Torsten Madsen

Continuity and Change

The development of Neolithic societies in central East Jutland, Denmark

Museum Horsens

Jutland Archaeological Society

1. Introduction

When I studied archaeology in the late 1960s, it was to great extent focused on chronology and cultural diffusion across Europe. We paid almost no attention to the social organisation and the economic conditions of individual societies. This changed radically in the 1970s and 1980s, triggered by the Cambridge school of economic archaeology and the Anglo-American New Archaeology.

As a result, a new generation of Danish archaeologists began to focus their interests on individual prehistoric societies, dealing with issues such as ecological and economic settings, patterns of land use and the social organisation of society. Many of us, perhaps, thought that we were inventing the wheel, but this was far from true. In fact, South Scandinavian archaeology already had a deeply rooted tradition for a 'settlement' approach to archaeology started by Sophus Müller (1904, 1911, 1911b, 1913, 1914), and developed by Therkel Mathiassen (1948, 1959). For a complete overview of the 'settlement archaeology' tradition in South Scandinavia, see Henrik Thrane 1989.

The renewed interest in settlement archaeology, however, did bring a real change to the existing tradition, because of the theoretical background of the British and American approach. There was a willingness to go beyond the mere description of observed patterns and present explanatory models for the societies behind the artefacts.

Projects were formulated with diverse backgrounds and objectives. Many were earnest, while others were no more than hot air. For those who persisted, however, the practical reality of running a settlement archaeological project soon became obvious. There was more to it than modelling prehistoric societies. My own project was formulated in the mid-1970s (T. Madsen 1978d), but only now, more than 40 years later, have I achieved something that matches my original ambitions.

From early on, the formation of agricultural societies fascinated me. This fascination stayed with me, and was the background for the settlement archaeology project I designed. I wanted to study the organisation and development of Neolithic societies in a restricted area. The area I chose was a 1,600 km^2 part of east Central Jutland in Denmark (Fig. 1.1, top). In chronological terms, I limited the study to the Funnel Beaker Culture (FBC), dating to between 3900 and 2600 BC, and I started to undertake excavations on a regular basis within the area. I also began to record material from the area in general and in 1981 wrote an article called 'Settlement Systems of Early Agricultural Societies in East Jutland, Denmark: A Regional Study of Change' (T. Madsen 1982). The objective was:

> "to build a general model for the development of these settlement systems on the basis of our current knowledge of settlement and grave sites within the study area as well as supplementary information from other parts of Denmark. The purpose of the model at this preliminary stage is to serve as a guideline for future research in the area and to elicit comments on the interpretive framework underlying the research project, not least the part concerning change in land use patterns" (1982: 197).

Theoretically, the article was strongly influenced by New Archaeology and the Cambridge School, as the following citation shows:

> "Man never willingly fights nature, but rather utilizes it as economically as possible. That is to say, he chooses the option which will give him the highest possible returns for the least work under the given circumstances" (1982: 220).

The article was not, however, a clear case of economic determinism. It was quite obvious to me that social mechanisms played a crucial role:

> "In a case [...] where each group needs a large territory to make a living, symbolic expressions of rights to that territory might be expect-

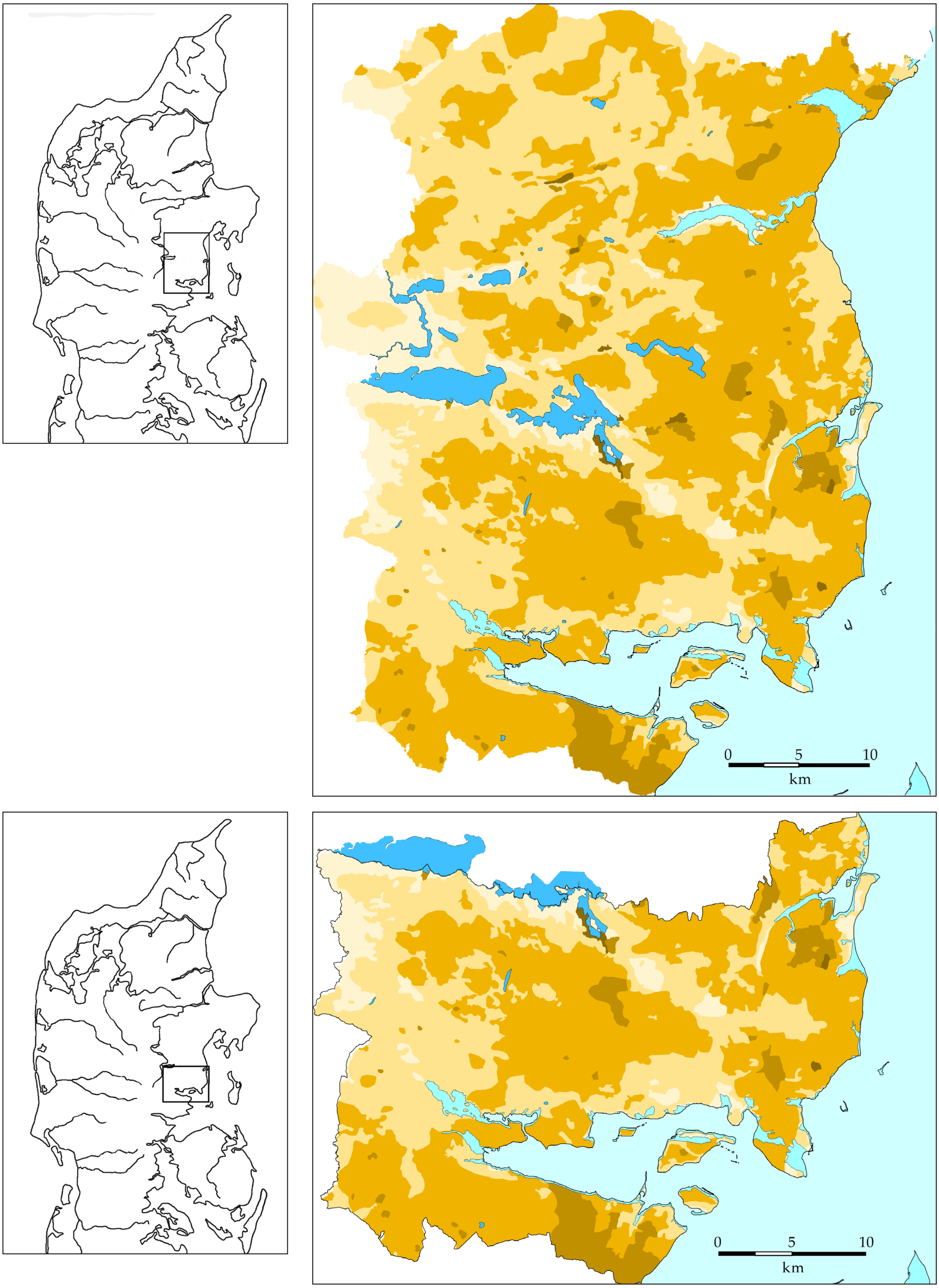


Figure 1.1. *The study area as originally planned (top) and as delineated today (bottom). The three shades of blue (from light to dark) show the current sea, the Stone Age sea and the lakes. The colours of the land surfaces (from light yellow to dark brown) show the soil quality (from sand to heavy clay).*

> ed. Elaborate social organization and ritual also may develop to control patterns of access over large areas" (1982: 221).

The general model that was presented operated with three chronological phases: an early phase between 3900 and 3550 BC, a middle phase between 3550 and 3000 BC and a late phase between 3000 and 2600 BC – using the current ^{14}C chronology.

I considered the settlements from the early phase to be of two kinds: those located by the sea or on lake shorelines and those located in sandy areas away from the shoreline. The former type was clearly associated with fishing and hunting, whilst I assumed that the latter was related to agriculture. From excavations, it was clear that the individual fishing and hunting sites were in use continuously for long periods, while the agricultural sites appeared to be small and short-lived.

The general pollen diagrams showed a forested landscape for this phase, with only few traces of agriculture. This, combined with the nature of the settlement sites, led to an assumption of a mobile forest fallow economy with small slash-and-burn plots and animal husbandry in temporary clearings. Hunting and fishing from advantageous positions along the shore supplemented the agriculture.

In the middle phase, the agricultural sites apparently grew in number and size, whilst the 'Landnam' (land-taking) effect in the pollen diagrams, indicating clearances in the forest, peaked. At the same time, new types of sites appeared. The megalithic tombs were constructed during this phase along with a number of causewayed enclosures. These pieces of evidence led me to a hypothesis of a society in which groups competed for land and resources, and where the tombs – apart from being tombs – functioned as markers of land ownership, whilst the causewayed enclosures were considered centres with a function of social regulation in society.

The late phase involved profound changes. The settlement sites became larger and more permanently inhabited, and the causewayed enclosures went out of use, or rather, were transformed into settlements. Megalithic tombs were reused, but no longer constructed. I interpreted this development as a consolidation of society with a more permanent territorial structure and therefore less social stress.

In three separate articles, I elaborated on these ideas. An article at the same time (T. Madsen & H.J. Jensen 1982) analysed in detail the land use pattern in the early phase, whilst another in 1988 (T. Madsen 1990) dealt more broadly with the FBC land use, and provided an updated version of the model presented in the 1982 article. Another article written in 1988 (T. Madsen 1991) dealt with the social organisation in Early Neolithic society. This was actually the last article I wrote in connection with the project.

What then happened to the project itself? The answer is that it slowly faded away in the face of severe practical problems. I simply had not anticipated the amount of data that was available. I could not find a way to record the artefacts in a manageable fashion, nor could I find a dynamic way to create distribution maps. I had started making sketches of the artefacts, but they were not suitable for publication, and publishing just a few selected items was not what I intended. I kept the sketches and notes in a card index organised according to location and mapped the material on a parish-by-parish basis. This was easy enough to use, but when I wanted to see the total distribution of say an axe type, it began to get complicated. First, I had to locate the individual items in the card index, find their position on the parish map and then transfer the points to a general map of the area. Soon it became clear to me that I needed something that was still in its infancy, but had not yet developed to a degree where it was useable: I needed digital technology.

I got involved with computers at a very early stage. In the late 1970s, I took courses in programming at the university, and I used the university mainframe computer on a regular basis, mostly for statistical analyses. I experimented with databases as well, but was unimpressed. In 1984, I acquired my first PC, but that was years too early. From 1987 and onwards, I became increasingly involved with computing in archaeology, and through the 1990s I almost exclusively worked with the development and introduction of computing in Danish archaeology. The East Jutland Project was mothballed.

Around 2002, I began to reconsider the project. I now knew what I was up against, and also had the tools. I started creating the maps that were required, and from 2006, when I retired from the university, I began working full-time on the project. 'Full-time' needs modification, though. I also spent time travelling extensively and also had a major backlog problem with some of my own excavations, primarily Aalstrup, which I excavated in 2000-2005.

Restarting the project also meant that I had to reconsider its objectives. Firstly, my experiences from the initial attempt showed me that the area that I had chosen was far too big. If I was to have any chance of completing the project, I would have to reduce its size. I decided to focus on the southern half of the original study area, where almost all of my own excavations were (Fig. 1.1, bottom). Another change was to include all Neolithic periods in the project, instead of just the FBC. The main reason for this was that within the study area is a well-documented presence of the earliest Single Grave Culture (SGC), which is contemporary with the latest FBC. This provided me with an opportunity to investigate how these two different traditions merged into a single cultural tradition leading into the Late Neolithic period.

I recorded the information for the project between 2007 and 2017, and when I decided to stop recording it was not because the sources were exhausted, but rather because I was. I needed to move on with the analyses and into the publication phase. As the first stage in this process, I created a catalogue and released it online early in 2019. After the catalogue was completed, I began to work on the manuscript for this book and by February 2023, after peer review, it was ready for the publication phase.

2. The East Jutland Project

The 640 km² study area consists of Horsens Fjord and its hinterland to the north. Its irregular outline is due to the Kattegat coast to the east as well as it being defined by 43 parishes (Fig. 2.1). Parishes have been used to delineate the boundaries because of the traditional practice in Danish archaeology of recording site locations based on parishes and cadastral townships within the parishes. A straight border cutting across parishes and cadastral townships would, apart from being impractical to work with, have hindered the use of some of the material recorded in the border area.

