Archaeological Evidence for the Exploitation, Reclamation and Flooding of Salt Marshes

Archäologische Befunde für die Nutzung, Trockenlegung und Überflutung von Salzwassermarschen

Données archéologiques sur l'exploitation, la récupération et l'inondation des marais salants

Mark Gardiner

In the last ten years freshwater and salt marshes have been a major area of research in English archaeology. Surveys have been undertaken on many of the major English wetlands to identify the character of the archaeology and determine the methods necessary to conserve them. These studies had been prompted by a realization that marshlands contain abundant organic materials, such as wood and leather which survived in the waterlogged conditions. The emphasis in most of these surveys has been the prehistoric remains; the evidence from the medieval and later periods has been studied in less detail. However, there have been exceptions. Work by *Rippon* (*1996*; *1997*) on the Welsh and English sides of the Severn estuary has allowed a study of the complex landscapes of the medieval period to be unravelled. In the Fens, the *Hall* (*1996*) and *Silvester* (*1988*; *1993*) have uncovered medieval landscapes and outlined their development. These studies of have shown how during the Middle Ages, and particularly in the twelfth and thirteenth centuries, the growing population of England occupied new - marshlands, first exploiting areas and later draining them.

Much of the work on the medieval expansion into the wetlands has used morphological approaches to identify the stages of reclamation. The basic techniques of landscape analysis – identifying earlier and subsequent phases of fields – have proved a powerful tool in analysing the advance of settlement. However, it is possible to complement morphological analysis with an understanding derived from the study of physical processes operating on salt marshes. We may interpret the environment which medieval people encountered by considering the natural processes of salt marsh development, and this enables us to understand the way the marshlands were utilized and subsequently reclaimed. The present paper outlines this alternative approach. It contrasts evidence from an area of active salt marsh in the north of Norfolk with reclaimed salt marsh in Walland Marsh near the boundary of Kent and Sussex. Three particular issues are considered – the exploitation of marshlands without reclamation, the reclamation process and its remains, and the flooding of marshland and its impact.

The character of salt marsh

Salt marshes are bands of land parallel to the coast or within the lower part of estuaries flooded twice daily by tides. They must be protected from high-energy wave action to allow the deposition of sediment. Coastal salt marshes are sheltered from the sea by a barrier, typically a band of sand or shingle. Those within estuaries are protected by their location from wave action. It is not only the presence of salt water which distinguishes salt marshes from those flooded by fresh water, but also the regular ebb and flow of tidal water which cuts creeks into the marsh deposits and introduces new sediment into the system. It is important to distinguish two different zones within the salt marsh. Unvegetated mud flats develop on the coastal edge of the marsh. The movement of sea water there is too strong and the mud too unstable to allow the growth of plants. Behind the mud flats is the vegetated salt marsh. covered with halophytic (salt-loving) plants. A typical sequence in northern Europe is *Spartina spp.* as a colonizing species on the lowest marsh, followed by *Salicornia spp.* and *Puccinellia maritima* on the low salt marsh. Away from the coast, the marsh will have less salinity and other less-salt tolerant species will be found.

Marshes are dissected by a system of creeks which channel water into the marsh at high tide and allow it to drain during the ebb tide. There are a number of creek patterns. Some have a parallel form; others a dendritic form. Each form seems to have developed to absorb the energy of the tidal waters and that of the waves which can force sea water up the creeks. Where the dominant influence is tidal, the creek forms tend to be dendritic as the force of the incoming water is dissipated in a network of branching channels. Where marshes are exposed to the force of waves, the pattern tends to have a linear form (*Pethick 1992*, 53–60).

The pattern of creeks on almost every marshland in England has been altered to a greater or lesser extent by human exploitation. Creeks have often been canalized to make larger channels to drain the marsh more effectively, or to act as boundaries. This aspect of

Fig. 1. *Plan of surviving salt marsh in England and Wales (after Burd 1989) and the main areas of reclaimed salt marsh.*

human action is of little interest to physical geographers who have been largely interested in natural processes and have ignored these canalized creeks as irrelevant to their concerns. An example is the discussion of creek systems on the Dengie Peninsular (Essex) which fails to acknowledge that some elements have clearly been straightened by human intervention (*Pethick 1992*, fig. 3.7). Archaeologists too have failed to identify the contribution made to the morphology of creeks by human activity. They have not realized that this is still apparent in active salt marsh and provides an important record of past activity. The extent of human impact on existing salt marsh has, therefore, been little studied and recorded.

A new approach to the study of salt marsh

It is clear that any study of salt marshes needs to identify and understand both the natural components and the result of human impact. In this way it is possible to interpret how humans have interacted with the conditions in salt marshes, exploited the land and eventually reclaimed it. Although salt marshes are a dynamic environment, creek patterns are remarkably persistent and provide a partial record the changing environment. The study of creek morphology, combined with an understanding of human activity, enables us to interpret the nature of the changing marshland. The evidence survives in three conditions. The ideal environment is surviving salt marsh in which we can identify a sequence of changes. However, the area of existing salt marsh is a small fraction of what once existed and such conditions cannot provide a very comprehensive view of human activity (*fig. 1*). Instead, archaeologists may hope to work in the second situation – reclaimed former salt marsh where topographic features still survive. These are areas which have not been ploughed since they were reclaimed. Here we can identify with ease the line of former creeks and the way in which they have been cut across by later embankments (*fig. 2*). Unfortunately, there are only limited areas of unploughed salt marsh in Britain. The third situation is ploughed, or formerly ploughed lands where the evidence for the character salt marshes may be recovered from excavations, soilmarks or may be observable in or below ploughsoil. This is the least informative and most difficult type of evidence to interpret.

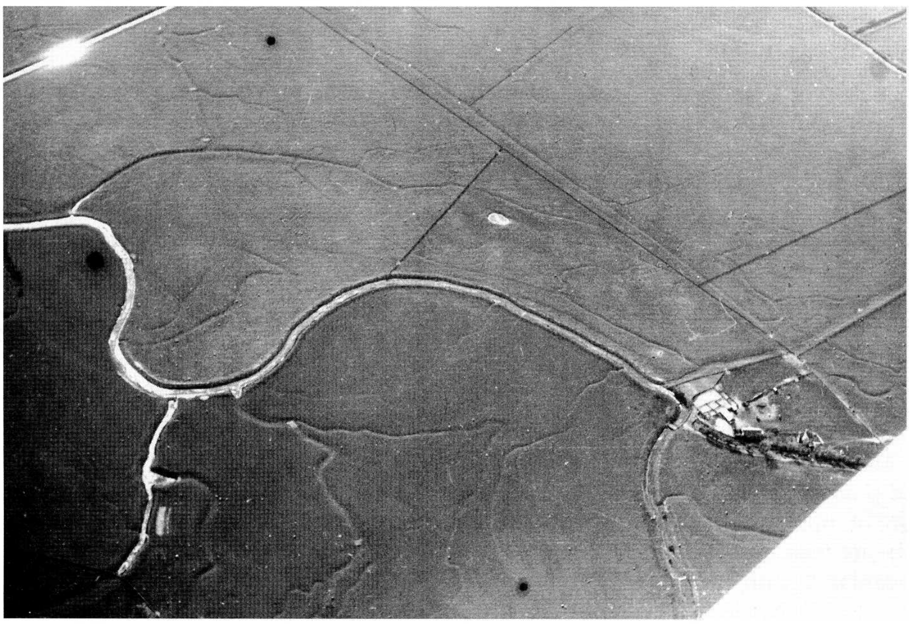

Fig. 2. *An area of former salt marsh at Lower Agney (Walland Marsh, Kent) photographed in the 1930s before the land was ploughed. The area in the photograph was reclaimed in 1598, but former salt marsh creeks can be identified as depressions in the pasture and as water-filled ditches which now served to drain the land. New, straight ditches have been also been dug for drainage.*

