with a walkway, to be later followed by an arc of alder stakes in AD 630. At some stage, this palisade collapsed out again. People continued to occupy the site, but now it was moving towards the final phases of its occupation and the crannog was probably abandoned by AD 650.

Palaeoecological studies of the waterlogged deposits revealed various insights into the living conditions they experienced. Insect studies revealed that there were relatively few beetles in the deposits, possibly reflecting the fact that the site did not see continuous occupation. Sheep parasites probably indicated the presence of sheep skins brought in for wall hangings and bedding. The absence of cattle dung indicates that animals were not kept on the site. However, this was a farming group who worked the local landscape. Cattle, sheep and pigs, and even geese were tended and eaten. Wooden churn lids demonstrate the importance of dairying and butter-making and a wide range of cultivated foodstuffs, including barley, oats, and linseed, were consumed. Quern stones attest to the preparation of some grain for porridge or breadmaking. Interestingly, wild foods were gathered and red deer and roe deer were hunted. Perhaps the most fascinating aspect of Buiston crannog is the revelation through wetland archaeological investigations of how people constantly struggled and coped with mucky, damp conditions, perpetual flood waters, structural collapse, and buzzing flies. They chose to live with the problems of slumping and structural collapse, as waterlogged deposits settled into position and slid outwards. For one household or social group over two generations, this island dwelling was a place of constant work and renewal, with houses and palisades rebuilt, floors relaid, and hearths reconstructed at very short intervals indeed.

Early medieval fortified lake settlement at Charavines-Colletière, France

The lake-dwellings of the Circum-Alpine region of central Europe are well known, but are almost entirely dated to the Neolithic and Late Bronze Age (Menotti 2004). However, amongst the most remarkable medieval wetland settlements in France is the 11th-century fortified lake-shore settlement at Charavines-Colletière, on Lac de Paladru, Isère, southeast France (Colardelle and Verdel 1993a; 1993b; 1999; Coles and Coles 1996: 78–86). This site was investigated through an underwater archaeological excavation and an extensive multidisciplinary palaeoenvironmental analytical programme, and the results provide a unique insight into medieval daily life and economy, as well as the chronology and occupation history of the site (Fig. 3.5). Dendrochronological studies revealed that the first trees for the wooden structures were felled in AD 1003, that the main felling occurred in AD 1007–8, and that no wood was felled after AD 1040. In other words, the site had a relatively short and dynamic history of occupation lasting no more than three decades. Colardelle and Verdel (1999: 189–90) interpret Charavines-Colletière as a settlement established *c.* AD 1000 by a new type of social group—knight-farmers—at a time of population and sociopolitical change associated with the proto-feudal transformations of *L'An Mil*.

The settlement was located on a small local rise at the edge of the lake, separated from the dry land by marshy ground. At the time of its foundation, woodland cover prevailed in the surrounding landscape, which had not seen much settlement activity since the Roman

FIGURE 3.5 Reconstruction drawing of a medieval fortified lake settlement dated to *c.*AD 1003–1040 at Charavines-Colletière, on Lac de Paladru, Isère, southeast France. (Based on images in Colardelle and Verdel 1993b; from Coles and Coles 1996.)

period. A period of warmer climate and a fall in lake levels possibly enabled settlement at this particular location; conversely, as lake levels rose decades later after AD 1040, the site was abandoned. The settlement consisted of a rectilinear enclosure defined by a heavy wooden palisade, enclosing a space of 1,300 m^2, within which there were at least three larger wooden buildings, along with several sheds and workshops. The site probably had a gate at the water's edge and a more elaborate entrance facing the land. The central main, rectangular building I had a tower 14m in height and was probably the main focus of inhabitation, with an attached stable and porch, and every indication that its inhabitants were wealthy. Building III was represented by unexcavated posts, while Building II dates to the 1020s and started life as a stable, but was used for human occupation after a period of rebuilding. Outside of Building II there was a metalworking area and a forge.

The site was located in an environment that was initially rich in woodland cover, though large areas were cleared for cultivation (and after the site's abandonment, much of this woodland regenerated). The people of the settlement grew rye, some wheat, as well as oats, barley, flax, and hemp and possibly grapes for wine, as well as peas, beans, and millet (Colardelle and Verdel 1999: 185). Faunal analyses indicate that their diet included a lot of pork—perhaps as much as one pig a month over the thirty years of occupation—as well as sheep/goats, some cattle, and hens (Coles and Coles 1996). Other animals around the site included horses, dogs, and cats. As might be expected by its location, wetland resources were exploited to at least some extent particularly in the earlier years of occupation. People collected acorns, beechnuts, hazelnuts, and huge quantities of walnuts, as well as cherries, strawberries, raspberries and sloes, hips, and haws later on. There was some hunting of red and roe deer, hare, and wild birds, but it was the domesticated animals that provided most of the meat. Fish, such as perch and possible roach, were caught in late winter and early spring, augmenting the diet and providing food for those days when a Christian community would abstain from meat.

The site's inhabitants probably included families, and the artefactual evidence indicated that they were relatively prosperous and self-sufficient, with finds including agricultural

tools, wooden utensils, woollen cloth, musical instruments, and gaming pieces (Coles and Coles 1996; Colardelle and Verdel 1999: 185). However, there is also clear evidence that this was a militarily oriented social group, comprising both mounted cavalrymen and footsoldiers. There were several objects relating to horses, including harness, bits, saddles and bridle fittings, and spurs. There was also a range of weaponry, including spears or javelins, fighting axes and swords, crossbows, and bows and arrows. It seems likely that Charavines-Colletière was a settlement of a wealthy family—farmer-knights as they have been described—and their dependants (Colardelle and Verdel 1999: 189). They may have established this fortified settlement—at a time when at least three others were being established around the lake—as part of a bid by the local archbishop of Viene to control the local territory of Sermorens against the bishopric of Grenobles (Colardelle and Verdel 1999: 189)

Amongst the valuable aspects of the project was again the ability of wetland archaeology and dendrochronology to trace the dynamic character or cultural biographies of settlements across time. When the main building I was established, building II was probably a stable. However, the latter shifted in use and became a dwelling for people after *c.*AD 1020. However, the people who inhabited it ate no venison, and consumed more of the wildfowl eaten on the site. Additionally, their diet was more dominated by beef than pork, unlike their neighbours in the main building. Presumably these were the dependants of the wealthy household who used the main building. At about AD 1040, the settlement—and others around the lake—was abandoned as lake levels rose, at a time when historical records claim that the years AD 1033, 1034, and 1035 were exceptionally wet. Not long after, in the early 12th century, small mottes or stone castles were built in the same territories as the former lake-shore dwellings, probably by their descendants.

Exploitation and movement in wetlands

It is evident that medieval peoples across Europe exploited wetland environments—bogs, lakes, rivers, and coastal marshlands—in a range of ways. People also moved into wetlands themselves to fowl for birds in fens and marshy areas, to trap fish, to gather a range of raw materials (wood for building and crafts; reeds for thatch; peat for burning in domestic fires; occasionally bog iron ores for metal production). Salt production was a significant source of income and livelihood in some parts of northwest Europe, usually carried out by boiling off brine at salterns (Rippon 2000: 226–7). Coastal marshland environments, particularly saltmarshes, provided excellent seasonal grazing for sheep and cattle, and in some regions during the medieval period, vast herds of sheep were tended on marshes to produce wool. Reclaimed coastal marshes (see below) were also utilized for tillage and pastoral farming, while water channels were used to power watermills for grinding grain.