In this chapter, I will examine the physical and biological environment of the study area. I will then describe the available sources of data and discuss their validity. Finally, the recording and handling of data will be described and discussed.

2.1 – The study area

2.1.1 – The physical environment

2.1.1.1 – The land

Geology

The last glaciation (Weichsel) formed the landscape of the study area. For more than 100,000 years, the ice covered the area, but it was only during the last 10,000 years of retreat that it sculpted the landscape into its present form. It was not the result of gradually retreating ice, but rather a series of partial retreats, followed by new advances, in which each new advance piled up material that had been released by previous retreats. There were at least three major advances after the ice began to retreat and during these there were apparently numerous, minor fluctuations in the position of the edge of the ice. One of the advances was the Young Baltic Ice Stream, which in its East Jutland phase (around 16,000 BC), had an ice edge that ran right through the study area (M. Houmark-Nielsen & K.H. Kjær 2003). The line of an earlier advance also passed through the area, but the Young Baltic Ice Stream has almost obliterated evidence of this. Along the north side of Horsens Fjord, the ice moved across a much older formation and remodelled the surface of this. This is a deposit from the Late Eocene period 45-35 million years ago, called 'Søvind marl' after the village Søvind in the study area. In many places, it lies only a few metres below the current surface.

In more recent years, seismic investigations and investigations using electric and magnetic fields, induced by short bursts of electric currents (TEM – transient electromagnetic method), have revealed hidden structures known as buried valleys, which played a part in the formation of the landscape (P.B.E. Sandersen & F. Jørgensen 2016). During the various stages of the Ice Age, water under pressure below the ice shield eroded up to 350 m-deep and 0.5-4 km-wide valleys into the underlying Quaternary and pre-Quaternary sediments. The valleys are characterised by a complex structure of erosion and sedimentation, in which the sediments are a mixture of material from various periods of the Ice Age and from underlying structures. Existing valleys were clearly often 'reused' during new glaciations and many of them remained, leaving visual marks in the landscape created by the Weichsel glaciation, which also reused former valleys. Therefore, in many places, the tops of the slopes of buried valleys are still visible in the landscape, and many major watercourses follow their lines.

The most prominent of the buried valleys runs east-west along the south side of Horsens Fjord and continues straight inland, following Bygholm Å. It is at least 28 km long and 2-3 km wide and has a maximum depth of 300 m. The valley dates back to the Elster glaciation 350,000 years ago and has a varied fill of glacial and interglacial deposits. The southern edge of the valley is responsible for the straight, distinctive south shoreline of Horsens Fjord, which partly lacks the wide, shallow areas that are otherwise characteristic of the fjord (Fig. 2.2). Another buried valley that

Figure 2.1. *The 43 parishes (black lines) constituting the study area. The lines within each parish show their subdivision into cadastral townships.*

contained a major tunnel valley during the Weichsel glaciation lies beneath Hansted Å, from its mouth at the head of Horsens Fjord and inland to the northwest. This turned north, where the Gudenå River now flows, and formed the basis of the valley of this river during the last stage of the Weichsel glaciation.

Terrain

The study area is characterised by varied terrain, ranging from low, plain-like areas along the Kattegat coast and south of Horsens Fjord, to a quite rugged area north and northwest of the fjord (Fig. 2.2). This area known as 'Denmark's roof' includes the highest point in Denmark, although it has been difficult to decide exactly where this is located, because the terrain at the top forms an undulating plateau. Officially, it is now a site called Møllehøj – 170.86 m above sea level – but this only differs by a few centimetres from other candidates for the highest point. One of these, Yding Skovhøj, a couple of metres higher was for many years claimed to be the highest point in Denmark, but has now been ruled out as the measurement was recorded on top of a Bronze Age barrow.

The ice has mainly left behind a rolling landscape. Only in some areas has it left hills with steep slopes, as in the push moraine landscape of Sondrup Bakker, north of Horsens Fjord (Fig. 2.3). Otherwise, steep slopes are only found in post-glacial erosion valleys, where the water has cut through the periphery of more high-lying ground (Fig. 2.4). In general, only a few areas are unsuitable for agriculture solely because of their sloping terrain.

Soil texture

The assessment of soil quality for agricultural purposes has a long history in Denmark, and has typically been associated with taxation. The first more systematic and 'objective' method for assessing the quality of soils dates to 1688 (H.B. Madsen et al. 1992: 1-12). In this, the soil was divided into six classes, and for each of these, it was noted how many acres of land it would take to produce "a barrel of hard grain", which was a taxation unit. In 1844, a revision was implemented that was aimed at more fair taxation, but otherwise the system remained unaltered. In 1906, it was completely abandoned as a taxation system, but was used for administrative purposes until the 1950s.

In the 1970s, a new quality assessment system called 'the Danish soil classification' was developed (H.B. Madsen et al. 1992: 17 ff.). The new system was not for taxation purposes, but for the planning of future land use in view of the rapid growth of residential and industrial areas. This system involves several parameters, but here I will only use the soil texture classification.

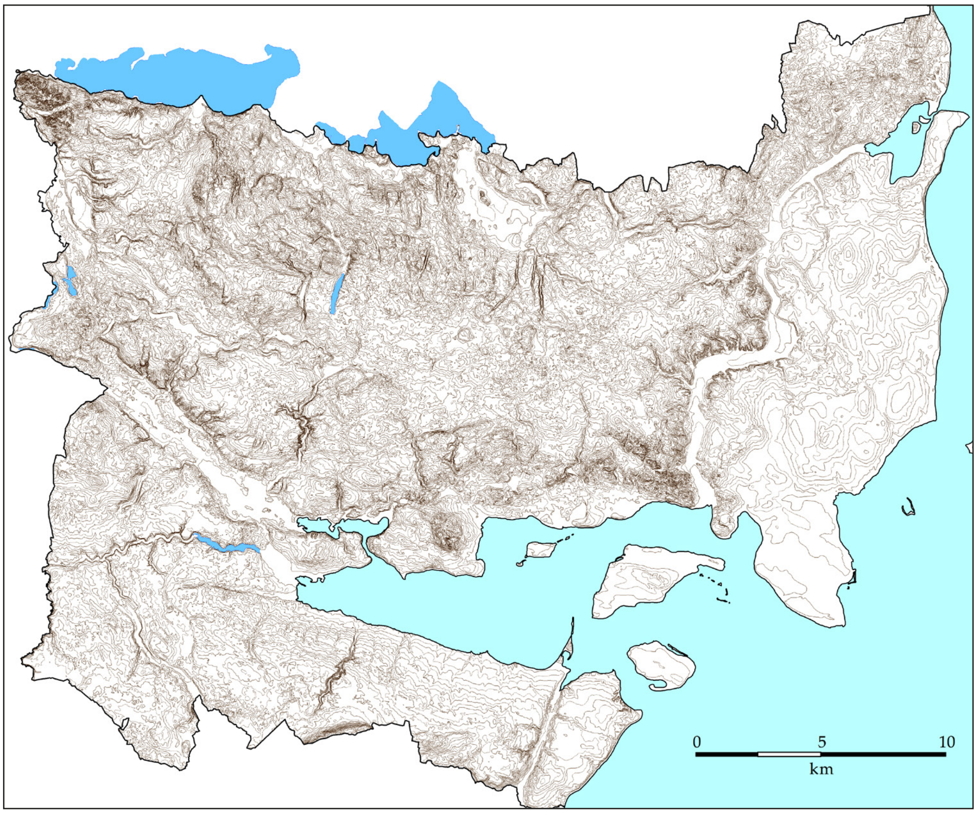


Figure 2.2. *Contour map of the study area with 3 m between the isolines.*

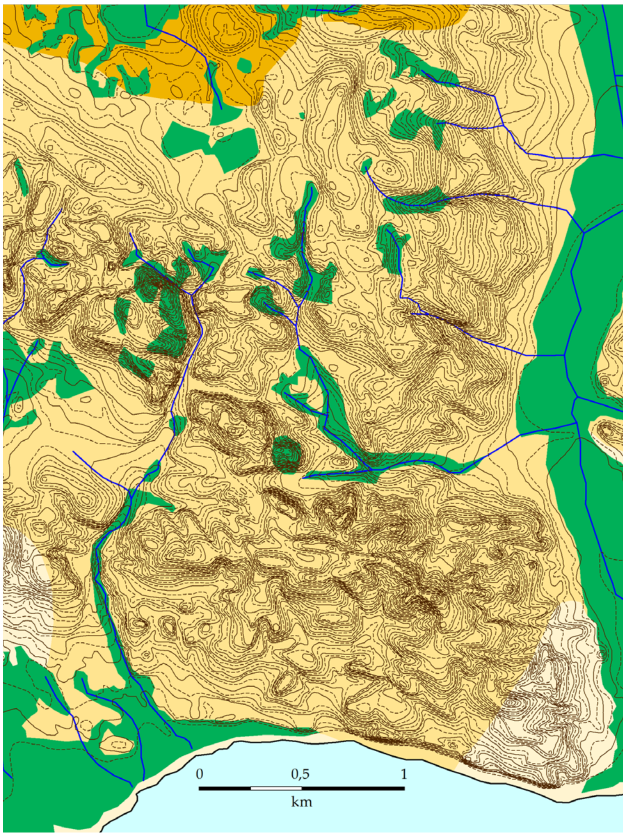


Figure 2.3. *Contour map of Sondrup Bakker, north of Horsens Fjord, showing wetland areas (green) and soil textures. For key to the soil textures, see Fig. 2-5. The rugged surface is the result of push moraine activity combined with the melting of dead ice.*

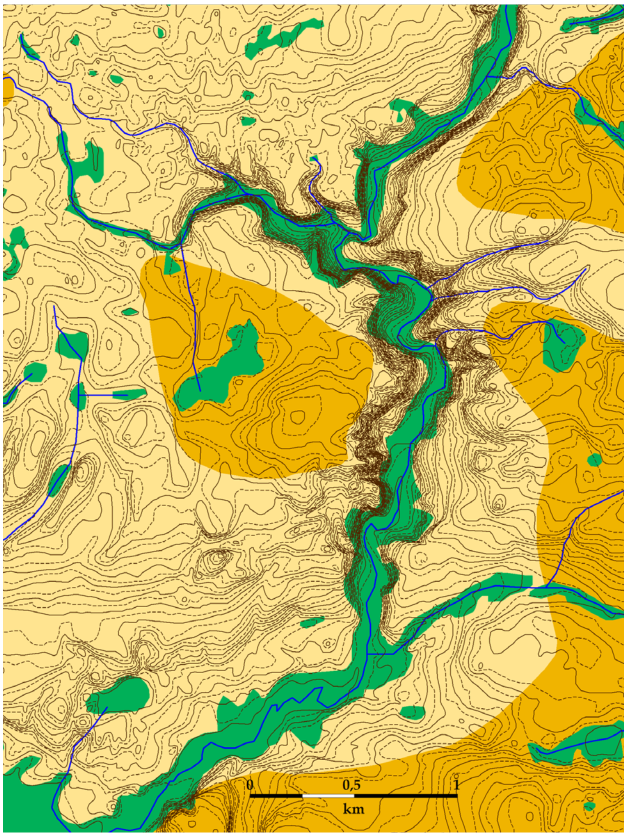
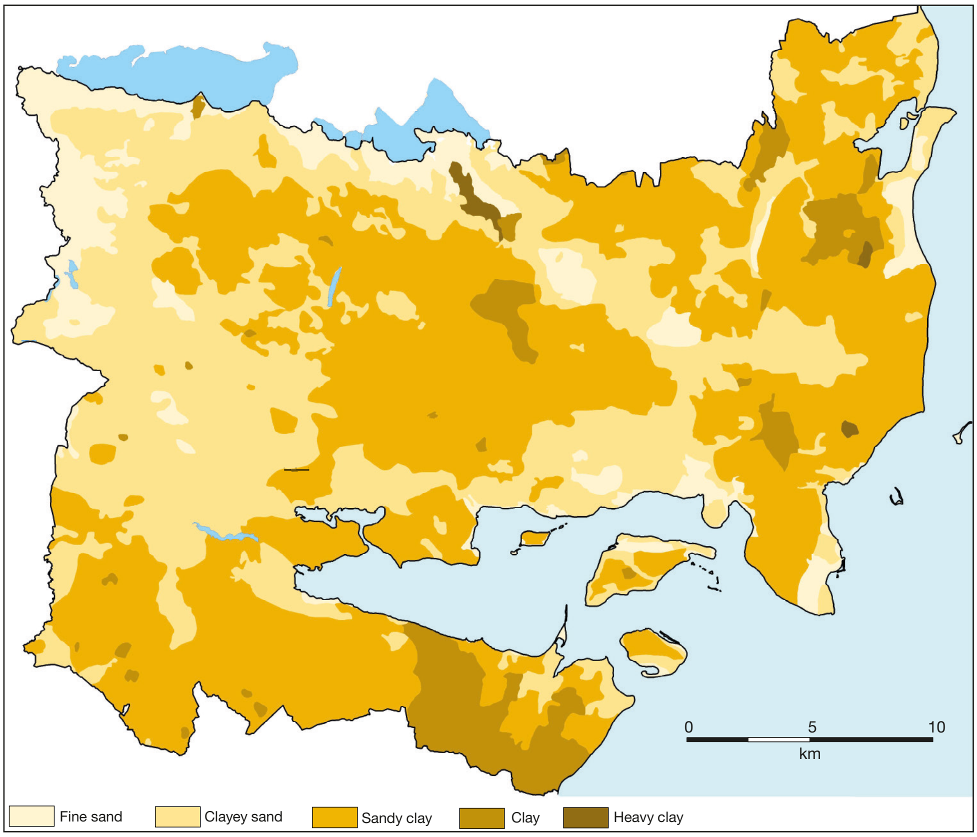