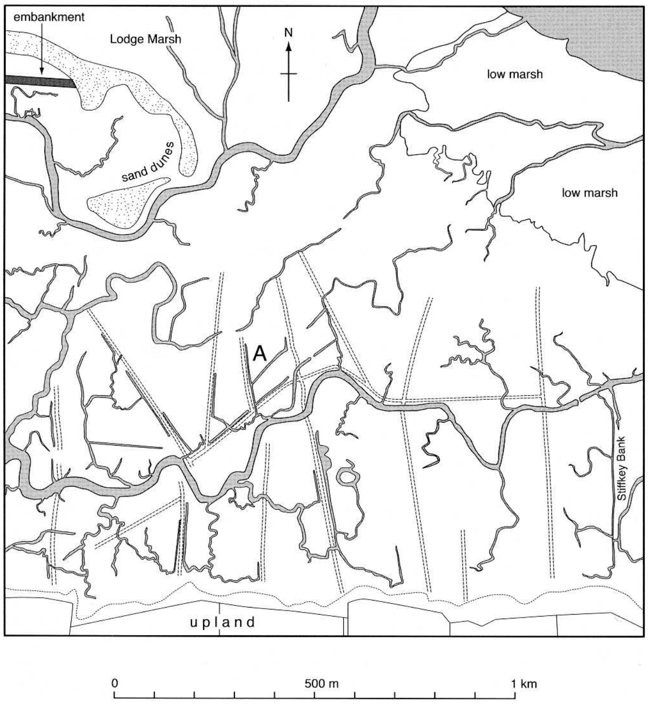

Fig 3. *Plan of Warham Marsh (Norfolk) compiled from field notes, aerial photographs and Ordnance Survey first-edition one-inch and six-inch maps. The sea lies to the north and the dry land to the south. Track ways are marked by dashed lines. The embankment on the north-west corner of the plan enclosed Lodge Marsh, but did not protect most of the area shown.*

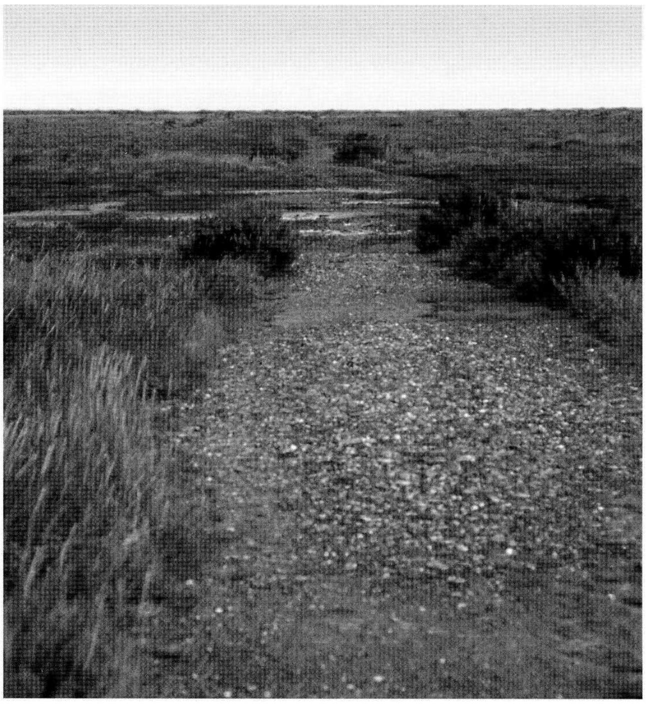

Fig. 4. *A drove road at Warham Marsh. The example shown here has been surfaced with gravel, possibly during the Second World War.*

The present paper uses the evidence from existing salt marshes and from reclaimed marshland to understand the environment of the past and the way the land has been used. The study here considers two areas. The first is an area of active salt marsh at Warham, and Titchwell in the county of Norfolk. This marshland has been extensively modified over a period of centuries by human activity, and there is considerable evidence of periods of reclamation and alteration. The second is an area of reclaimed marshland on the Kent-Sussex border in Walland Marsh. That area is part of the much larger marshland known as Romney Marsh. It was reclaimed in the twelfth and thirteenth centuries, but parts were then lost to the sea in floods in 1288. The flooded area was subsequently reclaimed in the sixteenth and seventeen centuries. By studying these very well preserved areas, we can draw broader conclusions about the usage of salt marshes more generally.

Exploitation of marshes without embankment

Many activities, such as wild-fowling and the gathering of rushes, will leave very little archaeological evidence. Salt-making and perhaps fishing, if it included fixed fish traps, may leave some evidence. Grazing is likely to leave the most conspicuous traces of the exploitation of unreclaimed salt marsh. Cattle and sheep can both graze on coastal marshes, though the main problem for farmers is to ensure that they can either be moved off the wetland at periods of flood tide, or to ensure that they have access to higher land above the level of the water. Within the marsh the clearest evidence of grazing is the establishment of drove roads to allow the animals to be moved on and off the marsh, and grazed in different areas. These tracks extend from the upland on to the edge of the marsh, and then across the width of the salt marsh. There is little difficulty in encouraging animals to cross minor creeks, but there are greater problems in persuading them over deeper, often more sharply incised channels, especially since these may have fast-flowing currents during the ebb and flow tides. Bridges would very probably have always been needed to cross these watercourses.

Some salt marsh is still managed using the traditional practice of grazing, particularly in the north and west of Britain (*Lambert 2000*). Evidence of the former use for grazing survives in a few further marshes, although they are no longer managed in this way. One of the areas is to be found on the north Norfolk coast at Warham. The earliest Ordnance Survey map, the one-inch sheet surveyed in 1815–16, shows tracks leading from the upland on to the marsh, many of which were named droves – roads for driving animals. A network of routes on the marsh allowed animals to be moved across the pasture. The positions of these former marshland tracks are visible on aerial photographs. They may also be observed on the ground for the tracks were marked by banks with ditches on the inside edge (*figs. 3, 4*). The purpose of these banks seems to have been to prevent animals from straying off the track when they moved about on the marsh. The tracks themselves are not causeways raised up about the

Fig. 5. *The site of a former bridge at Warham Marsh. Wooden stumps are all that remain of the former supports for the bridge over a deeply incised creek.*