Medieval fishing and fish weirs

In the Middle Ages, fish were an important part of the diet for much of the population, whether for monastic houses or for people living in growing towns (Aston 1988; Dyer 1988; Childs and Kowaleski 2000). Medieval fish weirs provided a harvest of rivers, estuaries, and

coastal waters that could be used to sustain these populations. Fish weirs are barriers of stone walls or wooden fences, erected in estuaries and rivers, designed to catch fish either on ebbing or flooding tides (Salisbury 1988; 1991). Recent coastal archaeological surveys in Britain and Ireland have produced an array of evidence for the construction and use of wooden and stone fish weirs throughout the Middle Ages (O'Sullivan 2001c; 2003b). These fish weirs, with their wooden fences, basket traps, and other features, vary in location, size, date, and complexity. Regional and local traditions are evident, and it has been suggested that fish weirs provide interesting insights into the labour and practices of medieval fishing communities, particularly in terms of cultural continuity and social identity (O'Sullivan 2003b; 2005; Van de Noort and O'Sullivan 2006: 79–87).

This sense of regional and local variations can particularly be seen in Mont St Michel Bay in Normandy (Billard et al. 2006; Billard and Bernard in press). The earliest fishweirs in Mont St Michel Bay date back to the Early to Middle Bronze Age, but most of the dated fish weirs are from the Middle Ages, including thirteen 6th–9th-century wooden and stone-built V-shaped weirs over an area of 15 ha at Champeux 'Les Falaises', and 10th–12th century fish weirs at St-Pair-sur-Mer and Champeaux. These were typically large, stone-built, V-shaped weirs designed to catch fish on an ebbing tide. Many of these weirs are known in 15th-century historical records and some are referred to by name, often in historical documents associated with the abbey of Mont St Michel, while some continued to be used until modern times.

In Britain, there is also a sense that different types of fish weir are being used along the coast. On the Blackwater estuary, Essex, fish weirs have been typically dated to the Anglo-Saxon period, between AD 650–800; although there is fishing activity up until the 10th century AD (Gilman 1998; Hall and Clarke 2000). The Anglo-Saxon weirs are usually large (with fences up to 100m–300m in length), L-shaped or V-shaped structures built of oak, alder, birch, and willow posts, with well-surving baskets of hazel buried in the clays at the trap ends. At the Sales Point fish weir at the mouth of the Blackwater estuary—located close to a small Saxon church—a large, thick deposit of fish bone was situated beside the pound or trap end indicating that cod and bass fish were being gutted and filleted on the mudflats and the fishbone dumped beside the weirs (Strachan 1998).

On the Severn estuary, Wales, there is evidence for several different types of medieval weirs (Godbold and Turner 1994; Turner 2002). In the Anglo-Saxon period, (6th–9th centuries) V-shaped weirs were common, somewhat similar to types found elsewhere around the coast of Britain, and these may be what are termed in 11th-century documents 'Haecweras' or hedge weirs (Rippon 2000: 221). In the 11th–12th centuries, a new type—known in the sources as 'cytweras'—seems to have emerged that was basically very similar to the modern 'putt' weirs in use on the Severn until recent years. These 'putt' weirs comprised massive three-piece baskets erected on wooden platforms in rows across the mudflats, with fences guiding fish towards them. Dendrochronological evidence suggests their repair every few years, and use of the same place over decades (Nayling 1997; 1999). These weirs were oriented to harvest virtually all fish (down to shrimp size) from the ebbing tide. Historical documentary sources link many of these fish weirs with local bishops, suggesting yet again that these weirs were owned by the church.

On the Shannon and Fergus estuary in Ireland, there are now at least 50 fish weirs dated to between the 5th and the 15th centuries AD (e.g. O'Sullivan 2001c; 2005; 2010). Recent intertidal archaeological surveys at Boarland Rock, on the Fergus estuary, Co. Clare, have revealed at least 25 medieval fish weirs situated over a stretch of shore, 1km in length (O'Sullivan 2010).

In the 12th/13th centuries, these were small, wooden V-shaped ebb weirs, with fences 30–40m in length and multiple basket traps. By the early 15th century masive V-shaped weirs, such as that found at Boarland Rock 1, were constructed with fences up to 120m in length (Fig. 3.6). The shift in scale of fishing activity may well relate to development of an Augustinian abbey on Canon Island. By the early 16th century the tradition of using large V-shaped weirs may have died out, and there was a shift in emphasis towards the use of single-basket eeltraps fastened to the muds. Although fishing communities had worked here for generations, changing social and economic fortunes influenced changes in actual fishing practices (Fig. 3.7).

Movement and trackways in wetlands

People moved into wetlands for various reasons in the medieval period. Wooden and stone trackways in bogs have certainly been dated to the medieval period, although rarely in numbers equivalent to the large numbers of prehistoric trackways of Germany, England, or Ireland (see Brunning and McDermott, Chapter 21). Anglo-Saxon, Viking Age, and medieval wooden causeways and bridges are known from England, Denmark, and Norway, where they typically date in the latter country to between the 9th and the 15th century AD (Smedstad 2001: 194). The more prominent and ambitious of these Viking Age causeways or wooden bridges across rivers or marshlands were often constructed as royal building projects, demonstrating the power and centralizing influence of local kings. A wooden bridge at Ravning Enge , Denmark, built in AD 980 was probably one such structure, associated with political and military activity during the reign of Harald Bluetooth. Viking Age bridges are also occasionally associated with votive deposition of objects such as weapons, particularly in

FIGURE 3.6 Medieval fish weir at Boarland Rock 1, Fergus estuary, Ireland, radiocarbon dated to AD 1414–1444. Recent intertidal archaeological surveys on the Fergus estuary have revealed a complex of 25 medieval fish weirs at this site dated from the 12th to the early 16th century AD, indicating continuities of practice over many generations of medieval fishermen. (Photograph: Aidan O'Sullivan.)

FIGURE 3.7 Reconstruction of a medieval fish weir with vertical post-and-wattle fences and horizontal woven basket traps, based on a medieval fish weir at Bunratty, Co. Clare, on the Shannon estuary, Ireland. (Reconstruction painting by Simon Dick; from O'Sullivan 2001c.)

Denmark, where they represent an aspect of pagan religious practice going back into the prehistoric past (Lund 2005).