Figure 2.4. *Contour map of the post-glacial Hansted river valley, north of Horsens town, showing wetland areas (green) and soil textures. For key to the soil textures, see Fig. 2.5.*

Figure 2.5. *Map of soil textures in the study area (adapted from H.B. Madsen et al. 1992).*



Soil texture is determined by measuring the grain size in soil samples. Eight classes exist, but two of these have been omitted: humus (examined below in connection with hydrology) and atypical soils that do not occur within the study area. Furthermore, I have not distinguished between coarse and fine sand, because the former is very rare in the area. I therefore use five classes of soil: fine sand (or simply sand), clayey sand, sandy clay, clay and heavy clay/silt.

The soil map (Fig. 2.5) shows that clayey sand and sandy clay dominate, whilst sand and clay are modestly represented and heavy clay only occurs in a few pockets. In general, the soil types of the area are ideally suited to low-technology agriculture. They are not too hard to work and have the potential to produce a decent return.

Based on soil samples taken with an average frequency of only one per 70-90 ha, the soil classification system is very generalised (H.B. Madsen et al. 1992: 19). The geological mapping of soil types, with more than 30 geologically-defined soil classes, is much more detailed, with one sample for every 4 ha (H.B. Madsen et al. 1992: 14). Unfortunately, the mapping project, which has now lasted for well over a century, is still unfinished and will probably never be completed. Within the study area are unmapped areas, which prevent the general use of a geological soil map.

Hydrology

Apart from the sea, which is examined separately below, the hydrology of the area consists of two components. On the one hand, there is the pattern of runoff defined by watersheds and river systems, and on the other, areas of water accumulation (Fig. 2.6).

The main watershed through the study area separates an area with runoff directly towards the Kattegat from an area with a runoff to the west, joining Denmark's largest river, the Gudenå. The latter flows in a northerly direction for 50 km, before turning east towards the Kattegat. The main watershed in Jutland, which separates a runoff to the North Sea from another runoff to the Kattegat, is located further to the west and is not involved here.

There are two typical situations in which there is extensive water accumulation. One is in higher-lying flat terrain, often close to or at a watershed, where water accumulates in numerous hollows, mainly created by dead-ice formations and from where it cannot find a way out (Fig. 2.7). In their natural state, such areas are very poorly drained, hard to traverse and ill-suited for agriculture. The other type occurs in low-lying areas, often at the bottoms of valleys, where large amounts of water from higher ground passes through at low gradients before entering the sea or a lake (Fig. 2.8). These areas are often alluvial, due to the amount of material

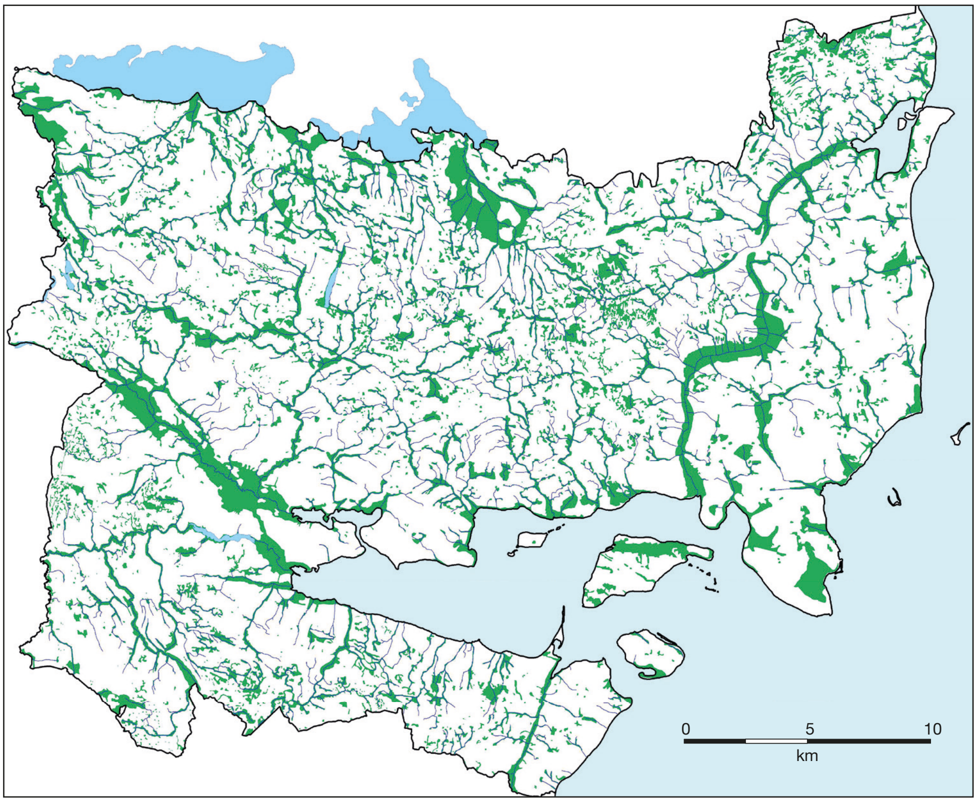


Figure 2.6. *Map showing wetland areas as recorded on nineteenth century maps.*

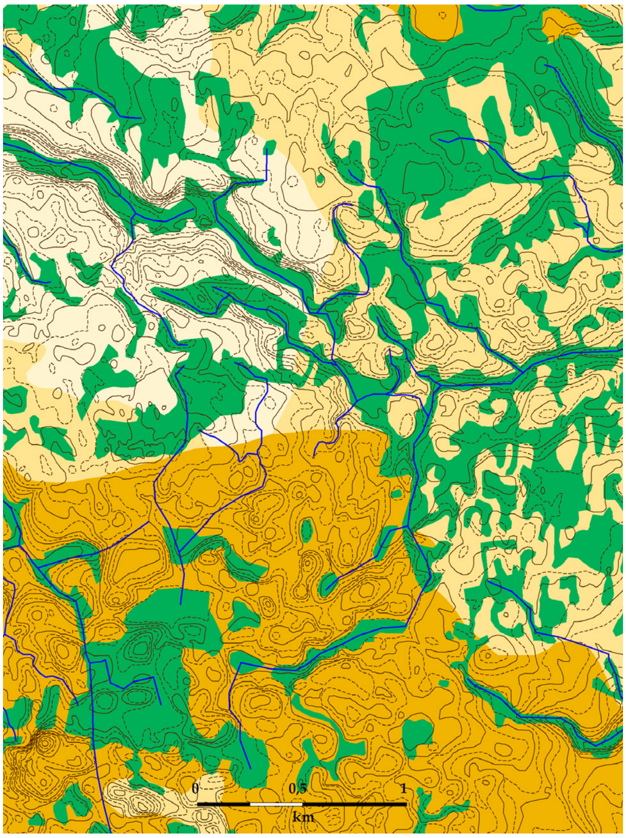


Figure 2.7. *Contour map of an area near Hovedgård in the central northern part of the study area, which is characterised by dead ice holes resulting in extensive areas of accumulated water (green). For key to the soil textures, see Fig. 2.5.*

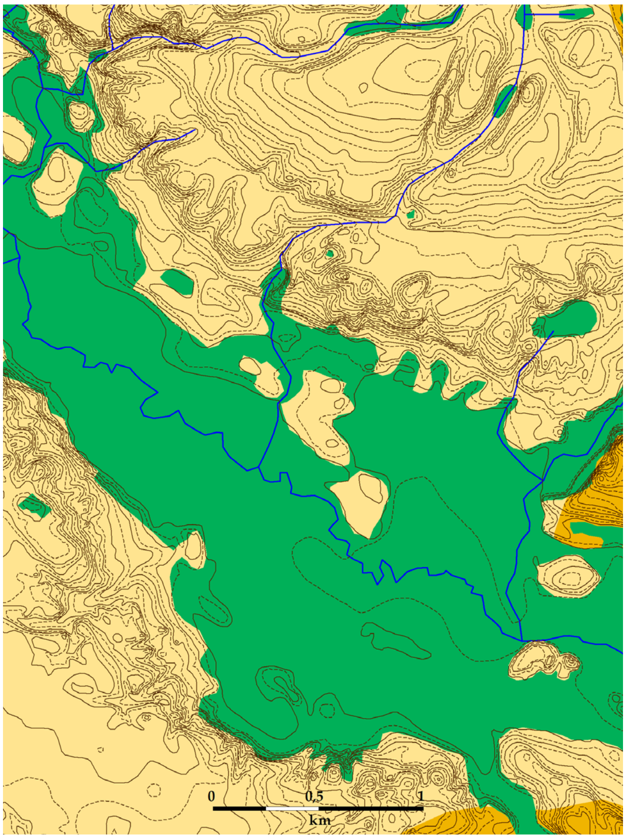


Figure 2.8. *Contour map of Store Hansted Ådal, northwest of the town of Horsens, showing an extensive accumulation of water (green) along the valley bottom. For key to the soil textures, see Fig. 2.5.*

that is eroded and transported by the water on its way down. Typically, lake sediments or occasionally sea sediments are often present below the surface in these areas. As we often find the low-lying areas of accumulated water at the bottom of valleys with steep sides, the soils along their margins are mostly well drained and thus well suited to settlement and agriculture.

When mapping the extent of wetland areas, or perhaps more correctly wet areas that are unsuitable for agriculture, care has to be taken in how these are recorded. Waterlogged soils mostly result from poor drainage, which is of course something that modern agriculture has dealt with. The situation in the landscape today is very different to the one before drainage work began. To come closer to the natural situation, we have to go back in time to early maps, as illustrated in Figure 2.6, to see what it was like at that time (section 2.2.3.3 below). They provide us with a picture that is definitely closer to the situation in prehistory than the current one. It does not, however, represent the true picture, because drainage work had even been undertaken by the time the maps were produced, and also because the natural erosion of watercourses has altered the drainage pattern over millennia.