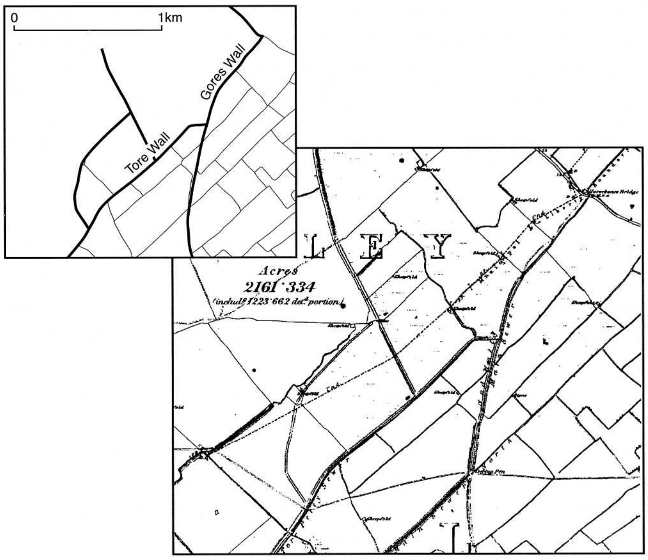

Fig. 6. *An area to the north of Lydd Quarry showing how Gores Wall was constructed across an existing field pattern, enclosing the area to the south-east. From the first-edition six-inch Ordnance Survey map.*

surrounding level of the marsh, though some of them are surfaced with gravel to prevent the ground being broken up by the passage of animals. That surfacing may have taken place during the Second World War, when the area was occupied by military forces. The tracks are conspicuously straight, except where they cross or skirt the deeper creeks: on the salt marsh there was no other reason to prevent the construction of straight routes. The position of former timber bridges which carried the drove roads over the creeks are marked by waterlogged stumps. These stumps still survive on the edge of creeks and indicate that successive bridges have been constructed in the same positions (*fig. 5*).

The most remarkable feature of Warham Marsh is that there are a further set of straight ditches which appear to be unrelated to track ways. They do not have associated banks, and although there are traces of bridges across them, these do not seem to be associated with any route way. These were evidently field boundaries, effectively dividing the marsh into a series of blocks of land to allow more controlled grazing and also serving to drain the marsh after high tide. The timber bridges would have allowed access between fields over the ditches. These have not been systematically mapped yet, but some of them have been planned from field notes and from aerial photographs, and are shown in the area marked *A* on *fig. 3*.

The marsh at Warham was still grazed in the early nineteenth century when the Ordnance Survey map was drawn up. A shepherd's hut is shown on the adjoining high ground. An earlier map of 1797 surveyed by Faden depicts the positions of some bridges over the creeks. It is uncertain when the practice of salt-marsh grazing was established here. A map of 1586 shows sheep on the marsh at Morston, a short distance to the east of Warham (copy in Norfolk Record Office, MC 106/28/1; reproduced in *Cozens-Hardy 1924*, pl. 28). The salt marsh at nearby Holkham was grazed by sheep in the fourteenth century (*Hassall – Beauroy /eds./ 1993*, 111–12, 397). It seems possible, therefore, that the practice of salt marsh grazing at Warham may also date back to the Middle Ages.

These marshes have never been reclaimed. The Ordnance Survey map does show a feature labelled Stiffkey Bank to the east of Warham Marsh, which might be interpreted as an embankment. Examination on the ground suggests that it is most unlikely to have been a sea defence. It has ditches on both sides and is not raised above the level of the surrounding salt marsh. It is possibly another drove road, or perhaps a boundary between two areas of grazed marsh. The only reclaimed area is Lodge Marsh which lies to the north-west of the area considered here and part of its embankment is shown on *fig. 3*.

Warham appears to be an unusual survival in eastern England of the medieval practice of grazing salt marsh, but many marshlands had been used in this manner in later medieval England. The marshlands around Essex were extensively grazed in the later eleventh century, according to Domesday Book (*Darby 1977*, 157–59). A survey of 1222 of another Essex manor, Tillingham, records that there were four sheep walks or pastures called *Howick*, *Middelwich*, *Doddeswich* and *Pirimers* on which it was possible to graze 550 sheep (*Hale 1858*, 59). On the nearby manor of Langenhoe, raised causeways of peat were built and bridges were made for the sheep out of wattle hurdles (*Grieve 1959*, 5). Grazing was common both on the salt marsh and also freshwater marsh in the Fens. The animals were allowed to graze with little supervision, but periodically round-up and driven to pounds, so that those who were pasturing their animals illegally could be fined (*Neilson 1920*, xii–xiii, 178–80).

Recent archaeological evidence at Lydd Quarry on the boundary of Kent and Sussex has provided new evidence for the medieval practice of grazing unenclosed salt marsh Excavations in advance of gravel extraction have allowed the record of a large area of marshland landscape and shown that the field pattern was laid out before the embankments were constructed (*Barber – Priestley-Bell forthcoming*). The landscape must have been similar to that at Warham where the salt marsh was divided into fields for the better control of grazing. A small temporary building dating to the late twelfth or early thirteenth century was found in the excavations. Similar buildings suggest that it may have been a shepherd's hut, used as a temporary refugee while minding the sheep. It was certainly too small to be used for long-term occupation. Excavation has shown that in c. 1200 the land at Lydd was enclosed by the construction of an embankment named Gores Wall, leaving part of the area within and part without. Examination of the field pattern to the north-east of the excavated area reinforces this view. The embankment was evidently constructed across the line of the fields and clearly is secondary to them (*fig. 6*). The reasons for the construction of the embankment are not certain. It may have been built because deteriorating conditions were leading to more frequent flooding, or, more probably, the embankment was built to allow the land previously used as pasture to be ploughed and planted for arable. While pasture may be tolerant of occasional tidal inundation, such flooding will destroy an arable crop.

An area about 4 km to the north of Lydd Quarry provides further evidence for the practice of salt-marsh grazing. Three long-distance tracks lead into this area of marsh from what would have been drier land to the north-east (*fig. 7*). One of these crosses a substantial creek at Sumnerhouse Bridge. *Wallenberg* (*1934*, 476) suggested that the bridge was named from the summoner who ordered suitors to attend a court held at the bridge. He further proposed that the bridge may have been called formerly Aloesbridge, the meeting place of a hundred (or administrative unit) recorded in Domesday Book (1086). If this were correct, then the bridge would have been a locally significant and ancient

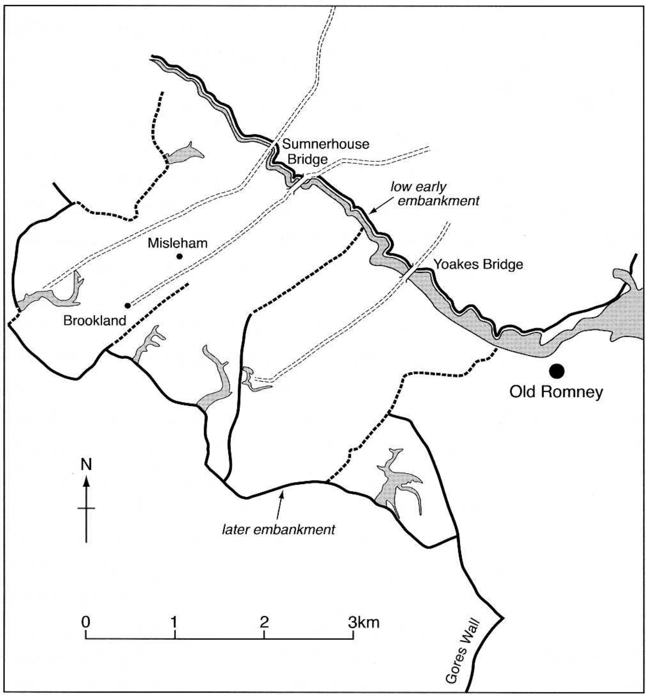

Fig. 7. *Possible drove roads the low embankment and later compartmental embankments near Misleham, Walland Marsh, Kent.*

site. The roads which extend from the creek south-westwards into the marshland are typically straight and resemble in plan the drove roads at Warham. An interesting detail is the absence of comparable route ways to the south-east. The creek was much wider nearer to its mouth and would have been more difficult to cross. There is a road across at Old Romney, but this does not lead directly to a straight road out into the former salt marsh and is likely to have a different and probably more recent origin.