There is certainly also a range of Irish medieval and post-medieval historical and archaeological evidence for wooden and stone 'toghers' (from the Irish word *tóchar* for road) in Ireland's midlands bogs (Lucas 1985; McDermott 1998; Moore et al. 2003; Whitaker 2009; Whitaker and O Carroll 2009; McDermott et al. 2009). These, like prehistoric trackways, have often been interpreted as structures that crossed or spanned the entire wetlands, as befits the modern perception of bogs as essentially wastelands or obstacles to travel (see Stanley 2003: 65). In fact, it is now known that large linear causeways that traverse a bog from one edge to another constitute only a small proportion of bog trackways, and most are in fact small, narrow pathways or platforms constructed of single planks laid lengthways, or hurdles, poles, or bundles of brushwood (McDermott 1998: 7; Stanley 2003: 65).

Although raised bogs or mires are not as resource-rich as coastal or riverine wetlands, they could have accommodated some hunting and fowling, and the gathering of some plants for medicinal purposes, crafts, and building, while also providing turf for fuel. Raised bogs can also be used intermittently for short-term seasonal grazing by burning the top layer of the bog, for the preservation of butter, the seasoning of wood, and the curing of leather. Stanley (2003) suggest that smaller wooden trackways indicate activity on the surface of the bog itself, rather than an attempt to cross it, and encourage 'a richer interpretative outlook in which bogs were part of everyday life for many people in the past and at different times would have represented a resource, a boundary, a barrier/refuge or a sacred place' (Stanley 2003: 65). Similarly, whether in prehistory or the Middle Ages, a bog can be regarded as a 'vernacular landscape, a place for everyday life and practice in fens and marginal woodlands' rather than a boundary to be crossed. At Derryville, Co. Tipperary, by the early Middle Ages (i.e. AD 650–1250) the presence of hut sites and trackways in the bog reveal an increasing activity, perhaps even inhabitation, on the surface of the raised bog itself, while waterlogged and

unsafe locations within the bog seem to have been demarcated by rows of stakes (Cross May et al. 2001a; 2001b).

Occasionally, medieval trackways within and across bogs indicate continuities with the prehistoric past. For example, the early medieval monastic settlement of Lemonaghan, Co. Offaly, in the Irish midlands was established in the 6th century AD on a bog island, apparently remote from other contemporary secular settlements. The traditional interpretation of this 'monastic island' within a region of bogland would have been that it was result of ascetic monks seeking spiritual isolation in the wilderness, inspired by the writings of the Coptic desert fathers such as St Anthony. However, archaeological surveys in the raised bogs around the island revealed that there were numerous trackways there, indicating that it was on a node of communication. Moreover, although some trackways were early medieval, late medieval, and even post-medieval in date and many contemporary with the monastery, other trackways leading to and from the island were dated to the preceding Middle Bronze Age and Iron Age (McDermott 1998; 2001; 2007; O Carroll 2001; Stanley 2003). The early medieval monastic settlement on the island of Lemonaghan could therefore be interpreted as being at a place along a routeway that had been used, at least intermittently, since late prehistory, before the island itself became a focus of medieval pilgrimage.

The transformation of European wetlands

Although people have been adapting and shaping wetland environments since early prehistory (e.g. the significant transformation of lakeshore environments by Neolithic and Bronze Age lake villagers), it is in the medieval period that large-scale landscape *engineering* took place and marshland environments began to be reclaimed to create new landscapes for tillage and managed pastoralism.

The large-scale transformation of coastal saltmarshes in northwest Europe, particularly around the North Sea regions, provides dramatic evidence for how wetlands were dyked, drained, and managed. Rippon (2000) has developed a key model for how this was achieved (Fig. 3.8). He suggests that in later prehistory and into the historic period, marshlands were in general initially *exploited* in their natural state—for fishing, wildfowling, livestock grazing (sheep in particular), salt production, and for the use of various plants, peat and fuelwood. By the Roman era and Migration Period, marshlands were being *modified* in various ways to maximize their economic resources, and marshland reclamation often began as a local response or initiative by marsh-edge communities, with droveways constructed to move animals and 'ring' or 'summer' dykes constructed to drain high saltmarsh in a small-scale and piecemeal fashion, enabling seasonal arable cultivation in the summer time (Rippon, 2001: 146; 2006). However, by the 8th and 9th centuries in some regions, but certainly by the 10th and 11th centuries across key regions in northwest Europe, *reclamation* became more ambitious, with the large-scale construction of embankments to defend large areas from the sea, the digging of drainage channels, and the progressive intensification of enclosure behind the sea banks through field systems, to enable a more intensive and permanent transformation, exploitation, and management of saltmarshes and freshwater backfens for agriculture (Rippon 2000; 2001: 146).

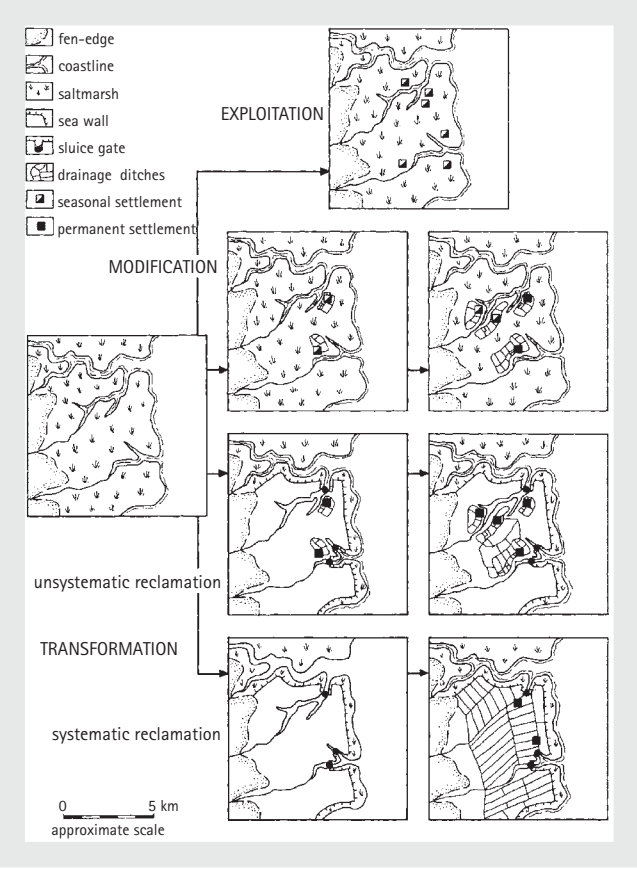

FIGURE 3.8 Schematic model illustrating the range of potential strategies adopted in the exploitation, modification, and transformation of coast wetlands in northwest Europe. (Based on Rippon 2000: 53)

Whether through secular or ecclesiastical power, lordship and landownership was key in the transformations of these landscapes. By the 13th century, it seems likely that the Church—with its monastic populations and large agricultural estates (with some saltmarshes controlled by houses some distance inland)—played a major role in northwest European reclamation programmes. It is also interesting to reflect that marshland reclamation by the Church may occasionally have been seen in moral and symbolic terms, as a transformation of 'wilderness' into civilized, productive land under Christian control (Van de Noort and O'Sullivan 2007: 84–7).