2.1.1.2 – The sea

Sea level changes

After the Ice Age, the global sea level rose by more than 100 m. The effect of meltwater from the ice on the sea level is known as eustasy. In large parts of the world, this was the only factor that determined post-glacial sea levels. In the ice-covered parts, however, another factor called isostasy played an important role in the balance between sea and land. In areas covered by massive ice sheets, the weight of the ice pressed down the earth's crust into the underlying magma. When the ice melted, the land began to rise again. Where the ice sheet was thick and permanent, the subsequent isostatic uplift had a far greater impact on the relative sea level than the eustasy. In North Scandinavia, coastlines have been recorded up to around 200 m above current sea level (H. Steffen & G. Kaufmann 2005: Fig. 3), suggesting an isostatic uplift in this area of up to 300 m.

Along the margins of the ice sheets, such as in Denmark, the depression of the surface was much more modest (around 90 m in north Jutland), so that eustasy is a more dominant factor than isostasy. Here, the interplay of the two forces is very complicated, as they do not operate at the same pace. The isostatic uplift is a gradual, long-term process, whereas the eustasy reacts instantly to the melting pattern of the ice. The combined effect of

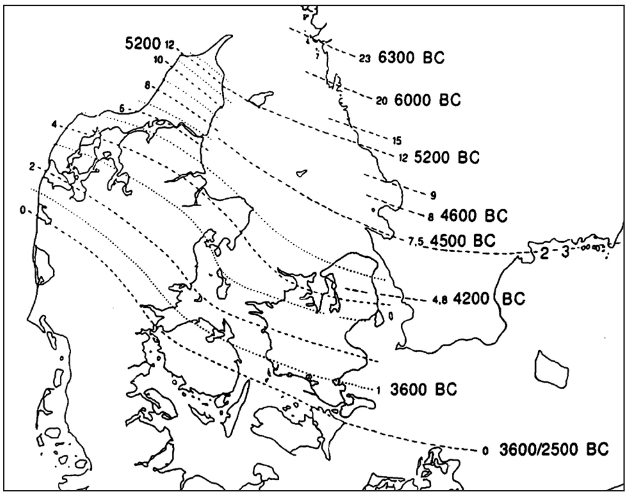


Figure 2.9. *Map showing the isolines for the highest post-glacial sea levels relative to land in Denmark, including the approximate dates of when the maximums were reached (map by C. Christensen 2001: Fig. 3, based on the original map by E.L. Mertz 1924).*

the eustasy and the isostasy along the margins of the ice sheet, as in South Scandinavia, is an immediate and rapid submerging of lowland areas by the sea, followed by partial reclamation of land by the isostatic uplift.

The fundamental principles of this have been clear for a long time, but the details are open to discussion and in particular the reconstruction of local patterns is somewhat debatable. The original breakthrough came with an article by E.L. Mertz (1924). She published a set of isolines drawn at 1 m intervals through the highest locally recorded shorelines in Denmark (Fig. 2.9). This showed a gradual drop in the highest sea level above the current level, from around +12 m in North Jutland to around 0 m at the Little Belt, and the northern parts of respectively the islands of Langeland and Falster. At Norsminde Fjord in the north of the study area, the isolines predict a maximum sea level of +2.5 m, whilst in Horsens Fjord to the south, a maximum sea level between +1.5 and +2.0 is expected.

The maximum sea level above the current level shows not only a decrease in height from north to south, but also decreasing age from north to south, with a difference of up to 2,700 years between the +12 m isoline to the north and the 0 m isoline in the south. After the major rise following the Ice Age ended around 5000 BC, the level of sea continued to increase, but only gradually. Because of marked short-term fluctuations, known as transgressions and regressions, the rise over time was not linear. It occurred in steps, and the highest sea level at various locations in the Kattegat region, for instance, was determined by which transgression was dominant in a particular area at the time when the isostasy was less pronounced than the eustasy (Fig. 2.9).

The maximum sea level

According to Mertz's map, we should expect the Sub-Boreal transgression at the beginning of the Neolithic to be responsible for the maximum sea level in the study area, although the Late Atlantic transgression at the end of the Mesolithic could have caused it in the northern part. At Norsminde Fjord, there are some indications that the sea level may have been higher than would be expected. At the Norsminde shell midden, Søren H. Andersen found that during the Late Atlantic transgression, and possibly the early Sub-Boreal transgression, the sea level was 3.5 m above current sea level (1994: 18-20). This is one metre higher than would be expected, but as the evidence comes from erosion of the shell midden, it may reflect wave action on the shoreline rather than the actual mean water level.

In 1:25,000 geological maps produced by GEUS, the +1.5 m contour line often bounds the marine deposits in both the outer areas on the north side of Horsens Fjord and at the inner part of the fjord around the town of Horsens. On the south side of the fjord, it appears to be slightly lower. At the same time, the +1.5 m contour line is often the lowest of a series of contour lines marking relatively steep slopes that must have been coastal cliffs.

At Jensnæs close to Amstrup, in Falling Parish in the outer parts of Horsens Fjord, a section recorded from the sea and inland showed a maximum for the shoreline at +1.4 m (P. Borup 2003). In 1988, in the nearby area of Åkjær valley, geologist Holger Lykke-Andersen (personal communication) mapped the maximum extent of the sea with a series of auger holes drilled to a depth of 2 m. On the east side of the valley, the samples contained sediments with marine molluscs quite close to the +1.5 m contour line. On the west side of the valley and inland, however, there was a quite considerable distance to the +1.5 m contour line. If this is combined with the maximum shoreline of 1.4 m at Jensnæs, we will end up with a probable average maximum water table of around 1 m or less. This is definitely lower than the expected maximum sea level of +1.5 to +2.0 m for the outer parts of Horsens Fjord.

A particular problem affects the reconstruction of shorelines in the innermost parts of the fjords. Immediately after the retreat of the ice and before the impact of the eustasy, the sea level was way below the current level and water rushing towards the sea eroded the valley bottoms. As the rising sea flooded the valley bottoms, alluvial sedimentation replaced the erosion. Over time, the alluvial sediments and freshwater peat formations completely covered the marine sediments in the inner parts of the fjords and raised the landscape well above the level of the marine sediments. Consequently, a terrain lying at say +3 m today may well cover marine sediments at +1 m.

This problem especially affects Horsens Fjord because the sea level has remained relatively stable over the last 6,000 years (see the following section). A number of geological boreholes that were drilled in connection with the construction of motorway E45, west of the town of Horsens, illustrate the problem (P. Borup 2003: 274, Fig. 3). Here, the current level of the terrain is + 2 m, but below a layer of peat, marine sediments, 800 m wide and up to 13 m thick, were recorded along the old river beds. The top level of the marine sediments varied between 0 m and +1 m. Thus, following the +1.5 m contour line will not reconstruct the old shorelines in this area. 2-3 km further to the east and therefore closer to the current coastline, two excavations (NM 447/54 and HOM 2750) have shown that the top of marine layers containing cardium shells lie around the current sea level, and a shoreline was encountered at +0.8 m at the two sites.

Primarily, I use the isolines to reconstruct the shorelines of the maximum sea level. For Norsminde Fjord, I have chosen the +3.0 m line as representing the top of the shorelines, and for Horsens Fjord, the +1.5 m line, with a gradual transition in the area between the two fjords. For the outer parts of Horsens Fjord on the north side, the +1.5 m isoline is probably close to being correct for the top of the shorelines (but not for the mean water table), whereas for the innermost parts and the south side of the fjord it is probably too high. Here, I use the +1.0 m isoline along the current coastline, whilst in the innermost parts of the fjord, core samples and results from archaeological excavations have been used (see below). Figure 2.10 is the resulting map, which probably shows the situation at the maximum extent of the sea in the area.

The sea level during the Late Mesolithic

There is a dramatic difference of 3.0-3.5 m between the level of the Late Mesolithic coastline in Horsens Fjord in the south and Norsminde Fjord in the north. In Horsens Fjord, it is submerged around 0.5 m below the current sea level, whereas in Norsminde Fjord it lies about 2.5-3.0 m above the current sea level.

There are numerous Late Mesolithic sites from Horsens Fjord, which lie in shallow water close to the coast, and tens of thousands of artefacts have been collected by members of the public whilst wading in the shallow water. However, we know very little about the individual sites, their chronology and their position in

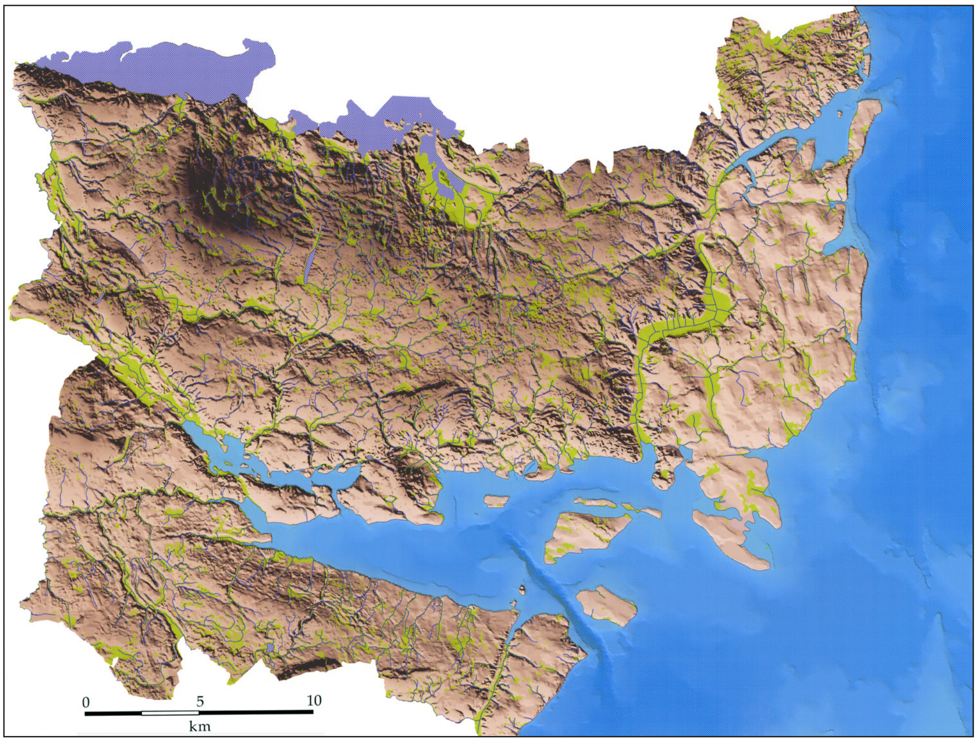


Figure 2.10. *Relief map showing the maximum extent of the sea in the study area. The level compared to current sea level is between +1.0 to +1.5 m to the south and +3 m to the north.*

relation to old shorelines. The national survey – *Fund og Fortidsminder* – lists 25 submerged sites from Horsens Fjord (Fig. 2.11). In the case of 20 of these, the only thing we can deduce from the information is that an adjacent coastline must lie at a depth of at least 0.5 m, whilst for the remaining 5 the depth must be at least 1 m. Based on the material that has been collected, it appears that we are dealing with sites from all of the Late Mesolithic – from the Kongemose Culture and right through to the end of the Ertebølle Culture (EBC). This is a more than a 1,500-year-long period, during which there were apparently only limited changes in sea level.

Off the southwest coast of Hjarnø, the only marine excavation carried out in Horsens Fjord revealed, amongst other remains, two shell middens – one from around 4500 BC (Middle EBC) and one from 5500-5400 BC (the transition between the Kongemose and Ertebølle cultures) (FHM 5184). The earliest of these lay on a shoreline around 1 m below sea level, whilst the later was on a shoreline only 20-40 cm higher (C. Skriver et al. 2018: 11). In the small town of Hou, to the north of the mouth of Horsens Fjord, a submarine Late Mesolithic settlement site is located 400 m southwest of the harbour, in very shallow water about 100 m from the current beach (FHM 3404). Divers, who investigated it to a limited extent, collected a number of artefacts. The artefacts clearly date the site to the EBC, although it is uncertain whether they represent an early or late phase. At Brakør in the western part of Horsens Fjord, a piece of a tree trunk, found 210 m from the coast at a depth of -0.9 m, dates to 5200 BC (HOM 2421) (P. Borup 2015: Fig. 3). The date probably coincides with the flooding of the tree and corresponds well with the dates from Hjarnø.