It is likely that the road system here first developed when the area was unenclosed marsh and resembled that still found on the Norfolk coast at Warham. The roads are characteristically straight, and were intended to provide access to the marsh for people (and animals) coming from some distance. An estate called Misleham is among those mentioned in a charter dated between 833 and 858, implying the area to the south-west of the major creek was being used by the mid-ninth century (*Brooks 1988*, 100). However, the land was only embanked in the mid- to late twelfth century (*Eddison – Draper 1997*, 82–84). For a period of at least three hundred years, therefore, the unenclosed marsh was being used, presumably for animals which were driven down to graze, perhaps on a seasonal basis. When the land was finally enclosed, the route ways were fossilized in the landscape, even though long-distance droving may have ceased by then.

Exploitation of marshes with embankments

The earliest embankments, which were constructed from the tenth century, were not intended to enclose an area of drained dry land and divide it from the wet flooded marshland beyond. They were probably intended to serve as flood defences to prevent the ingress of salt water at periods of high tide. Unlike modern coastal defences, they were not situated besides the sea, but set well back behind a natural barrier. They were generally low structures, not intended to protect the land from extreme conditions, but only against spring tides. The land behind the embankment may have been ditched, though this is not certain.

These early sea embankments, at least in the form in which we see them now, were very long. They had to provide a continuous barrier against the sea and extended up around the estuaries of rivers, such as those of the Nene and Great Ouse in the Fens (*Allen 1999*, 16). The most remarkable of these barriers is the so-called Roman Wall or Sea Bank or *Hafdic* which ran around the Wash and up along the Lincolnshire Fens. It certainly is not Roman in date, although its precise chronology remains uncertain. This structure has not been studied in detail, although the documentary evidence for it has been reviewed (*Owen 1975*; *1984*; *1993*) and a small number of excavations have taken place adjacent to it (*Crowson 2000*, 216–17; 225–30). It seems unlikely that this structure is the result of a single grand scheme of work. It is more probable that it was constructed in a series of sections by local communities working in conjunction with their neighbours. Indeed, it has been possible in some places to identify modifications as the defence was moved progressively nearer to the sea (*Hallam 1965*, 71–76). We may dismiss Owen's suggestion that the sinuous nature of some lengths of the embankment suggest that it was built along the line of a natural levée of a watercourse: in reality it cuts across the line of the drainage (*Owen 1984*, 47). Instead, it probably charted a course across the salt marsh avoiding, insofar as possible the deeper marsh creeks and ran along any drier, raised ground.

The archaeological evidence for the early sea embankments has been discussed by *Rippon* (*2000*, 47–48) and two further examples may be mentioned. These examples are both on Walland and Romney Marsh in Kent. The first lies in an area near Misleham already considered and runs parallel to a major marshland creek (*fig. 7*). The embankment no longer survives as an up-standing feature for most of its length but can be recognized most readily by the difference in ground level either side (*Allen 1999*). The second runs along the north side of a former tidal inlet known as the *Limen* and is so low that is barely perceptible on the ground. It must be relatively early, perhaps tenth century, because the inlet on which it was situated was rapidly silting up and shortly after would have been unnecessary (*Reeves 1996*; *Gardiner et al. 2002*, 265–66).

Later embankments, or walls as they were often called, were more substantial structures and intended to protect the land behind from all conditions and therefore allow the protected area to be drained and used for arable agriculture. The first land to be reclaimed was easiest to enclose. Land enclosed later was often gained only with considerable expenditure of effort, labour and money. We can distinguish two general types of enclosure. The first we can term 'compartmental'. These are found in well-developed salt marsh (and also freshwater marsh) and had the form of division into large areas or compartments, each containing many hundreds of hectares. Such large-scale reclamation was only possible because the marsh was at a high level with few deeply incised creeks. A clear example of compartmentalized land can be found on Walland Marsh in the area already mentioned (*fig. 7*). We have seen how the area around Misleham was embanked in the mid- to late twelfth century. The embankments were constructed along the southwest edge, but extended backwards to enclose blocks or compartments of land. The lateral embankments served a dual purpose. They marked the division between different lordships and reduced the risk of very widespread flooding should any length of the embankment be breached.

The second general type of enclosure can be described as 'incremental'. The construction of an embankment has two effects on the salt marshes beyond. It reduces the volume of tidal water entering the salt marsh system, since the creeks within the enclosed land have been blocked off. A reduced tidal flow allows sedimentation to take place along the creek system as the water flow has been decreased. Sedimentation also occurs at the foot of the embankment because water

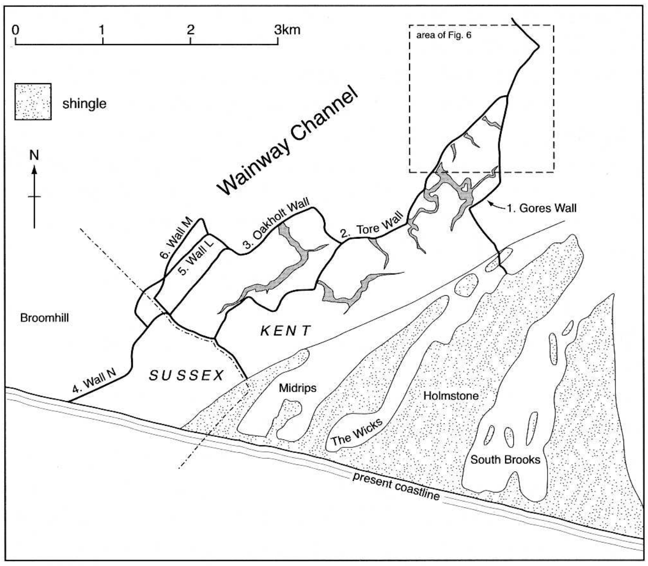

Fig. 8. *Incremental enclosure on the edge of the Wainway Channel, Walland Marsh. A sequence of embankments can be traced working gradually further north-westwards from the shingle. The present coastline is considerably further north than the medieval one.*

here is stationary between the flood and ebb tide, and deposits silt during the period of slack water. The construction of an embankment therefore begins a further cycle of sediment deposition at its foot leading to the development of raised salt marsh, which can then be followed by further enclosure (*Kestner 1975*, 394–95). Incremental enclosure proceeded in a series of stages, each one taking in further land and having the effect of preparing the unenclosed land for subsequent reclamation. Enclosures of this type were typically smaller than the compartmental innings, and were more strongly constrained by topography. Indeed, it is possible in some areas to see how the embankments have weaved their way across the marsh, avoiding the deeper creeks and have chosen areas of higher marsh. The line of such embankments give us a very clear idea of the conditions that appertained at the time of the enclosure.