Some of the earliest reclamation programmes were in the Severn Estuary, with a systematic reclamation of the Wentlooge Level and more piecemeal enclosure and drainage of parts of the Somerset Levels in the Roman period (Rippon 2000: 263). Otherwise, reclamation at this time tended to be local and small-scale. After a period of abandonment and desertion at the end of the Roman period and into the early medieval period, reclamation of the Severn Estuary Levels; the Fenland, Romney Marsh, North Kent and Essex marshes of southeast England; regions of the Netherlands and northwest Germany begins in the early medieval

period—being particularly clear from the 10th and 11th centuries AD (Rippon 2000: 152–85). It is presumably a development that relates to population growth, expansion of the agrarian economy, and intensification of both rural and urban settlement (Rippon 2000: 267). In the Fenland, Anglo-Saxon settlement evidence suggests some colonization of the saltmarshes in the 7th and 8th centuries and a process of reclamation that is initiated in the 9th and 10th centuries AD (Rippon 2000: 177). Archaeological excavations of the Sea Bank at Clenchwarton and a range of evidence suggest that it was constructed in the 11th century (Hall and Coles 1994: 127; Van de Noort 2011: 118). Palaeoecological analyses (of foraminifera, ostracods, crustaceans, and molluscs) of the soils behind the sea bank indicated a transition from a marine influence to no direct marine influence, and that this was effected by digging a ditch with a sea bank to the seaward side (Van de Noort 2011: 118–19). By the 10th century, the East Anglian fenlands had been embanked and thereafter were not subject to normal marine flooding.

Reclamation of saltmarshes in the Netherlands begins around this time also. While saltmarsh drainage and reclamation was initiated in the Roman period, and some dykes were constructed locally close to some *terpen* mounds in the Migration Period in the Netherlands and Frisia, it was largely towards the end of the early medieval period—the 10th and 11th centuries—that serious reclamation of marshes in Belgium, the Netherlands, northwest Germany, and Denmark began. In Belgium, in Flanders, the Kaaidijk dates to the 11th century (Rippon 2000: 178). In Zeeland, the earliest dykes date to the 11th century, in south and north Holland to the 12th. The embankments in the Dutch Wadden Sea area date to the 10th or 11th century. In the German part of the Wadden Sea, the earliest dykes were 'ring dykes' or *Ringdeiche*, constructed by raising banks (1m in height) and ditches around settlements and their fields to protect arable land from spring and summer flooding (Rippon 2000: 185; Ey 2010). These *Ringdeiche* can date to the 11th century, but by the 13th century were being connected to form continuous sea defences (Rippon 2000: 185; Meier 2004, 66–67; Ey 2010).

On the Severn estuary, in Somerset and Gloucestershire, during the 12th and 13th centuries, enclosure and drainage activities were now extended into the backfens, the lowlying freshwater wetlands inland of the higher saltmarshes. Former pasture and meadow was changed in use to arable farming, reflecting the increasing intensification of land use. In the Gwent Levels in Wales, estates were further improved by Anglo-Norman lords in the 11th and early 12th centuries through further reclamations (Rippon 2000: 187). In the Essex marshes, some marshes were embanked and cultivated, others were reclaimed for pasture only, while there were also large areas of saltmarsh that were used for sheep pasture (Rippon 2000: 201). In the Fenland, of eastern England, there were already extensive reclaimed and settled marshes close to the coast in the 11th century, and 12th- and 13th-century activities focused on claiming land from saltmarshes beyond the original sea bank, or on the freshwater backfens inland of the coastal wetlands, as villages extended their reach into former marshland environments.

Similarly, in north Holland in the Netherlands, 10th-century reclamations were followed up by peatland reclamation in the 11th and 12th centuries, some of which was used for arable cultivation (Rippon 2000: 215–16). In the northern Netherlands and Germany, by the 12th century, the coastal marshes were thoroughly embanked and again, attention turned to the enclosure, draining and settling of the peat backfens, while some of the old *terpen* were abandoned as settlement expanded onto the reclaimed lands (Rippon 2000: 218). By the 13th century, most—though certainly not all—of the coastal marshes around northwest Europe had been embanked and drained.

Conclusions

This chapter has explored three key themes of occupation, exploitation, and transformation in European wetland environments from the Migration Period (AD 400–600), through the early Middle Ages to the end of the medieval period. It is clear that social elites, whether Migration Period chieftains, proto-feudal medieval knight-farmers, or medieval bishops and lords, were all engaged in wetland settlement, exploitation, and transformation. On the other hand, most of what we see archaeologically was actually created by ordinary people—local peasant communities, labourers, and fishermen—working within their own traditions of practice and ingenuity. The wetland archaeological investigation of medieval crannogs or fish weirs, with their excellent chronological evidence, also gives us unique insights into the cultural biographies of places and objects and the ways that people coped with dynamic wetland environments (e.g. Van de Noort and O'Sullivan 2006). Finally, it is in the medieval period that Europe's wetlands started to be reclaimed, as coastal marshes, bogs and river flood plains were diked, drained, and managed in engineering terms, transforming wetland environments that had existed since prehistory.

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THE AMERICAS

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CHAPTER 4

OCCUPATIONS OF PAST WETLAND ENVIRONMENTS IN THE UNITED STATES

BARBARA A. PURDY

Introduction

A major problem in understanding past cultures is that most classes of materials, particularly organic components, have not survived, or have not survived in quantities large enough to be studied statistically. This situation becomes more pronounced as one moves backward into time. Time itself is not to blame as much as the instability of climate and the effect that climate change has on water, soils, plants, and animals. For example, a group of people living near a lake shore (a wetland) 14,000 years ago would have discarded an assemblage of identifiable items, furnishing a fairly clear picture of their activities. However, unless those materials became incorporated into a perpetual anaerobic deposit (wet site), or a continuously dry cave, only stone and a few bone artefacts would remain today for retrieval and study. And that is the situation for the overwhelming majority of Paleoamerican sites.

To add to the frustrating problem described above, ancient nomadic hunter-gatherer groups were small, with a meagre and portable material inventory. In other words, they did not live in established settlements and build permanent structures with elaborate furnishings and decorative accoutrements.

The following formula demonstrates how interpretations of the past are affected by the number of surviving material items available for study:

$$\frac{k(k-1)}{2} = X$$

where k = number of categories and X = number of interactions. Thus, if only stone implements are available for study, there are no interactions (except within the category itself; e.g., stone source, artefact type, etc.):

$$\frac{1(1-1)}{2} = 0$$

The more categories that survive—i.e. stone, bone, wood, ceramics, shell, plants, weaving—the more interactions can be studied. But, any item in a cultural or environmental inventory is vastly complex and warrants more than one value. Each of the seven categories listed above, for example, played an important part in technology, social organisation, and ideology (the major components of any culture); thus, a very minimum of three values for each can be calculated, and the interactions expand to 210.

As these pieces of information increase in number, archaeologists as anthropologists are able to discover relationships between resources available and resources utilized by prehistoric groups of people, and to proceed from speculations about the past to reasonably valid holistic reconstructions even though lacking historic records to consult or living descendants to interview. This is the viewpoint upon which I wish to focus as I discuss wetland occupations during the Paleoamerican, Archaic, Formative (Late Prehistoric), and early Historic times in the United States.