In 1953, at Bygholm Enge west of the town of Horsens, the National Museum excavated a small part of an EBC settlement that had been uncovered during the digging of drainage ditches (NM 447/54, 16.03.03 sb. 22). The EBC artefacts were found on the subsoil, in the bottom part of a 0.8-0.9 m thick layer of sand containing marine molluscs (mostly cardium, but also a few oysters), which covered the subsoil. There were no artefacts in the central and upper parts of the shell layer. The artefacts date the site to the final phase of the EBC. The current surface level at the site is +1 m and the excavation demonstrated that the depth to the top of the subsoil was 2 m, suggesting a level of -1 m for the surface of the subsoil. Due to the compression of layers after drainage, the surface level in 1953 was probably higher than it is today. If 30 cm is subtracted and the subsoil level is presumed to be -0.7 m, then the sea level matches the one at Hjarnø.

The site is occasionally mentioned as an example of a Mesolithic shell midden in the innermost parts of the fjord, but there is no evidence to support this interpretation. The thick layer of sand and shells is clearly marine deposits that were laid down during a subsequent transgression. When the sea transgressed the settlement, the cultural layers were washed out and the artefacts became mixed up with the bottom marine deposits.

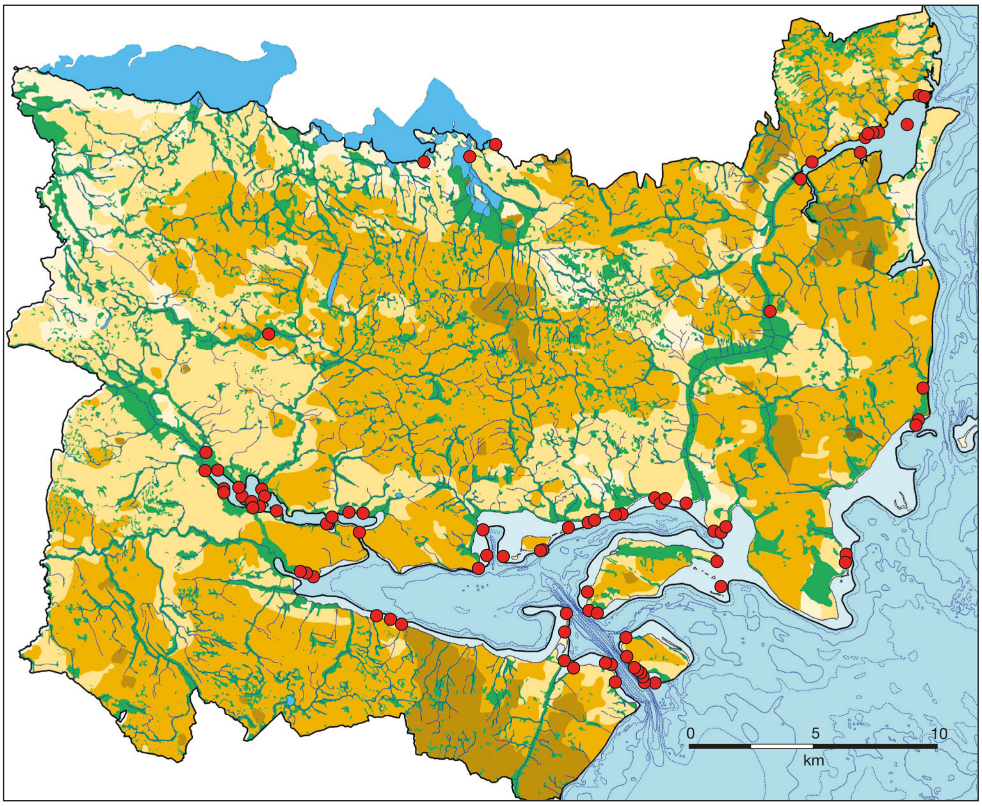


Figure 2.11. *Map showing the extent of the sea during the Late Mesolithic, around 4500 BC. The shoreline relative to current sea level is +2 m to the north and -1 m to the south, except in the inner part of Horsens Fjord, where the marine strata are covered by alluvial sediments. Here, data from boreholes and archaeological excavations are used. Light blue areas show land that is now covered by the sea and the red dots recorded Ertebølle settlements.*

The situation in Norsminde Fjord to the north is very different from that in Horsens Fjord. Here, all Late Mesolithic settlements lie well above the current sea level and the effects of the various transgressions are quite obvious. As mentioned above, the Norsminde shell midden has traces of a transgression at +3.5 m, but as we are dealing with high water marks, the true sea level is probably somewhat lower. Between Saxild and Dyngby, 6 km south of Norsminde Fjord, a small inlet of the Littorina Sea contains a number of small shell middens from the late EBC, some of which have been partly excavated. Their position suggests a sea level of around +2.0 – +2.5 m (S.H. Andersen personal communication).

To reconstruct the Mesolithic coastline, I have decided to use a level of +2 m in Norsminde Fjord, +1.5 at Dyngby and -1 m in Horsens Fjord (Fig. 2.11). The reconstruction certainly reflects one or more situations during the Late Mesolithic. It very probably also reflects the situation at the transition from the Mesolithic to the Neolithic around 4000 BC, but we have no solid evidence for this.

The sea level during the Neolithic

Neolithic artefacts are also found in seawater in Horsens Fjord, but in smaller quantities than the Mesolithic finds and mostly of an entirely different nature. A considerable number of complete, high-quality artefacts have been retrieved over the years. They were clearly deliberately deposited in the water as offerings. There are, however, also artefacts that are probably part of debris from submerged settlements.

Figure 2.12 shows the spatial distribution of artefacts dating to the Early Neolithic and the early part of the Middle Neolithic (3900-3000 BC) from Horsens Fjord. These consist of flint and stone artefacts as well as pottery. Most of the pottery vessels are or were complete when they were found, and in cases where only sherds remain, these may be fragments of pots that were complete when they were deposited. This especially applies in Stensballe Sund and at Nørrestrand, where dredging with chain and bucket machines has resulted in almost all of the finds. Most of the complete flint and stone artefacts also come from this area and from Horsens harbour, and have all been found during dredging. There is one fragmented flint axe and one fragmented stone battle axe from Nørrestrand and Stensballe Sund respectively, but neither of these are likely to have come from settlements. On the other hand, five fragmented flint tools found in seawater at Snaptun, on the south side of the fjord, probably come from settlements. The front part of a thin-butted, thick-bladed axe, probably of an early type, is from the top layers of a submerged shell midden, 100 m from the coast (170104-51) – numbers in brackets of this type refer to the catalogue, see section 2.2.4.

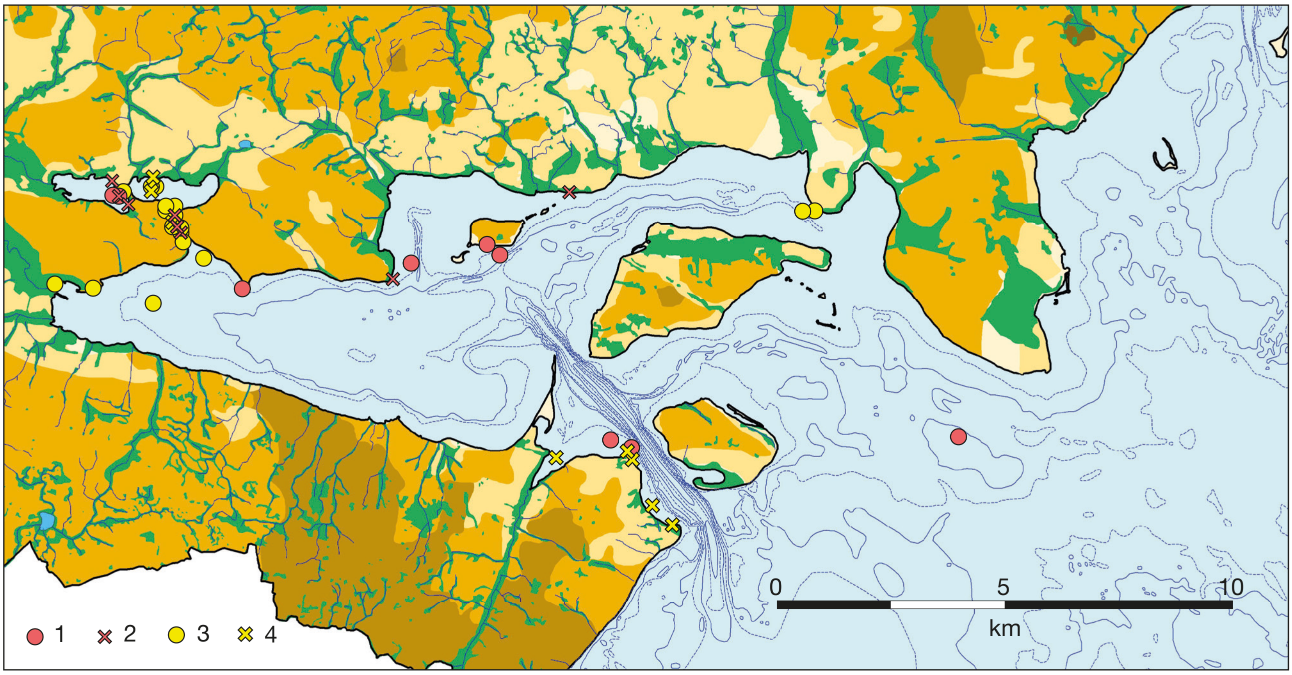


Figure 2.12. *Artefacts from Horsens Fjord dating to between 3950 and 3000 BC. 1: Complete pottery vessels; 2: Sherds of pottery vessels; 3: Complete flint and stone artefacts; and 4: Fragmented flint and stone artefacts.*

There are no finds of pottery from the late part of the Middle Neolithic (3000-2300 BC), but an extraordinary number of flint and stone tools, especially FBC (Funnel Beaker Culture) flint axes and SGC (Single Grave Culture) battle axes (Fig. 2.13). Once again, there is a very significant concentration in Stensballe Sund and at Nørrestrand, but deposited axes have also been found in other parts of the fjord. A number of tanged arrowheads from this period have not been included on the map, as they may have ended up in the water during hunting. There is only one example of fragmented material that may come from a settlement. This consists of four fragments of flint axes found at a location on the south side of the fjord (170112-17). They were collected at the beach, but their black patina clearly indicates that they have been in contact with mud deposits from the fjord.

There are fewer complete artefacts from the fjord during the Late Neolithic and the beginning of the Bronze Age (2300-1700 BC), although there is still a notable concentration in Stensballe Sund (Fig. 2.14). This mainly consists of pressure-flaked flint daggers, but battle axes are also present. Interestingly, however, there are considerable numbers of fragmented tools from seawater as well. These come from several locations along the fjord and include both fragments of pressure-flaked flint tools and flint axes. Three fragments were recovered from the site where late MN artefacts (170112-17) were also found, and three fragments come from off the coast near a large settlement, where they may have ended up in the sea as a result of costal erosion (150201-2). Fragmented LN I artefacts have also been retrieved in shallow water off the south coast of Alrø, at Henneskov Hage (150201-8). More notable, however, are three fragments from the top layers of a submerged Mesolithic shell midden at Snaptun on the south side of the fjord (170104-31).

There is thus evidence to suggest that throughout the Neolithic there may have been settlements along the shores of the fjord that are now to some extent submerged, although this evidence is also somewhat insubstantial. As with the submerged Mesolithic settlements, the existence of submerged Neolithic settlements in Horsens Fjord does not correspond with what might be expected. The situation in Horsens Fjord is apparently similar to that further to the south in Denmark, but how is this possible?