We can illustrate this also using evidence from Walland Marsh. We have already established that the Gores Wall was constructed over existing fields within the salt marsh. The salt marsh extended behind the coastal shingle barrier as far as a major marsh inlet known as the Wainway Channel. We can trace a series of enclosures, each working progressively outwards and further down the Channel (*fig. 8*). These were embanked one after the other, and with careful analysis it is possible to establish the sequence of construction. The line of the embankments also provides some indication of the conditions in which they were constructed. Tore Wall follows a tortuous path parallel to, but some distance from the shingle. It carefully passes around the larger creeks, crossing them as high up as possible, because of the problems of constructing an embankment over deep channels. It stops at the boundary between the counties of Kent and Sussex, a boundary which had been established at a very early date (*Brooks 1988*, 99). A third embankment enclosed a much smaller area further out into the Wainway Channel. The following wall, named Wall N lay in the county of Sussex and we can establish from documentary evidence was constructed in c. 1200 (*Barber – Gardiner forthcoming*). Finally, Wall L and later Wall M were built. These are discussed further below. Each enclosure represented a further advance into the Wainway Channel as it was possible to embank progressively more land.

Methods of embankment and drainage

The usual method of enclosure of marshland was to construct an embankment or 'wall' on the vegetated marsh, set back from the edge of the muddy foreshore. Some medieval records detail precisely the dimensions of the embankment and its position in relationship to the edge of the vegetated marsh. For example, in c. 1200 the archbishop of Canterbury agreed the enclosure of land at Oxney in Kent and allowed up for an area of up to 24 feet (7.3 m) of 'foreland' in front of the wall (*Neilson 1928*, 51). An agreement of 1471 with the prior of Christ Church Canterbury mentions a foreland of 12 feet (3.7 m). The document also details precisely the dimension of the embankment at its base and top and states that it must be at least 2 feet (0.6 m) above the height of spring tides (Canterbury Cathedral Archives, DCc Charta Antiqua A173; *fig. 9*). The front face of the embankment was protected by bundles of thorn where it was exposed to wave action. The bundles of thorn were secured by wooden stakes called 'needles' (*Beck 1995*, 166). In the freshwater Fens in East Anglian, the growth of rushes and reeds was encouraged at the base of the embankment to perform a similar function (*Neilson 1920*, lxiv). Where there was a strong flow of water in front of the embankment, for example in estuaries where the tidal waters surged in and out, the base was protected by groynes of timber or earthen mounds which projected at right-angles to the wall. These served to slow the movement of water and ensure that it did not undermine the embankment (*Hall 1977*; *Smith 1943*, 186).

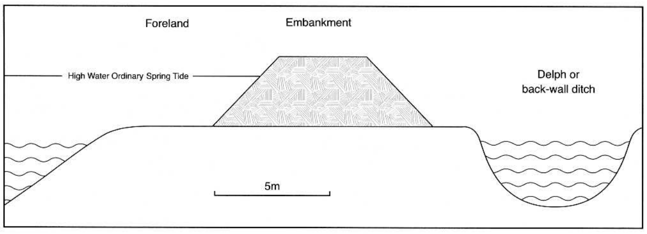

Fig. 9. *Diagram showing the height and width of an embankment constructed in Walland Marsh according to an agreement of 1471 (Canterbury Cathedral Archives, DCc Charta Antiqua A173).*

The position of embankments was carefully planned. Marking-out ditches for the embankment have been identified near Broomhill on Walland Marsh where an intended wall was not constructed and indeed, even the work of completing the initial ditches was not finished as the ditch on one side continues further than the other (*fig. 10*). Soil for the construction work on embankments was dug behind to create a channel known as the delph ditch. This then acted to collect any water which seeped through the wall, but more importantly, to gather water from rain on the reclaimed marsh. The delph ditch was set back a short distance behind the embankment. In the Fens, soil for repairing

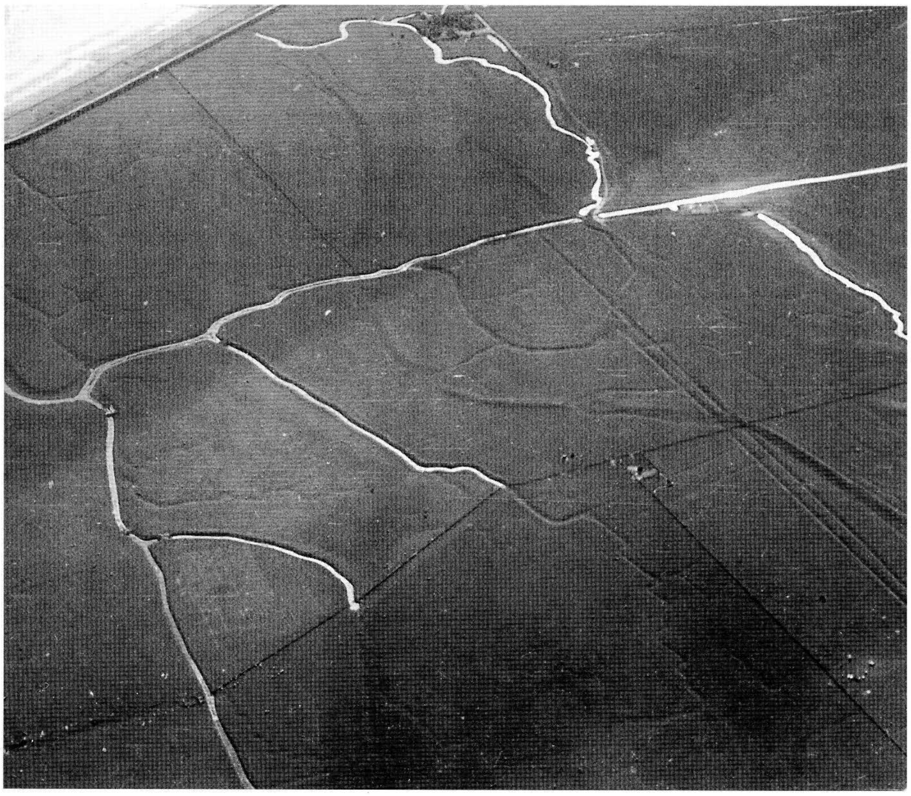

Fig. 10. *Aerial photograph taken in the 1930s showing marking-out ditches for an embankment which was not constructed. The ditches occur in the middle distance entering on the right-hand side of the photograph. The most likely date for the ditches is the sixteenth century when this area was being reclaimed from the sea. The photograph also shows traces of medieval gripes on the right-hand side cut by the marking-out ditches. A medieval embankment, which snakes across the photograph, is also apparent with two or three breaches caused by flooding.*