Paleoamerican stage

There are two matters that I need not address. One has to do with the precise time of arrival of the first inhabitants into the Western Hemisphere, and the other relates to the location(s) of their original homeland(s). While some archaeologists, including myself, believe that people were in the Americas before 25,000 years ago and probably arrived by crossing the Bering Land Bridge, the issues of origin and antiquity remain in dispute after several hundred years of speculation. These problems may soon be resolved, as escalating information emerging from recent genetic research becomes available.

From California to Florida and from the Canadian to the Mexican borders, however, sites dating to approximately 14,000 years BP contain proof of the coexistence of humans with now extinct late Ice Age animals. The information from these locations is scant due to severe climate changes that nearly destroyed all signs of their presence. What has survived is a stony and bony skeleton, making it necessary to generalize about a once intricate way of life. I will summarize the prevailing scenario and then follow with tantalizing bits of information, which furnish insights into more specific aspects of Paleoamerican society.

Areas of the United States that are now desiccated or desert-like (i.e. the Plains and the Great Basin) had ample sources of water from streams, pluvial lakes, and springs during the dying years of glaciation. In contrast, coastal areas, such as the Northwest and Southeast, were more arid than today. This apparently homogeneous ecological situation across the nation appears to have resulted in a similar life style known as big game hunting. Small bands congregated near water sources where they could observe the arrival of large beasts (e.g. proboscideans and bison), or they followed the animals and camped on nearby high ground awaiting an opportunity to dispatch them (Fig. 4.1). There is not complete agreement about the methods utilized to accomplish this task, but at most sites where sufficient evidence is preserved, Clovis or typologically related bifaces are present and were presumably discharged using a thrusting motion or an atlatl. The associated tool kit of unifacial stone implements is very similar to those of the European Upper Palaeolithic. Bone and ivory artefacts are recovered occasionally also. That these groups were primarily nomadic is inferred

FIGURE 4.1 Landscape as it may have appeared during Paleoamerican times looking from a vantage point near Paisley Caves, Oregon, US. (Courtesy T. W. Stafford, Jr.) Inserts: Hypothesized depiction of a mammoth kill (courtesy Dean Quigley), and Clovis points typically found at kill sites (courtesy Alvin Hendrix). Note the paucity of material culture items available for analysis.

because of the presence of stone weapons manufactured from high-quality chert (flint) obtained at quarry sources often located hundreds of miles away, and because there is little indication of long-term or returning occupation at most sites. Using the formula discussed above, four indisputable characteristics can be applied to the Paleoamerican lifestyle: nomadism, big game hunting of late Pleistocene megafauna, stone weapons, and water sources.

To paint a broader picture, it is useful to mention a few traits that occur frequently enough to be considered part of the cultural inventory. At some sites, assemblages of animals other than proboscideans or bison have been recovered. The presence of deer, turtle, and fish, for example, although poorly preserved and rare, reveal that the Palaeo diet was not restricted to now extinct Ice Age species. Plant remains are practically nonexistent at Clovis kill sites, or around ancient dry lake beds, but there must have been grasslands that fed the animals, and woven items, such as mats and sandals, are found in caves (Jennings 1989). Eyed bone needles, recovered from several sites, confirm the use of tailored skin clothing. Perhaps most interesting of all is the use of red ochre, which is known from the Old World as far back as Neanderthal times. The ritual application of red ochre to animate and inanimate objects purportedly brings good luck or restores good health. At several Clovis caches, including

Richey-Roberts in Washington (Kirk and Daugherty 2007), artefacts were covered with red ochre as was a child burial at the Anzick site in Montana (Morrow and Gnecco 2006). Human coprolites, 14,000 years BP from Paisley Cave in Oregon, while still controversial as of this writing, furnish information about genetics and diet (Gilbert et al. 2008). Cave paintings or portable art objects are virtually absent from Paleoamerican cultures. At the Gault site in Texas, however, pieces of incised limestone were recovered (Collins 2002), and bone and ivory artefacts engraved with parallel or zigzag lines occur at numerous locations throughout the Americas (Purdy 2008). Although hoaxes have appeared off and on for many years, the oldest and only verified example in the Americas of Ice Age art has been found in Florida (Purdy et al. 2011).

By considering the traits mentioned above, it is possible to assign a wider range of activities to the Paleoamerican way of life than merely killing Pleistocene megafauna at water holes. The presence of plants and small animals at some sites demonstrates that gathering as well as hunting occurred. Caches, burials, red ochre, and weaving, all recovered from non-wetland locations, furnish information about the customs of these long-vanished people. More importantly, archaeologists can advance from ethnography (the anthropological technique of describing a single type of site) to ethnology (the anthropological technique of comparing and interpreting a variety of sites and cultural trash) and create a more complete picture of the 13,000–14,000 years BP period.

The last Ice Age appeared to be in full retreat 14,000 years BP when, in a heartbeat of geologic time, the onset of the Younger Dryas ushered in a return of glacial conditions for one thousand years. There is uncertainty about the cause of the Younger Dryas, but before it ended the Clovis culture had disappeared along with the mammoths and mastodons. A few groups lingered on, such as the *Bison antiquus*-hunting Folsom people, but by 13,000 years BP the Paleoamerican way of life and thirty-five genera of large (>40kg) animals were extinct. The demise of the megafauna is often attributed to a loss of habitat, disease, rapid climate change, or overhunting by Clovis and related groups, but no one knows for sure. Their departure was not as significant as the recasting of the environment that took place about the same time (see further Meltzer 2009).

Archaic stage (the Holocene)

The Holocene brought higher sea levels, balmier temperatures, and drastically altered ecological conditions. Archaeological records from sites excavated across the United States reveal that an abrupt change occurred around 13,000 years BP. Strata containing extinct Pleistocene animals are sharply delineated from overlying strata containing all modern species. It is not known if the former big game hunters merged with coexisting people, whose non-dramatic subsistence practices have drawn little attention, or if the Paleoamericans led a dual lifestyle, which they fell back on when necessity arose.

Jennings (1989: 118) describes the Archaic (the equivalent of the Mesolithic in Europe) as 'the most successful lifeway ever devised by humans' because it was 'an adaptation to the total natural environment'. Its long persistence, he says, is testimony to its effectiveness. There are, however, other reasons why cultures do not change. There must be a need (and it must be perceived) or an internal or external stimulus for people to make drastic alterations in their

economic *modus operandi*. Also, there should be assurances that new enterprises will not end in failure.

The Archaic stage lasted for 10,000 years, and did not cease in some regions until AD 1500 or later. The Archaic way of life implies (1) a subsistence base, where anything and everything edible might turn up on the dinner table, (2) regionalism with small hunter-gatherer groups exploiting resources within a seasonal round, (3) a growing knowledge of local geography and less nomadism, and (4) semi-permanent habitations resulting in a great variety of surviving identifiable trash.

The wetland niches exploited can be depicted in a very general manner from west to east as maritime, lake shores or marshes, and riverine. While the Archaic is correctly characterized as a hunting-gathering way of life, the commodities available to hunt and gather differed radically from coast to coast. The abundant resources of the humid Northwest and the Eastern Woodlands contrasted sharply with dwindling supplies and increasing desiccation of the Basin, Southwest, and Plains. The food bowl in the Eastern Woodlands, for example, probably held various species of nuts and quantities of deer meat, while that of the Basin held seeds, insects, and an occasional rabbit.