The answer to the question lies deep below ground. In geological terms, Horsens Fjord lies above a depression in the underlying chalk formations. The bottom of the depression is 400 m deeper than the surface of the surrounding chalk. The neotectonic activities that created this depression may have been due to dissolution and movements in low-lying salt horsts (H. Lykke-Andersen 1979: 4). The process has been active for hundreds of thousands and possibly millions of years, and is still continuing. Precision measure-

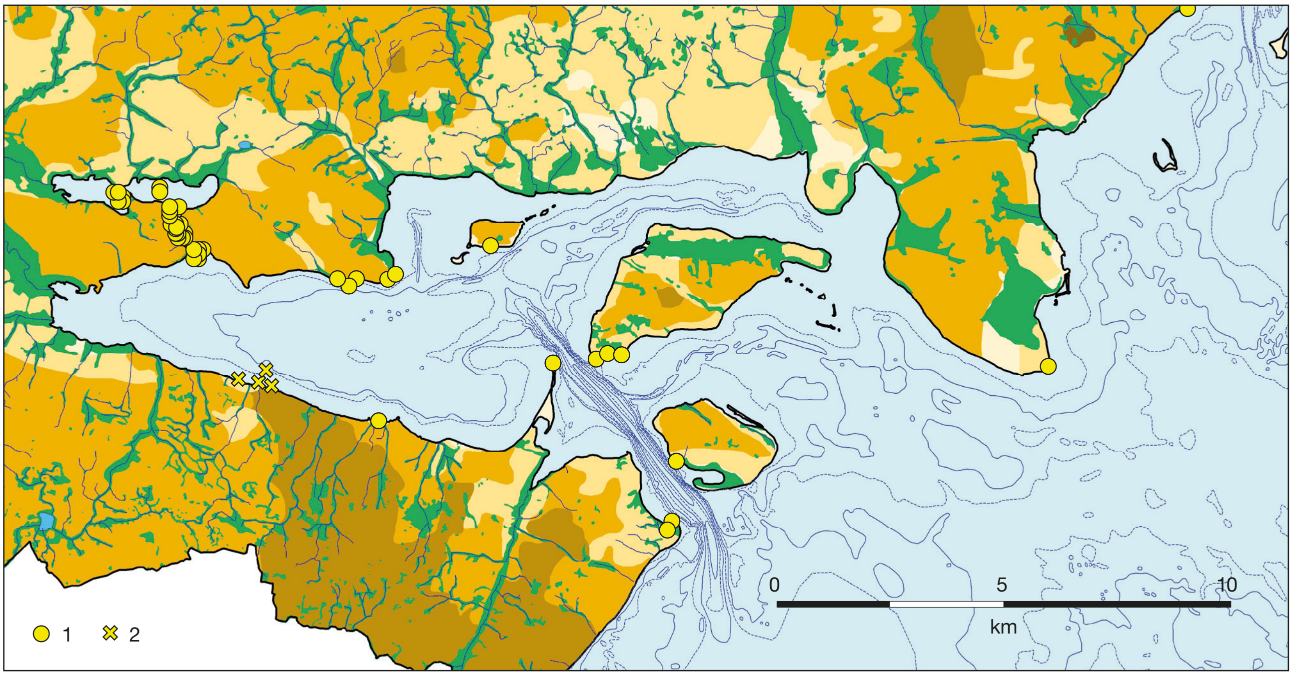


Figure 2.13. *Artefacts from Horsens Fjord dating to between 3000 and 2300 BC. 1: Complete flint and stone artefacts; and 2: Fragmented flint and stone artefacts.*

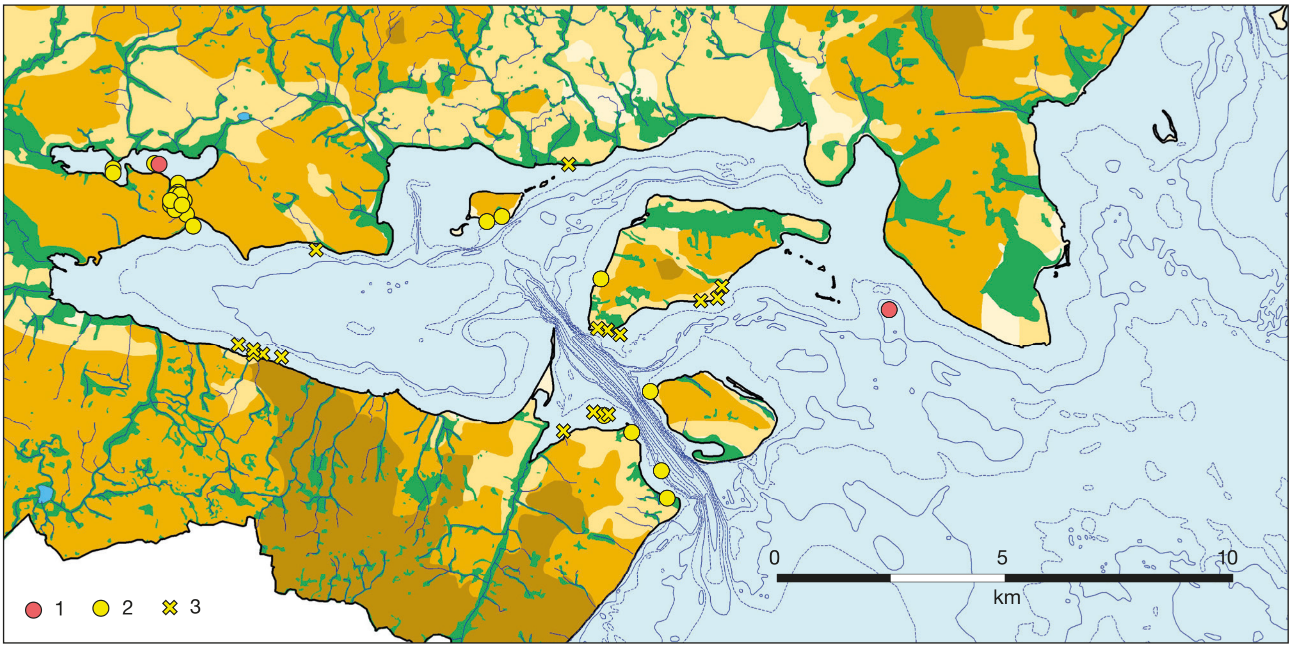
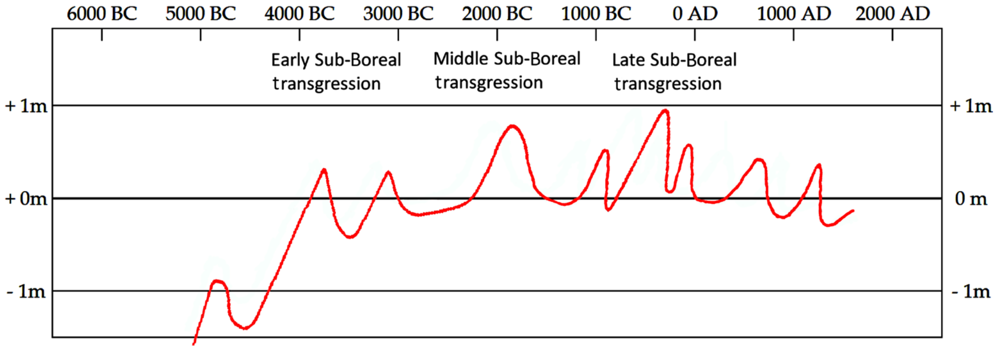


Figure 2.14. *Artefacts from Horsens Fjord dating to between 2300 and 1700 BC. 1: Complete pottery vessels; 2: Complete flint and stone artefacts; and 3: Fragmented flint and stone artefacts.*

ments at Horsens show a yearly lowering of 0.1 mm per year (H. Lykke-Andersen 1979: 4). This, however, is not enough to explain the anomaly in Horsens Fjord. With a rate of 0.1 mm per year, the lowering since the Mesolithic would amount to around only 60 cm. As the level of Late Mesolithic settlements is 2.5-3.0 m lower than would be expected, the average yearly lowering is about 0.4 mm per year. Thus in some periods, the lowering must have occurred at different rates than the current one. Such changes in the rate cannot be documented, but based on the evidence for the Neolithic presented above, it appears that the isostatic uplift and the tectonic movements in Horsens Fjord kept one another at bay through this period.

Figure 2.15. *Eustasy curve produced by N-A. Mörner (1976: Fig. 7; 1979: Fig. 16) applied to the situation in Horsens Fjord. See text for details.*



For a more detailed assessment of the sea level changes during the Neolithic, it is necessary to use information from elsewhere. A set of usable data comes from Niels-Axel Mörner (1976; 1979), who produced a 'neutral' eustasy curve without isostatic influence. Mörner's curve is shown in Figure 2.15. I have adjusted the curve vertically, to allow the level at the time of the EBC to coincide with the level of the Late Mesolithic settlements in Horsens Fjord at one end and the most recent part of the curve with the current sea level at the other.

What can be observed is a sea level that fluctuates, and from 2000 BC slightly above the current sea level. The early, middle and late Sub-Boreal transgressions can be easily identified in the curve, which also interestingly suggests a slight rise in overall sea level from transgression to transgression, before it begins to fall to the current level. Furthermore, the curve indicates that settlements along the shores of the fjord, that are now submerged, may have existed periodically between 4000 BC and 2500 BC and possibly after the middle Sub-Boreal transgression, as indicated by finds of fragmented flint tools in shallow water. The curve cannot, however, be applied with precision.

The tidal amplitude in the Littorina Sea

The salinity of the water in Horsens Fjord is dependent upon the mixture of water from three sources: freshwater from the rivers, brackish water from the Baltic Sea and water with a high salt content brought into the Kattegat by the tidal current. The latter two are mixed up and brought into the fjord by tidal currents.

The tidal current originates in the Atlantic Ocean and enters the North Sea via both the English Channel and the sea to the north of Scotland. In the open ocean, it is insignificant, but as it passes over shallow ground it grows, and when it meets land may build up significantly. However, as it moves on from its point of origin, the amplitude between ebb and flow becomes less and less. The tidal wave from the north moves down along the east coast of Britain, where today at Aberdeen the ebb-flow amplitude is 4 m at spring tide. Towards the south, it joins the tidal current from the English Channel and combined they continue up along the continental coast. At Esbjerg, in the southwestern part of Jutland, the ebb-flow amplitude is 1.5 m at spring tide, at Hanstholm in north Jutland it is 0.5 m and when it reaches the tip of Jutland, it is only 0.3 m. From here, it continues into the Skagerrak and Kattegat, where it retains its amplitude. Thus, at Korsør in the Great Belt, the amplitude at spring tide is 0.25 m, and at Horsens Fjord, it is 0.3 m.

The tidal current around the North Sea has apparently not changed since the formation of the English Channel (K. Uehara et al. 2006). This does not mean that the amplitude of the tidal current in the Littorina Sea along the Kattegat coast was the same as it is today. At that time North Jutland consisted of numerous islands scattered in the sea and there was an open passage from immediately north of Hanstholm through to the Kattegat. Part of the tidal current could have passed through here with ebb-flow amplitudes of 0.5 m to begin with. Moreover, a study of a core bored into sea sediments at the Skaw in North Jutland indicates there were increased currents in the sea at the end of the Atlantic period, which brought more water into the Kattegat. This was probably caused by a general change in the weather conditions at the beginning of the Sub-Boreal period (K. Conradsen & S. Heier-Nielsen 1995). The tidal current must generally have been stronger than it is today, as is also indicated by the higher level of salinity in the Littorina Sea (see section 2.1.2.2).

2.1.1.3 The climate

The study of post-glacial changes in climate based on plant macrofossils began in the 19th century, and as early as 1909, a study of the distribution of hazelnut shells in peat formations in Sweden led to the conclusion that the maximum post-glacial summer temperature was 2.5° C higher than that of today (H.J.B. Birks

& H. Seppä 2010: 655, 662-4). Johannes Iversen's (1944) study of climate indicator species through pollen analysis provided more detailed knowledge of post-glacial temperature changes, including the winter temperatures (H.J.B. Birks & H. Seppä 2010: 666-7).