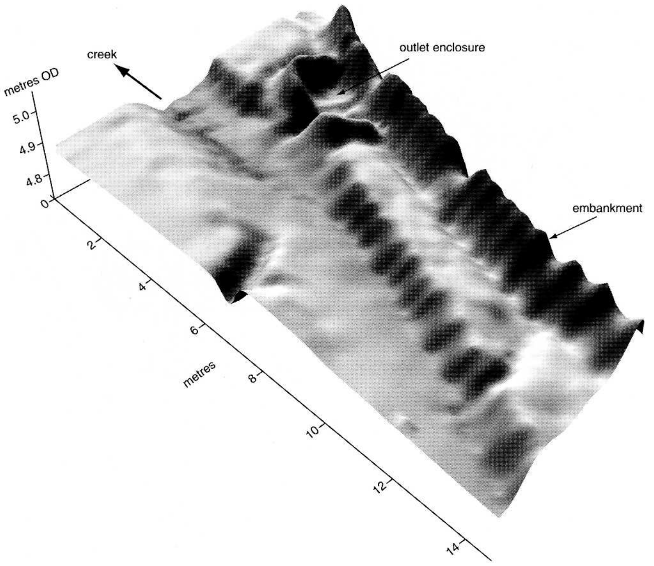

Fig. 11. *Digital elevation model of the earthworks adjoining a sluice outlet to the south-east of Moneypenny Farm, Walland Marsh, Sussex. Documentary evidence shows that the sluice was constructed in 1650. The foreland between the embankment (right) and the (left) creek can be clearly identified as a raised band.*

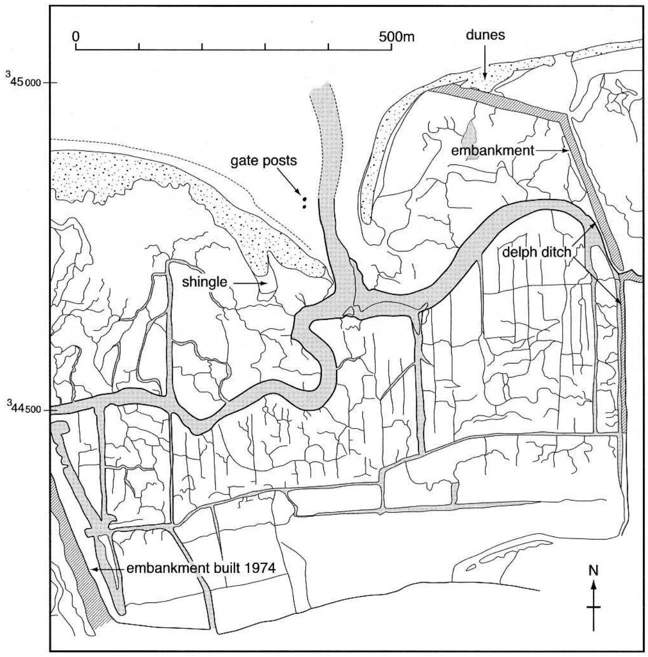

Fig. 12. *Plan of Titchwell Marsh (Norfolk) flooded in 1953. The former gripes have been incorporated into the creek system and can be clearly identified.*

the embankments had to be dug at least 2 perches (11 m) from the base of the wall so that it was not undermined (*Neilson 1920*, xlix), but the delph ditch was usually situated much closer.

The construction of an embankment cut off the heads of creeks. These areas trapped behind the wall remained as a water-filled depression known as fleets. A survey of 1390 describes Kete Marsh, an area recently enclosed in Walland Marsh. A total of 107 customary acres, equivalent to 130 statute acres (52 ha) had been enclosed at the cost of more than £220, an immense figure equivalent to the wages of 13,240 person/days. Of this, 16 statute acres (6 ha) or 12 % were covered by the marshy fleets and could not be used for agriculture or pasture (Lambeth Palace Library, Carte Antique et Miscellanee VI/83).

The delph or back ditch provided a channel to move the excess water behind the embankment to a sluice through which it could be released at periods of low tide. Sluices were complex and expensive structures and therefore few were constructed. They were not placed on the line of former creeks, because the land was too unstable. Instead they were situated close to a channel into which they were discharged, but not so close as to be undermined by tidal flow. The timber structures of the sluices rarely survive, but the positions can sometimes be identified by depressions in the top of the embankment caused by the collapse of material into the former conduit. However, earthworks from an outlet constructed in 1650 have been recorded near Moneypenny Farm on Walland Marsh. The channel of the outlet was surrounded by banks to ensure that it did not become silted up (*fig. 11*).

The land behind the embankment was drained by a network of field ditches or 'sewers'. These acted both as field boundaries preventing animals from crossing, and as the means by which water could be channelled to the delph ditch and so drained from the reclaimed land. In some places drainage within the fields was assisted by shallow ridges and ditches. These were not like the ridge and furrow using for draining arable in the clay uplands in medieval England (*Hall 1999*). The ridges on marshland were both longer, wider and less pronounced. Examples of this are abundant from the post-medieval period when they were known as grips or gripes, a term derived from the Old English *grype*, 'ditch or drain' (*Rippon 1996*, 52–54). The medieval ditches were between 20 m and 25 m and often extremely long, stretching up to 1 km or more. These have been identified at East Guldeford on Walland Marsh in an area flooded in 1288 and therefore must pre-date that inundation (*Gardiner 2002*, 113). A similar, but less extensive system of medieval gripes has been noted on aerial photographs at Broomhill, also on Walland Marsh, in an area flooded at the same time (*fig. 10*). Further ditches of the same type have been identified in the Cambridgeshire Fens where they can be up to 1.5 km in length and between 12 and 20 m in width. It is possible that in the Fens they may date from the tenth century (*Hall 1996*, 185–86).

Flooding

Salt marshes are highly unstable environments which are prone both to flooding and to silting dependent upon changes in sea-level and the configuration of the coastal barrier. Recent work on the archaeological evidence for flooding has shown that the impact of marine inundation can be recognized in the field. Flooding occurs when an embankment is breached at periods of exceptional high water. It is important to distinguish between two types of breaching. The first is

Fig. 13. Limited erosion has occurred even in the mouth of the breach at Titchwell Marsh. Plough furrows, partially covered by sand, and gate and fence posts from the period before the flooding in 1953 still survive.

very localized and is due to particular weaknesses in the embankment. These can occur as a result of animal action, such as burrowing, or through general negligence in maintaining the embankment. It may also be due to the use of unsuitable material in the construction of the embankment, particularly sandy soils which have a low structural strength. The second type of breaching is gross failure. It occurs when a storm subjects a wall to conditions well beyond its intended performance standards. The storms of 1953 in the North Sea provides an example of this. Embankments, which were sufficient to prevent flooding in normal conditions, were overwhelmed by the exceptional height of the sea.

Archaeologists have assumed that such flooding destroys a landscape, but observation of areas which were inundated in 1953 shows that this is not necessarily true. The landscape at Titchwell on the north Norfolk coast flooded that year has survived largely intact (*fig. 12*). An area on the north side has been lost to the sea, but a shingle and dune barrier has been re-established protecting the marsh behind. A creek system has developed within the flooded marsh and it incorporates many of the channels present before the flood event. Shallow gripes have been included in the creek pattern and are clearly recognizable. Indeed, the survival of landscape is so good that it is still possible to find on the foreshore two gate posts and a fence post dating from before the flooding (*fig. 13*). Where the sand has been swept away, traces of the land ploughed in the winter of 1952–53 can be observed, even near to the mouth of the main creek. There are abundant traces of the former landscape even fifty years after the land was flooded and it reverted to salt marsh. Flooding is not necessarily a destructive influence: it may alter a landscape, but does not remove all trace of the features which were there.