Artefacts that appear at the beginning of the Archaic and increase in number and diversity as time passes include new styles of chipped stone points, ground stone implements including milling stones and pestles, bone weapons and tools, weaving and basketry, wooden objects, and a few artistic specimens executed in several media. Grave goods (including dogs) that accompany human burials, and ritual behaviour associated with hunting and gathering activities, provide rare insights into ancient belief systems. The formula presented above now incorporates hundreds of cultural and environmental items resulting in thousands of relationships that can be used to interpret the Archaic way of life (Fig. 4.2).

Ironically, the best holistic views of the Archaic come from locations that are totally different environmentally and are separated geographically by two or three thousand miles.

Dry caves

Dry caves in Oregon, Utah, Nevada, and other western states furnish remarkable evidence of habitations that endured for millennia. Danger Cave in Utah, on the western edge of the Great Salt Desert, for example, overlooked several spring-fed bogs and was occupied from *c.*12,000–2,000 years ago. Cultural accumulations, including dietary items and perishable as well as non-perishable artefacts, reached a depth of four metres and represented six periods of use. Excellent stratigraphic control made it possible to document the adoption of new tools and methods as time passed, such as a shift in basketry techniques from 100 per cent twining from the lower levels to 15 per cent twining and 85 per cent coiling by 6,000 years ago (Jennings 1989: 155–6). The Archaic people used Danger Cave as a dwelling place. Other caves served as cache or storage areas, or as locations to bury the dead.

Human skeletal remains from cave sites permit reconstructions of physical attributes, genetic links, and other information that does not usually survive. A man in his early 40s wearing a rabbit skin blanket, breechcloth of fibre, and leather moccasins died about 9,400 years BP and was buried in Spirit Cave in Nevada. The upper and lower parts of the body were wrapped in separate mats and then a large mat of tules (bulrush) covered the entire body, which rested in a semi-flexed position on the right side. The man had shoulder-

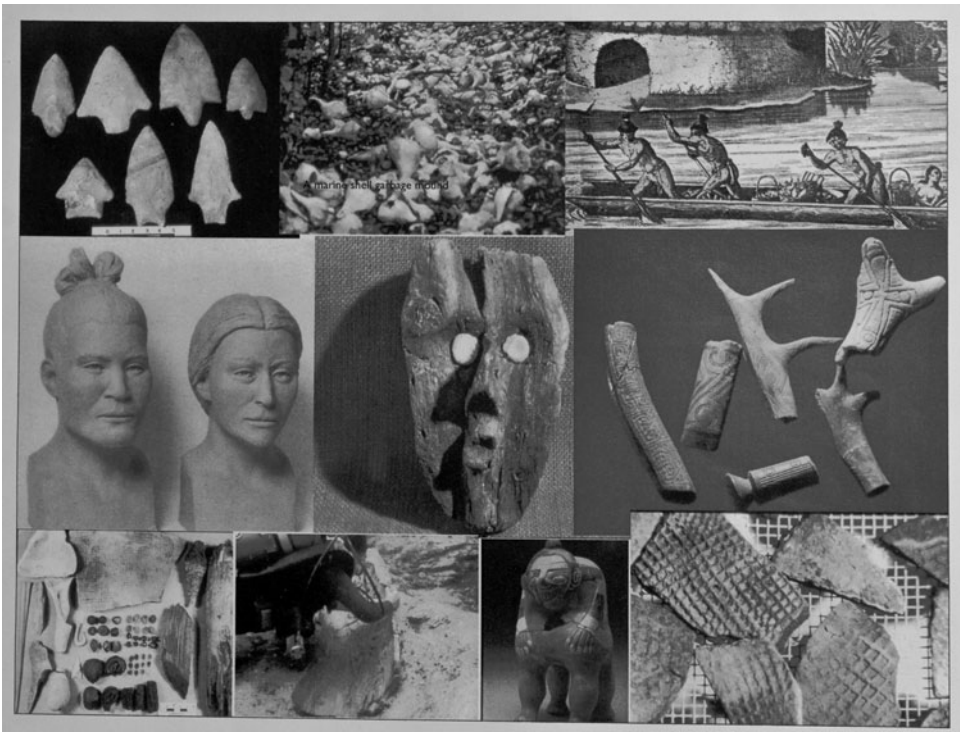

FIGURE 4.2 Examples of material items available for analysis during the Archaic and beyond. Top row: Thermally altered stone point styles, shell middens, canoes. Middle row: Facial features reconstructed from wet-site burials, wood artefacts, bone artefacts. Bottom row: Assemblage of materials from a waterlogged site, recovery of 6,000-year-old canoe, ceramic art, and ceramic sherds with possible weaving patterns. Note how the increased numbers and diversity of surviving objects paint a more complete picture of past human activities.

length black hair and was partially mummified from the hips up. The cranial and facial features suggest that the Spirit Cave mummy is not closely related to more recent populations of American Indians. The presence of tule matting and fish bones from human coprolites at Spirit Cave, as well as other items, confirm that marshy conditions existed nearby (see Dixon 1999 and his citations).

Wet sites

At the other end of the spectrum, sites that have remained waterlogged throughout time furnish information comparable in age, abundance, and diversity to that from dry caves. Wet sites dating to the Archaic are almost exclusively located in Florida. Unlike the millennia-long duration of dry caves, however, the waterlogged sites of Florida tend to date to single time periods.

During the late Pleistocene, very little surface water was available in Florida and megafauna congregated around springs and sinkholes seeking this commodity. Human skeletal remains and artefacts similar to Paleoamerican cultures elsewhere attest to the fact that people were

living in Florida and hunting these animals. The lakes filled and the rivers flowed as the Holocene brought wetter conditions and rapid changes in artefact styles and habitats. The Bolen point appears along with all modern fauna. The people making Bolen points were probably the earliest Archaic inhabitants and the first permanent residents in Florida. As time passed, populations grew and spread into all areas of the state. Without the information from wet sites, thousands of years of human occupation would be known primarily from changing styles of stone projectiles and, eventually, from the accumulation of shell middens along rivers.

All of the early wet sites in Florida are mortuary ponds. The oldest and most meticulously documented is Windover, which is 8,500–7,500 years BP (Doran 2002). A brief summary of the contents of the Windover pond follows. About 50 per cent of the pond was excavated. The bodies were interred within 48 hours of death into foot-deep, water-saturated, anaerobic peat on the edges of the pond. One hundred and sixty-eight individuals were recovered, of which 91 had preserved brain material. All ages were represented, with 50 per cent sub-adults and an equal number of males and females. Grave goods accompanied many of the burials, and some bodies were wrapped in woven textiles. The woven materials were produced using twining techniques, which were employed also at Danger Cave in the early deposits (see above). Where it could be determined, bodies were flexed resting on the left side with head to the west. Many were held down with wooden stakes. Because of the excellent preservation, it was possible to recognize pathologies, injuries, age at death, and to extract DNA samples (although the results have not been fully satisfactory—see Schlumbaum and Edwards, Chapter 33). Tools and utensils of wood, bone, antler, and dentary from this amazing site were numerous and varied. A complete paleoethnobotanical analysis identified 63 types of plants, 34 of which were edible. The presence of 381 amaranth, 2753 elderberry, and 124 wild grape seeds in the abdominal area of one burial suggests that the seeds were consumed for dietary or medicinal reasons. The earliest bottle gourd north of Mexico was situated near the spine of another burial (Newsom 2002). The virtual absence of stone and shell materials is interesting but explainable. There are no chert (flint) sources in the vicinity of Windover, and the paucity of shell is due to the fact that the people of Florida were not exploiting marine and freshwater species extensively from 8,500 –7,500 years BP.