A thorough study by K.J. Brown et al. (2011) using the indicator species approach has provided us with a detailed temperature graph for both summer and winter temperatures during the post-glacial period. It shows how after the glacial period both summer and winter temperatures rose to a maximum around 5000 BC, and then gradually fell to current daily temperatures, with a dip during the Roman Iron Age. July mean temperatures (today 16.6° C) were 18-19° C at the beginning of the Neolithic, decreasing to 17-18° C at the end of this period. January mean temperatures (today 1.1° C) were 3° C at the beginning of the Neolithic and around 2.0° C at the end of the period (K.J. Brown et al. 2011, Fig. 4). The current temperatures mentioned refer to an average for the years 1981-2020, measured by the Danish Metrological Institute.

Two different factors may have influenced the climate. The summer temperature perhaps reflects the position of the mixing zone between cold polar air and warm tropical air in Europe (M. Magny 1982: 39-43). At the maximum temperature, the zone was probably positioned over South Scandinavia, deflecting the stream of low pressures from the Atlantic to the north, which resulted in dry, warm summers. As the mixing zone moved south, the maritime low pressures began to influence South Scandinavia, bringing cooler and more moist air. For winter temperatures, on the other hand, the sea is a significant determining factor. The Littorina Sea was clearly warmer than the sea is today (section 2.1.2.2), and this must have greatly influenced the winter temperatures in South Scandinavia during the Neolithic, creating a warmer winter climate.

2.1.2 – The biological environment

2.1.2.1 – The land

The primeval landscape

The natural environment of Denmark was completely dominated by forests. Johannes Iversen (1967: 399-401) painted a picture of a dense and dark forest on heavy, fertile soils, with various more light and open variants on more sandy soils and in moist areas. Common lime (*Tilia cordata*) completely dominated the forest on the fertile higher terrain, where its canopy blocked out all light and left the floor almost barren. Only where trees had recently fallen, could a variety of tree species and herbaceous plants become established in the forest, but this lasted just until the gap in the canopy closed up again. In areas with more sandy soils, the lime trees were mixed with mountain elm (*Ulmus glabra*) and sessile oak (*Quercus petraea*). Here, more light penetrated through the canopy, allowing more varied undergrowth. Similarly, a more varied forest existed on more moist soils, with oak often present, whilst on wet soil the composition of the forest changed to a mixture of pedunculate oak (*Quercus robur*), ash (*Fraxinus excelsior*), common alder (*Alnus glutinosa*) and some varieties of elm (*Ulmus minor* and *Ulmus laevis*). In these waterlogged areas, the forest was much more light and open.

The mammals that inhabited the forests were primarily red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), wild boar (*Sus scrofa*), beaver (*Castor fiber*), otter (*Lutra lutra*), fox (*Vulpes, vulpes*), wildcat (*Felis silvestris*), squirrel (*Sciurus vulgaris*) and pine marten (*Martes martes*). Other animals that could be encountered included bear (*Ursus arctos*), polecat (*Mustela Putorius*), badger (*Meles meles*), lynx (*Lynx lynx*), moose (*Alces alces*) and aurochs (*Bos primigenus*) (K. Aaris-Sørensen 1985: 465-466).

The picture painted above of the forest as a generally dark and closed environment, obviously implies that the number of animals per square unit of land must have been limited, and this is the generally accepted view. It has been challenged, though, by the suggestion that large herbivores, from the early post-glacial and onwards, maintained an open landscape and created a mosaic of open grassland, regenerating scrub and forested groves (F.W.M. Vera 2000). Palynologists reject this hypothesis, however (H.J.B. Birks 2005; F.J.G. Mitchel 2005).

A more recent study has attempted to quantify and map the degree of openness in the landscape, using pollen counts from 25 selected taxa (A.B. Nielsen et al. 2012). It involved 11 timespans, ranging from AD 1900 to 6700 BC, in which the occurrence of the individual taxa were mapped separately in each timespan. The plants were also combined into a map of vegetation openness. The timespan of the latter which is of interest here is the one around 4000 BC (Fig. 2.16). For Denmark, the map shows that the darkest primeval forests were located on the Danish islands, with an openness index of 0-15%. In eastern Jutland around the study area, it was 15- 20% in the east, increasing to 30% towards the west, and in the western parts of Jutland, reached 40%. According to the study, the absolutely dominant factor that determines openness is soil types (A.B. Nielsen et al. 2012: 140 ff.). Thus, sandy soils

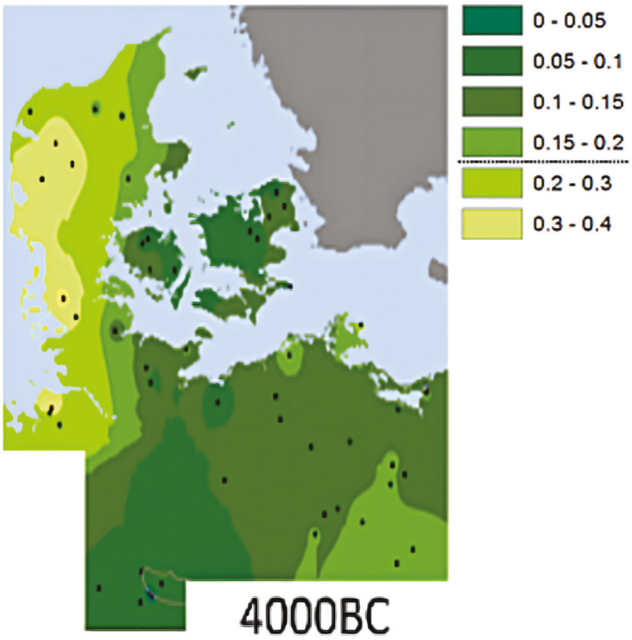


Figure 2.16. *Map showing the degree of openness in the primeval forest around 4000 BC. The black dots on the map show the positions of the pollen samples used as sources for the map (adapted from A.B. Nielsen et al. 2012: Fig. 3).*

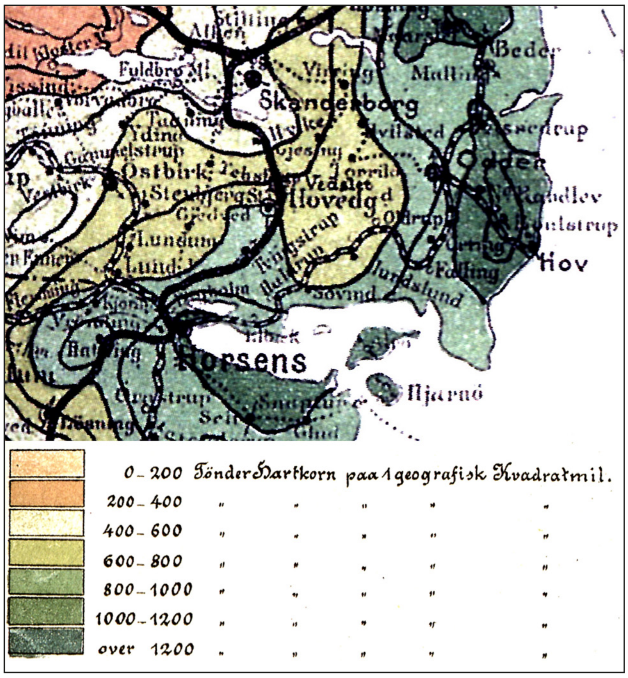


Figure 2.17. *Map from 1844 showing the distribution of 'barrels of Hartkorn' per 55 km² in and around the study area. The map is an excerpt from a full map of Denmark (H.B. Madsen et al. 1992: Fig. 3).*

with fewer nutrients favour not only more light, open species like oak, but are also associated with slower forest regeneration after disturbances in the canopy.

The nearest pollen analysis to the study area lies to the north (see sample locations in Fig. 2.16). This, combined with the marked differences in soil types within the area (see section 2.1.1.1), means that the general prediction of 15-20% openness is somewhat uncertain. However, the study does allow us to use the soil maps to differentiate between local areas with a potentially high degree of openness and areas where a more dark, primeval forest prevailed.

Conditions for agriculture

The potential yield of field systems has been a vital issue for centuries, and in medieval times and later constituted the basis for taxation. Figure 2.17 shows the valuations from 1844 for eastern Jutland in and around the study area. The values shown are barrels of 'Hartkorn' per Danish square mile (approximately 55 km²). The name Hartkorn refers to hard cereal grains, such as barley, rye or wheat, but was used as an arbitrary measurement of value, into which everything was converted. One barrel of honey was thus equal to six barrels of Hartkorn, as were 12 geese (H.B. Madsen et al. 1992: 1).

The overall map of Denmark looks very much like the map of openness in Figure 2.16, with the highest values (and lowest degree of openness) reached on the Danish islands and the lowest values (and highest degree of openness) in western Jutland. The common denominator of the two is of course the nature of the soil. To the east within the study area, there are peak values of 1,000-1,200 barrels of Hartkorn on both the north and south side of Horsens Fjord, and otherwise 800-1,000 barrels of Hartkorn. To the west are 600-800 barrels, decreasing in some areas to 400-600 barrels of Hartkorn.

Based on an assumption that farmers always want to optimize the results by selecting the areas that produce the highest yields, we would expect the distribution of settlements to in some way relate to the distribution map for barrels of Hartkorn. In Bronze Age studies, such an assumption was made (K. Randsborg 1975, K. Kristiansen 1978), but was never generally accepted, and there are good reasons for this. The map is not just a map of soil quality: it is a map of productivity and wealth, and thus a map of where people lived and worked for whatever reason. If the map shown in Figure 2.17 is examined, it is evident that the values are higher along the north coast of Horsens Fjord than in the hinterland, but if we compare this with the modern soil map (Fig. 2.5), we find better soils here than on the coast. Several factors that have nothing to do with the quality of soil may influence a farmer's choice of where to settle. This especially applies to the initial phase of farming in a primeval forest area.

Figure 2.18. *A ground surface littered with stones in a forest area that has never been cleared for agriculture. The forest, Stjær Stenskov, is one of the few such areas that still exist in Denmark today, and provides a good impression of the conditions that the first farmers encountered. Photo: T. Madsen.*

When the first farmers entered the area, they probably did not measure the quality of land in terms of the soil quality but rather in terms of the amount of stones. It is perhaps hard to imagine when looking at the landscape today, with its huge, stone-free fields, but when the ice melted, it left a landscape littered with stones of all sizes (Fig. 2.18). The forests eventually covered the stones until the early farmers had to deal with them. The stones were not, however, evenly spread across Denmark. Some moraine deposits contained less stones than others, and there were completely stone-free areas on late glacial meltwater sand, although the soil quality here was very poor.

Finding good-quality soils was only one factor to consider, however. Depending on the kind of farming that was practised there were also others. If pigs were kept, for instance, a forest type was needed nearby that could feed them. The lime that dominated the better soils was of no use; oak or hazel were required instead (beech trees were not present at that time). This meant that the farmers had to find lighter soils or utilise wetland areas. Cattle, on the other hand, did not tie farmers to a specific type of forest: grazing areas had to be created for these animals under all circumstances. This could be done efficiently by ring-barking trees and the type of forest was immaterial. This provided areas without vegetation suitable for agriculture and subsequently browsing areas for cattle, as the forest began to regenerate.

Another factor to consider is the need for alternative subsistence strategies, if farming proved to be insufficient on an all-year-round basis. The heart of a primeval forest was not a good place to hunt, fish and gather, but the river valleys, the lake shores and especially the coasts were. Even though these were farming societies, the potential for hunting, fishing and gathering may have played an important role in the location strategy.

Finally, there was the social dimension. People do not settle in an open pattern across the landscape, at least not for long. Deeply rooted patterns of settling develop and govern where the next generation will settle. People come to live where their kin live, not because of optimal agricultural conditions, but because that is where they belong.

2.1.2.2 – The sea

Shallow waters dominate the sea bordering the study area to the east and particularly in the two fjords that cut into the landscape. The low, flat land bordering the coast continues below the surface, and 2-4 km from the coast, the depth rarely reaches more than 4 m. Stream channels, which have been cut through the shallow ground by tidal currents, are an exception, however. The most notable of these channels in Horsens Fjord lies between the mainland to the south and the islands of Hjarnø and Alrø in the north (Fig. 2.10). It is up to 20 m deep and only 400 m wide at its narrowest point. Today, under normal tidal conditions, with up to 30 cm between ebb and flow, 15 million m^3 of water passes through the channel four times a day creating very strong currents (E. Holm 2000: 97). During abnormal weather conditions with heavy winds, the extremes of ebb and flow may be as much as -100 cm and +180 cm respectively.