Once the nature of flooding is understood, it is possible to apply that knowledge to areas which have been inundated in the more distant past. Broomhill in Walland Marsh, as we have seen, was flooded in 1288 and was progressively reclaimed from 1570s (*Eddison 2000*, 116). Some areas of the landscape have not been ploughed since the thirteenth century and there is

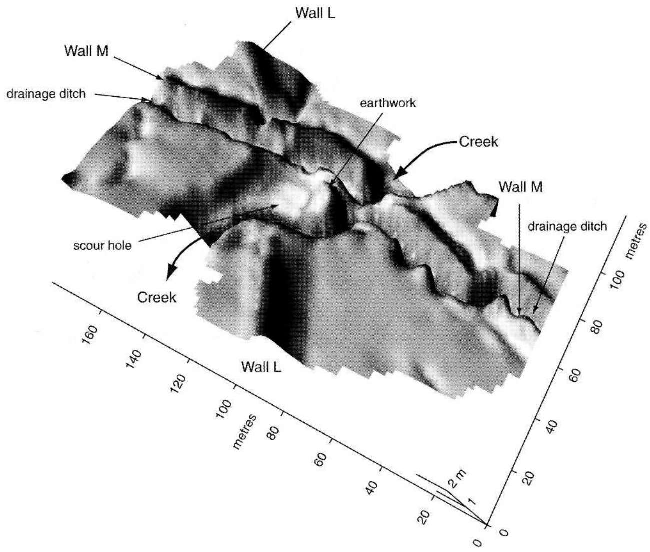

Fig. 14. Digital elevation model of the embankments and a scour pit near to Beach Banks Cottage, Broomhill, Sussex.

evidence for medieval fields, flooding and later reclamation. A programme of extensive survey using electronic total stations and aerial photographs has now been completed. It is not possible here to discuss the full details of this complex landscape, but it is appropriate to mention a few of the features. The thirteenth-century embankments in this area were not very high and as it was protected from the sea by a substantial coastal barrier of flint shingle. However, two separate flood events can be recognized. In the first, substantial breaches was made in a low embankment named Wall L (*fig. 8*). Water seems to have poured through to create two scour holes immediately behind the embankment. One of these has been surveyed in detail (*fig. 14*). As a result when the embankment was rebuilt, it was constructed on a different line to avoid one of the scour pits. The new embankment (Wall M) enclosed a smaller area to the south-west and excluded the land flooded behind the second scour hole. At a later date, this second embankment, Wall M, was also breached, possibly in the storms of 1288, allowing creeks to develop.

We can see at Broomhill some of the processes which had been observed at Titchwell Marsh. In both places the landscape was not destroyed by flooding, but was transformed. The creek system in the newly re-established marshland adopted the system of artificial ditches and gripes, but progressively modified them (*fig. 10*). However, there were also differences in the marshes. The flood event at Titchwell caused gross breaching of the barrier and the removal of many hundred metres, while at Broomhill the breaches were relatively minor and limited to a few places where the in-rushing of water created scour holes.

Conclusion

The present paper has sought to outline some of the major archaeological features to be found on salt marshes. The study of the earthworks of salt marshes has largely been ignored, because it has been assumed that, apart from field boundaries and embankments, there was very little to record. It has been shown here that marshes contain some of the most interesting and complex earthworks to be found anywhere in England. Their interpretation requires an understanding of both natural processes and human impact, and hence understand the way in which people have responded to the possibilities of a very dynamic environment. Salt marshes have a complex history which did not begin and end with the construction of embankments. The period before embankment deserves much greater attention from archaeologists, and the flood events which influenced the character of marshland are also important.

The work described here is only the first stage in the archaeological study of salt marshes, but it has sought to map out some of the methods which might be used. The study of reclaimed marshlands needs to go hand in hand with an examination of areas of existing salt marsh. It is very difficult to recognize the evidence of marshland in reclaimed pasture until we have learned to understand the processes in operation in present-day salt marsh. Almost as soon as we begin to study areas of surviving salt marsh, we also start to see the impact of human activity. Salt marsh is a 'fragile' environment. The digging of a ditch or the construction of a track leaves a trace which can survive for centuries. As a consequence, this environment offers immense possibilities for archaeological study.

Acknowledgements

I am grateful to Adam Rowlands of the Royal Society for the Protection of Birds for providing information and giving permission for access to Titchwell Marsh. The work on the Broomhill Level was funded by the Romney Marsh Research Trust as part of the study of the Wainway Channel. The assistance of Sarah Gormley in fieldwork at Broomhill is gratefully acknowledged. I am indebted to Mr Frank Cooke of Broomhill Farm for loaning the oblique aerial photographs of Broomhill. All the line drawings were prepared by Libby Mulqueeny. Attendance at the Ruralia conference was made possible by a travel grant from the British Academy.

Summary

The paper outlines the archaeological evidence to be found on salt marshes for the grazing of unembanked lands, for the process of embankment and drainage, and for flooding. It is argued that it is necessary to study both the physical processes operating on salt marshes and nature of human intervention. Two area are considered in detail. The first is the marshes at Warham and Titchwell on the north Norfolk coast in England. These salt marshes are still flooded twice daily by the tides, but contain extensive evidence of their usage at earlier dates. The second area is Walland Marsh in Sussex and Kent, which has been reclaimed. The evidence here has been derived from very large-scale excavation, landscape analysis and detailed ground survey of areas. The marsh here has been reclaimed, but it is possible to recognized features of the salt marsh dating from the thirteenth century. It is suggested that through the analysis of the earthworks we can trace the changing environment of salt marshes and the different uses of the land over the last millennium.

Zusammenfassung

Dieser Artikel umreisst kurz den archäologischen Befund auf Salzwassermarschen für Weidewirtschaft auf unbedeichtem Land, Eindeichung und Überflutung. Es wird argumentiert, dass es notwendig ist, sowohl die Auswirkungen der physikalischen Vorgänge auf die Salzwassermarschen als auch das Wesen der Intervention durch den Menschen zu studieren. Zwei Gebiete werden im Detail betrachtet. Das erste sind die Marschen bei Warham and Titchwell an der nördlichen Küste Norfolks in England. Diese Salzwassermarschen werden immer noch zweimal täglich von den Gezeiten überflutet, sie enthalten jedoch umfassende Befunde für ihre Nutzung in früherer Zeit. Das zweite Gebiet ist die Walland Marsch in Sussex and Kent, die trockengelegt worden ist. Der Befund wurde durch ausgedehnte Ausgrabungen, Landschaftsanalyse unde detailierte Feldaufnahmen des Areals gewonnen. Obwohl die Marsh in dieser Lokalität trockengelegt wurde, ist es jedoch noch möglich Kennzeichen der Salzwassermarsch, die in das 13. Jahrhundert datieren, festzustellen. Es wird vorgeschlagen, dass wir durch eine Analyse der Erdaufschüttungen den Wechsel in den Umweltbedingungen der Salzwassermarsch unde die unterschiedliche Nutzung des Landes über ein Jahrtausend hin verfolgen können.