Other wet/wetland site cemeteries in Florida date approximately one thousand years younger than Windover (i.e. 6500–6000 years BP), but they yielded essentially the same assemblage of materials (see Purdy 1991 and references). All of Florida's wet/wetland site cemeteries are located in the southern part of the state and predate the extensive use of shellfish and the introduction of ceramics (an exception is the AD 200–500 Fort Center site on Fisheating Creek west of Lake Okeechobee—see Sears 1982). If these had been terrestrial sites that typically are missing an organic component, little or no evidence of human presence would have been noted.

Middle to late Archaic: 6,000–3,000 years BP

In the mid-western and eastern United States, an explosion in the number, size, and contents of archaeological sites occurred between 6,000 and 3,000 years BP. These sites are a manifestation of changes that were under way for a long time as a consequence of emerging modern climate

conditions and the confidence people had in the predictability of resources. The utilization of marine and freshwater fish and shellfish resulted in huge shell middens, some more than six metres deep and extending for miles along the coasts and inland rivers. The availability of several varieties of nuts, such as walnut, hickory, and acorn, also led to sedentism and permanent or semi-permanent residences; nut trees cannot run, swim, or fly away. Storage pits with immense quantities of nuts confirm that they were an important dietary staple. One wonders, in fact, if the large burial mounds that appear during this time contain individuals who succumbed to mycotoxin poisoning from eating contaminated stored nuts.

The development of cultural complexity and possibly social hierarchy is evident by an increase in numbers and kinds of artefacts, including long-distance trade items and exotics. These materials required a transportation system. There is little proof that animals (with the possible exception of dogs) were used to haul supplies, but canoes appear by at least 6,000 years ago. More than 350 prehistoric and early historic canoes have been recorded in Florida. These numbers would undoubtedly have increased manyfold throughout the country had preservation conditions permitted. Canoe manufacture required skills in felling, hollowing, and shaping of the preferred species of tree, which in Florida was pine. Although the process is tedious, once finished, a canoe furnished a way to transport people, goods, and ideas. Canoes saved immeasurable energy for their owners and they did not have to be fed.

From west of the Mississippi River to the eastern slopes of the Rocky Mountains, people remained primarily hunters of bison and deer as well as smaller species. Deer provided food and, in the Plains as elsewhere, their antlers, bones, sinew, and hides supplied materials for tools, weapons, ornaments, cordage, clothing, and robes.

West of the Rocky Mountains, climate conditions during the Archaic became drier and drier with occasional short-term wet periods. Provisions were sparse and populations were small but, as Jennings (1989: 148) states, 'Foraging people do not exploit half a continent. They use the resources of a very small area—a series of adjacent microenvironments.' As mentioned earlier, the overwhelming information about the way of life of the inhabitants comes from dry caves.

The maritime environment of the Pacific coast, offshore islands, and the lush central valley of California provisioned its hunters and gatherers with all manner of food supplies similar to the Eastern Woodlands. Staples included sea and land mammals, fish, shellfish, acorns, and in some areas, pinenuts (piñon nuts). Milling stones, mortars and pestles, charmstones, shell beads, and occasional cobblestone cairn burials are all part of the inventory. From the northern California coast to the Strait of Juan de Fuca and beyond, people harvested a plethora of marine, brackish, freshwater, and terrestrial resources for thousands of years. As long as populations did not exceed the carrying capacity of the land and sea, a nirvana-like life style must have existed. Shellfish, salmon, camas bulbs, and berries furnished predictable food supplies, as did deer and elk. Cedar wood was used for plank houses, utensils, ornaments, and watercraft, including ocean-going canoes to hunt whales and other sea mammals. The Strait of Juan de Fuca and the Columbia and Snake Rivers connected the coastal dwellers to the inland Plateau. There is ample evidence of trade in Olivella and Dentalium shells from the Pacific in exchange for obsidian and other products from the interior. Pithouses along the Snake and Columbia Rivers are as old as 7000 years and were still being constructed when Lewis and Clark encountered the Plateau people in the early 19th Century. Loess soils and basalt monuments bespeak a volcanic past (for further reading about this area, see Jennings 1989; Kirk and Daugherty 2007).

Formative (late Prehistoric): 3,000 years BP–AD 1500

The Formative Stage is a term originally applied to groups in Middle and South America that cultivated crops and exhibited signs of hierarchical social division. It is not an appropriate designation for the United States, because the only visible new trait that distinguishes previous cultures from those of *c.*3000 years ago is the introduction of ceramic technology. Pottery actually appears in the Southeast about 4,000 years BP and spreads throughout the region by 3,000 years BP, eventually replacing steatite vessels in some areas. It does not show up in the Southwest until about AD 1, and never reaches the Northwest coast, where watertight baskets and wooden bowls functioned satisfactorily. At first, except for the appearance of pottery sherds, there does not seem to be any important change that can be identified in the archaeological record. This innovation seems like a major non-event, but there certainly must have been a need for ceramic vessels, probably related to a fish and shellfish economy. Because of the fragile nature of the poorly fired pottery, it is unlikely that it was transported long distances. Its appearance, therefore, is an important indicator of a more sedentary existence.

The cultures of the eastern and southwestern United States made the transition to food producers prior to Historic contact, but even so, a heavy dependence on foraged foods continued. People of the Plains, Basin, Plateau, California, and Pacific Northwest coast remained, by definition, hunter-gatherers because their primary subsistence was derived from nature's bounty and not from activities involving cultivation of crops or domestication of animals. The ranked societies and beautiful works of art that characterize the Pacific Northwest coast, however, illustrate that harvesting nature's abundance is sometimes as rewarding as cultivation and domestication. The catastrophe that preserved the contents of the Ozette Village site on the Olympic Peninsula furnishes convincing evidence (Daugherty 1988).

Eastern United States

The Early and Middle Woodland Traditions are known as Adena and Hopewell (2,800 years BP to *c.*AD 800), followed by Mississippian (AD 800 to after AD 1400), which includes an exotic complex of ceremonial artefacts known as the Southern Cult, introduced around AD 1200. Throughout this entire time, the number of habitation and ceremonial centres, burial mounds, trade items, and art objects increases dramatically, all made possible by a philanthropic environment in collaboration with a people who had learned over several millennia how to utilize its resources. Maygrass, knotweed, goosefoot, sunflower, cucurbits, and nuts were already major subsistence items, along with animal flesh and seafood, when maize (corn) was introduced around AD 800. Population shifts to the productive ecosystems of meandering rivers and streams occurred at this time.

Ceremonial complexes of the Mississippian Tradition, including truncated pyramid structures, are located at Spiro along the Arkansas River in Oklahoma; Cahokia (a World Heritage site) at the confluence of the Missouri and Mississippi Rivers east of St Louis, Missouri; Moundville along the Tombigbee River in Alabama; and Etowah along the Chattahoochee River in Georgia.

There is little doubt that the rivers, in addition to furnishing ideal alluvial soils, also provided a highway for transporting people, goods, and ideas. We may never know specifically what ideas were conveyed, but we do have artefacts that are probably the tangible results of some of those ideas. While the occurrence of cultivated crops and ceremonial centres is significant, the most impressive (in my opinion) is the creation of spectacular works of art in various media, such as mica, copper, stone, wood, ceramics, shell, and obsidian, often obtained from non-local sources. Copper from the area of the Great Lakes, for instance, had been mined for several thousand years and fashioned into tools and weapons, but now beads and bracelets of copper appear or it is hammered into thin sheets and embossed. Large conch shells from the Gulf of Mexico and obsidian from Yellowstone in Wyoming are other examples of materials that travelled long distances, sometimes overland, to be altered and used for ritual and prestigious reasons (for more information about the Eastern Woodlands, see Brose et al. 1985; Fundaburk and Foreman 1957; Power 2004; Smith 1986, and their references).

Southwestern United States

Prior to AD 1, the people of the desert Southwest began growing corn, squash, beans, and cotton as a result of stimulus diffusion from Mexico. These crops, as well as domesticated turkeys, joined literally hundreds of wild species (e.g. yucca and cactus), which had been utilized for millennia, and which continued to be exploited. Three separate but similar traditions emerged over the next 1,000 years: Mogollon, Hohokam, and Anasazi, plus Fremont (a related cultural group). The Mogollon, whose descendants are the present-day Zuni, evidently received the initial impetus from the south. The Hohokam are represented today by the Pima and Papago, and the Anasazi people are survived by the Hopi and related groups. In addition to cultivated crops, other traits diffused from Mexico over a period of time. Above-ground masonry buildings (pueblos) of adobe and rocks replaced Archaic pithouses, which then were constructed for ceremonial and religious purposes and known as Kivas. Ball courts and ceramic technology were also introduced from the south. Trade items consisted of shell from the Gulf of California, copper bells, onyx, and macaw feathers. Turquoise travelled in the other direction. Elaborate pottery shapes and decorations distinguish Mogollon, Hokoham, and Anasazi cultures from each other, and changes in their styles are time markers utilized extensively by archaeologists. The cultures reached a high point between AD 900 and AD 1300, when there occurred an extreme contraction of the Anasazi, including abandonment of cliff dwellings such as Mesa Verde, and the disappearance altogether of the Fremont. The reasons suggested for the sudden decline include climate change and the arrival of Athabascan groups from the sub-Arctic known as the Navaho and Apache.

The uniting factor in this environmentally diverse area of mountains, mesas, and desert is the lack of water. Successful farming in the Southwest depended upon ingenious methods to capture water, such as digging irrigation ditches along the Salt and Gila Rivers and the use of seep springs. Yet it is difficult to consider the Southwesterners as a people of the wetlands. There is no indication that ideas and merchandise were transmitted along rivers; nor is there evidence of the use of beasts of burden. This leads to the conclusion that traders trudged overland laboriously carrying their products on their backs (for further reading, see Cordell 1984; Kidder 1924).

Historic (after AD 1500)

Christopher Columbus may not have been the first visitor to America in the past 12,000 years, but following his voyage of AD 1492, the Atlantic Ocean became a major highway of sailing vessels, carrying people and diseases. Search warrants were issued to locate treasure and return with it to Spain to refill the royal coffers depleted by warfare and luxury spending. Passengers and cargo were deposited along the coasts near inlets that could be traversed by small boats in order to seek freshwater, food, and other resources. The ships then sailed for home and promises were made to return with supplies, which sometimes never materialized.

Encounters with the Native Americans are known mostly from records written by Europeans; the reactions of the Indians are rarely noted. The experience must have been like coming face to face with beings from outer space, a situation that probably never will be repeated. There is little doubt that the technologically superior Europeans with their firepower and other accoutrements could overcome the Indians in the long run, but the Indians initially did not feel threatened. They desired the exotic trade goods offered them and hoped the guns might be used against their eternal enemies (i.e. neighbouring tribes). They could not envisage the total world of the strangers, a world that had developed in isolation from their own for thousands of years. Because of the linguistic barrier, the natives often gave their land away without even knowing they had done it. Protests against the newcomers came too little and too late.

For nearly 150 years, voyages to the New World were greed-driven—first by Spain and Portugal and then by France and England—to obtain gold and silver, waylay treasure-laden ships, or claim land. Eventually, people thought of the present United States as a land of opportunity and freedom. Major rivers became locations of permanent settlements and arteries to transfer commodities to distant areas. While ancient hunter-gatherers may have altered hunting and fishing ecosystems to a certain extent, their modifications pale in comparison to the present-day (2010) situation, where industrialization and other enterprises have not left a square inch of the United States unaffected by human activities.

Summary and conclusion

Over a period of thousands of years, the ancient inhabitants of what is now the United States gradually added new subsistence and material items to their cultural inventory. These changes occurred so passively that they probably were not noticed from generation to generation. Except for big-game hunters during the Late Pleistocene and semi-farmers after AD 1, the Native Americans maintained an Archaic existence. Pottery technology, a few cultivated plants, and trade goods were late prehistoric postscripts.

We will never know what the Indians would be doing today if their way of life had not been disrupted in the early 16th century. They seem to have reached a steady state. Free time was directed toward monument building, artistic creations, social hierarchies, and warfare. The Indians did not capture energy from animal power, sails, the wheel, or fossil fuels, and the pyrotechniques they utilized for ceramics and metals were primitive. There evidently was no stimulus or perceived need for these methods, but their absence

contributed to the Indians' inability to adapt to the rapid changes inflicted upon them after AD 1492.

Years ago, I suggested that archaeologists in the United States should direct their attention mainly to wet sites, because it is only with that kind of evidence that archaeology can become anthropology and begin to answer questions about social organization, technology, and ideology of former societies. Unfortunately, the lack of ubiquity of wetland sites in the United States and the difficulty of discovering them has demotivated researchers. It is furthermore difficult to excite the public about an invisible heritage that may (or may not) yield environmental and cultural information comparable to sites such as Key Marco in Florida and Ozette in Washington (state). Finally, an additional problem is that a large number of archaeologists are not trained to meet the challenges of excavating, conserving, and curating materials from waterlogged sites, nor are granting agencies aware of the expenses involved in these activities compared to terrestrial sites that yield mostly stone and ceramics. As a result, waterlogged environments with great archaeological potential are neglected in favour of those 'dry' areas able to yield more 'tangible' results at lower cost.

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