Résumé

Cette communication décrit l'évidence archéologique qu'on peut trouver pour brouter sur le marais, évidence de construction des levées et de l'écoulement, et de l'inondation. C'est nécessaire d'étudier les mécanismes physicaux qui fonctionnent dans les marais maritimes et l'espèce de l'intervention humaine. Ici, on examine en détail deux endroits. D'abord on examine des marais de Warham et Titchwell dans la côte de nord de Norfolk. Les marées toujours inondent les marais maritimes deux fois par jour, mais les marais aussi préservent beaucoup d'évidence de leur usage d'autretemps. Walland Marsh dans Sussex et Kent, la deuxième région, est aussi réclamé. Les fouilles énormes, l'analyse de paysage et les études détaillées nous ont donnés l'évidence. Malgré la réclamation des marais, il est toujours possible de reconnaître les traites des marais maritimes qui datent du treizième siècle. On a suggeré qu'avec l'analyse de terrassements on peut trouver l'environnement changeant de marais maritimes et les usages différents de la terre au cours des derniers mille ans.

Bibliography

Allen, J. R. L. 1999:
The Rumenesea Wall and the early settled landscape of Romney Marsh (Kent). Landscape History, 21, 1–18.

Barber, L. – Gardiner, M. F. forthcoming:
Overall discussion. In: Barber, L. – Priestley-Bell, G.: Medieval Adaptation, Settlement and Economy of a Coastal Wetland: The Evidence from around Lydd, Romney Marsh, Kent.

Barber, L. - Priestley-Bell, G. forthcoming:
Medieval Adaptation, Settlement and Economy of a Coastal Wetland: The Evidence from around Lydd, Romney Marsh, Kent.

Beck, D. 1995:
The drainage of Romney Marsh and maintenance of the Dymchurch Wall in the early seventeenth century. In: Eddison, J. (ed.): Romney Marsh: The Debatable Ground, Oxford, 164–68.

Brooks, N. P. 1988:
Romney Marsh in the early Middle Ages. In: Eddison, J. – Green, C. (eds.): Romney Marsh: Evolution, Occupation, Reclamation. Oxford, 90–104.

Burd, F. 1989:
The Saltmarsh Survey of Great Britain: An Inventory of British Saltmarshes. Peterborough.

Cozens-Hardy, B. 1924:
Cley-next-the-Sea and its marshes. Transactions of the Norfolk and Norwich Naturalists' Society, 12, 354–73.

Crowson, A. 2000:
Norfolk excavation results. In: Crowson, A. – Lane, T. – Reeve, J. (eds.): Fenland Management Project Excavations 1991–1995, Sleaford, 163–230.

Eddison, J. 2000:
Romney Marsh: Survival on a Frontier. Stroud.

Eddison, J. – Draper, G. 1997:
A landscape of medieval reclamation: Walland Marsh, Kent. Landscape History, 19, 75–88.

Gardiner, M. F. 2002:
The late medieval 'antediluvian' landscape of Walland Marsh. In: Long, A. – Hipkin, S. – Clarke, H. (eds.): Romney Marsh: Coastal and Landscape Change through the Ages. Oxford, 101–20.

Gardiner, M. F. – Cross, R. – Macpherson-Grant, N. – Riddler, I. 2002:
Continental trade and non-urban ports in Mid-Anglo-Saxon England: excavations at Sandtun, West Hythe, Kent. Archaeological Journal, 158, 161–290.

Grieve, H. 1959:
The Great Tide: The Story of the 1953 Flood Disaster in Essex. Chelmsford.

Hale, W. H. 1858:
Domesday Book of St Paul's of the Year 1222. Camden Society (old series), 69.

Hall, D. H. 1977:
The Sea Bank in Cambridgeshire. Cambridge Antiquarian Society 67, 67–69.

Hall, D. H. 1996:
The Fenland Project, Number 10: Cambridgeshire Survey, Isle of Ely and Wisbech (East Anglian Archaeology 79). Cambridge.

Hall, D. H. 1999:
The drainage of arable land in medieval England. In: Cook, H. – Williamson, T. (eds.): Water Management in the English Landscape. Edinburgh, 28–40.

Hallam, H. E. 1965:
Settlement and Society: A Study of the Early Agrarian History of South Lincolnshire. Cambridge.

Hassall, W. - Beauroy, J. (eds.) 1993:
Lordship and Landscape in Norfolk 1250–1350 (Records of Social and Economic History, new series 20). London.

Kestner, F. J. T. 1975:
The loose-boundary regime of the Wash. Geographical Journal 141, 388–414.

Lambert, R. 2000:
Practical management of grazed saltmarshes. In: Sherwood, B. R. – Gardiner, B. G. – Harris, T. (eds.): British Saltmarshes: Held as a Joint Symposium between the Linnean Society of London, the Royal Society for the Protection of Birds and English Nature. London, 333–39.

Neilson, N. 1920:
A Terrier of Fleet, Lincolnshire (Records of Social and Economic History, 4). London.

Neilson, N. 1928:
The Chartulary and Terrier of the Priory of Bilsington, Kent. (Records of Social and Economic History, 7). London.

Owen, A. E. B. 1975:
Hafdic: a Lindsey name and its implications. Journal of the English Place-Name Society, 7, 45–56.

Owen, A. E. B. 1984:
Salt, sea banks and medieval settlement in the Lindsey coast. In: Field, N. – White, A. (eds.): A Prospect of Lincolnshire. Lincoln, 46–49.

Owen, A. E. B. 1993:
Beyond the sea bank: sheep on the Huttoft outmarsh in the early thirteenth century. Lincolnshire History and Archaeology, 28, 39–41.

Pethick, J. S. 1992:
Saltmarsh geomorphology. In: Allen, J. R. L. – Pye, K. (eds.): Saltmarshes: Morphodynamics, Conservation and Engineering Significance. Cambridge, 41–62.

Reeves, A. 1996:
Earthworks survey, Romney Marsh. Archaeologia Cantiana, 116, 61–92.

Rippon, S. 1996:
The Gwent Levels: The Evolution of a Wetland Landscape (CBA Research Report 105). York.

Rippon, S. 1997:
The Severn Estuary: Landscape Evolution and Wetland Reclamation. London.

Rippon, S. 2000:
The Transformation of Coastal Wetlands; Exploitation and Management of Marshland Landscapes in North West Europe during the Roman and Medieval Periods. Oxford.

Silvester, R. J. 1988:
The Fenland Project, Number 3: Norfolk Survey, Marshland and Nar Valley (East Anglian Archaeology 45). Dereham.

Silvester, R. J. 1993:
'The addition of more-or-less undifferentiated dots to a distribution map'? The Fenland Project in retrospect. In: Gardiner, J. P. (ed.): Flatlands and Wetlands: Current Themes in East Anglian Archaeology, Norwich, 24–39.

Smith, R. A. L. 1943:
Canterbury Cathedral Priory: A Study in Monastic Administration. Cambridge.

Wallenberg, J. K. 1934:
The Place-Names of Kent. Uppsala.

Dr. Mark Gardiner, School of Archaeology and Palaeoecology, Queen's University Belfast, Belfast, Great Britain, BT7 1NN, m.gardiner@qub.ac.uk