Today the common mussel (*Mytilus edulis*) is by far the most successful marine mollusc in the area, and in Horsens Fjord it is dredged from the bottom in large quantities (E. Holm 2000: 110). Cardium (*Cardium edule*) is also found along the shores, although in limited numbers of 10-270 per m^2, compared to 4,000-5,000 per m^2 in the mudflats of the North Sea (G. Thorson 1968: 87). Oysters (*Ostrea edulis*) are not present, as the water is insufficiently saline for them to exist and too cold for them to breed.

In the Littorina Sea during the Late Mesolithic and Neolithic, oysters as well as cardium were abundant, whereas common mussels were apparently less common. Mesolithic shell middens containing oysters have been found all along the coast and deep into the fjords. Huge natural shell banks are known from Horsens Fjord, in particular from the narrow passage (Stensballe Sund), which connects the main fjord with the inner branch called Nørrestrand, as well as from the first part of the latter. Between 1938 and 1966, these shell banks and parts of the submerged shell middens in the area were exploited by a particular industry, when barges equipped with a chain bucket system dragged up shells from the banks, which were up to 15 m thick. The shells were used as a dietary supplement for poultry (V.Ø. Lomholt 2003; 2004).

During the Neolithic, we have dates for oyster shells from Norsminde (150405-5) between 4,000 and 3300 BC, Toftum (160508-35) around 3400 BC, Aalstrup (150203-2) around 3000 BC, Egehoved (150201-2) and Bjerggård (160512-1) between 3000 and 2700 BC and Kalvø (150212-13) between 2600 and 1800 BC. Therefore, throughout the Neolithic period, oysters were common in both Norsminde Fjord and Horsens Fjord.

The presence of oysters during the Mesolithic and Neolithic clearly indicates that the conditions in the Littorina Sea were fundamentally different from what they are today. Oysters (*Ostrea edulis*) generally require salinities above 23-25 $^0/_{00}$ and water temperatures above 15^o C during the summer. Today, these requirements are only met along the west coast of Denmark, and thus today oysters are solely found in the salt marsh on the southwest coast of Jutland and in the western part of the Limfjord. A further obstacle to oysters is the sedimentation of fine-grained particles in their breeding grounds (Lewis et al. 2016).

In Horsens Fjord, the average salinity today is 22 $^0/_{00}$ in the inner fjord and 24 $^0/_{00}$ in the outer fjord (E. Holm 2000: 99, Fig. 99E), while the temperature of the water rises above 15^o C only in July and August (E. Holm 2000: 99, Fig. 99D). Sediments of silt and detritus mud transported to the fjord by the river systems are also common. All of these parameters were different during the Neolithic. A core sample from the south side of the middle of the fjord indicates there was a mean salinity of around 25 $^0/_{00}$ during the Late Mesolithic and the first half of the Neolithic, and during these periods there was also constant but moderate sedimentation in the fjord (J.P. Lewis et al 2016: Fig. 2). Moreover, there is clear evidence of higher air temperatures in both summer and winter (section 2.1.1.3), which along with the likely greater amplitude between ebb and flow mentioned above, points to a higher sea temperature.

A core sample is also available from Norsminde Fjord (J.P. Lewis 2011; J.P. Lewis et al. 2016: Fig. 2). It shows a lower salinity and higher sedimentation rate than in Horsens Fjord during the first half of the Neolithic, although the evidence from the sample is hardly conclusive. This is because the core comes from the narrow inner part of the fjord, not far from where the watercourses Odder Å and Rævså, the major suppliers of freshwater, flow into the fjord.

Today, professional fishing in Norsminde Fjord and Horsens Fjord has ceased. Plaice is no longer present due to pollution and cod is rare even in the deep stream channels (E. Holm 2000: 106). Within living memory, however, it was different. Fish were abundant and fishing was a viable industry. During the Mesolithic and Neolithic, the Littorina Sea would have made it an even more profitable occupation, and with plentiful fish in the stream channels, a professional fisher – the seal – also inhabited the fjords, as indicated by frequent finds of seal bones from both Mesolithic and Neolithic settlements along the fjords. 'Seal Bank', the name of a sand bank close to the main stream channel in Horsens Fjord, exposed at ebb, is evidence that not long ago the seal still inhabited the fjord.

2.2 – Data acquisition and handling

The material used in this study comes from excavations, archives, museum collections and private collections. I have tried to be as thorough as possible, but I have certainly not recorded everything – far from it. Private collections in particular contain much more, if they can be accessed. As mentioned in the introduction, I began recording material in 2007 and stopped in 2017, not because I had exhausted all the sources, but because it was time to move on to analysis and publication.

2.2.1 – Data sources

2.2.1.1 – Public sources

Museums

A number of museums have artefacts from the study area in their collections. They have, to varying degrees, also undertaken excavations within the area. I have included material from the following public museums: the National Museum (NM), Moesgaard Museum (FHM), Museum Horsens (HOM), Vejle Museerne (VKH), Museum Skanderborg (SBM), Odder Museum (OOM) and Glud Museum (GLM). The capital letters in brackets are the official codes for the museums. A directive of the Danish Agency for Culture and Palaces requires that these constitute the first part of all numbers used by the museums to identify materials in their archives and storerooms.

The numbering standard followed by archaeological museums today has a tripartite structure. The first part is the museum code. The second part is the project or filing number, which is simply a sequence of digits used to keep what belongs together separate from everything else. The third part is a set of sub-numbers used within each project. The sub-number system can vary from museum to museum, but the artefacts are mostly numbered with an X followed by digits, whilst other types of data from excavations, like features, layers, photos and drawings, are recorded in a separate list with different prefixes. It is common now, but for many years Moesgård Museum had its own peculiar system (from the early 1950s to the late 1980s). All artefacts and written records were numbered sequentially with letters (e.g. A, B, C-Z, AA, AB etc.). Drawings and photos had separate numbers, but whilst AA could, for example, be an artefact, AB might be a description of a drawing. There are several examples of this system in the catalogue, most of which are from my own excavations. From experience, I must say that it was a highly ineffective system.

All museums, however, have materials that predate their current systems. How they deal with this discrepancy varies. Some museums, like Museum Horsens, have transferred the old collection to the new system with a filing number. Thus, HOM 10 XA553 is an artefact from the original, main collection with the number A553. Similarly, HOM 12 X370 is an artefact from a large private collection (Lindeman's collection) that was handed over to the museum in 1914. Moesgaard Museum, on the other hand, has just added an AM in front of the original numbers (e.g. FHM AM625) (AM stands for Aarhus Museum, which was the original name of the museum). Inconsequently perhaps, they have decided to give a former private collection a filing number. From the beginning, the artefacts in the Rathlousdal collection had an H in front of the number to distinguish these from other artefacts in the museum. Now H1643 has become FHM 5164 H1643.

The National Museum naturally has a system of its own, which has not changed very much over the last 150 years or so. A striking thing about this system is that it files artefacts separately from written information relating to the artefacts. Thus, there is no common filing number connecting the artefacts from an excavation with the report that describes them. Artefacts are numbered using three different series. An A in front of a number indicates that the artefact dates to the Stone Age, a B to the Bronze Age, and a C to the Iron Age. Originally, every artefact was given a unique number in the series, but it soon became obvious that the numbers would become very large using this approach. As a result, sub-numbers were introduced. For example, A1233 refers to one artefact in 1873, whilst A50361 refers to numerous artefacts from the study area found in 1955 during an excavation at Toftum (160508-34). The artefacts have been given sub-numbers, where each of the 729 sub-numbers may refer to one or more artefacts. Thus, TT6 refers to "9 rim sherds decorated with a row of finger or nail imprints below the rim". The TT prefix is unique to Toftum, added to avoid having to write the full number on each artefact. Thus, what formally should have been A50361-6 is now TT6. More recent excavations undertaken by the National Museum have these two letter prefixes taken from the site names (e.g. <u>T</u>of<u>t</u>um).

In the catalogue, I use the current numbering systems as explicitly as possible. This may result in discrepancies in relation to other publications that mention the same artefacts. Thus, when an author refers to a copper axe as HOM A4 (H. Vandkilde 1996: 425), it may not be immediately apparent that it is the same as HOM 12 XA4, which is the formal number today and the one used in the catalogue of this publication.

Archives

All museums have their own archives. This was originally a simple register describing the artefacts acquired. It stated what had been acquired, how it had been acquired, and in some cases also where it had come from and what circumstances it had been found in. Letters and notes were not formally filed, and in many cases have been lost. Moreover, if they so exist, they may not be at the museums, but in a local historical archive. I have not attempted to track down information in the historical archives.

With the introduction of unique project and filing numbers, information was moved to filing cabinets, and it was not just scholarly information that was filed, but every scrap of paper that related to a project. The suspension files in the cabinets swelled, and it can be time consuming to work through the files to see if there is anything of interest. Today, the digital revolution has of course had a great impact. Digital archiving is now the norm and the volumes of the suspension files in filing cabinets are shrinking. This is good for the employees at a museum, who have all the information at their fingertips, but it causes big problems for visiting scholars in search for information. All information is stored in a computer system that only the employees can access, and for security reasons, there is no way an outsider can be allowed to access the system. The only way to acquire this information is to ask an employee to copy it onto a memory stick or forward it by email.

There is a more fundamental problem, however. If no immediate information is available, it is uncertain whether the material is of any interest whatsoever. The solution to this problem is provided by the national archives. There are two such archives that are of relevance to archaeology: 'Fund og Fortidsminder' (the Sites and Monuments Record) and 'Museernes Samlinger' (Museum Collections). Both have a public interface with free access and a 'professional' interface with protected access. The current URLs for public access are http://www.kulturarv.dk/fundogfortidsminder/ and https://www.kulturarv.dk/mussam/Forside.action respectively. Both sites are in Danish only.

The Sites and Monuments Record

The National Museum established a sites and monuments record as early as 1873, but it took almost 60 years before the initial recording was completed for all of Denmark (J. Christoffersen 1992: 10). The project, known as 'Herredsrejserne' (the District Journeys – also referred to as 'the National Survey'), aimed at creating a systematic inventory of existing monuments, monuments that were known to have existed, and sites where artefacts could be found or were known to have been found. Each year, employees of the National Museum systematically travelled through one or more of the 155 Danish districts, where they looked for monuments in the landscape and took notes of what the local population could tell them about finds and lost monuments. Klaus Ebbesen (1985b) has provided us with a thorough history of these journeys: what led to them, how they were organised, what results were obtained and how they should be evaluated.

One of the reasons why the survey was established was the alarming rate at which prehistoric monuments were disappearing throughout Denmark. There were no laws to stop people demolishing the monuments, and the destruction continued unchecked throughout the period of the district journeys and afterwards. Only in 1937 was a law passed to protect prehistoric monuments. This led to a new series of visits to identify the monuments that were worth protecting (B. Pauly 1992: 43 ff.). The results were depressing. All too often a monument described during the district journeys as well preserved, was briefly described as follows: disappeared!

The quality of the surveyors varied, which is very obvious from the records. Fortunately, however, those who undertook the surveys within the study area of this project (Fig. 2.19) were amongst those described as the best by Klaus Ebbesen in his evaluation (1985b: 14-16). Despite this, it is easy to see the limitations of the surveys. They merely scratched the surface of what was out there, and the surveyors obviously focused on the monuments, and paid less attention to traces of settlements and collected artefacts.

The district surveys came to form the basis of what we refer to as 'Sognebeskrivelsen' – the Parish Records, which were given this name because the content

County	District	Year of survey	Surveyor
Århus	Hads	1903-04	H. Kjær
Århus	Ning	1893-94	A. Reeh & C.I.W. Smith
Skanderborg	Nim	1894-98	M. Kristensen
Skanderborg	Tyrsting	1877	H. Petersen
Skanderborg	Voer	1894-98	M. Kristensen
Vejle	Bjerre	1878-79	H. Petersen
Vejle	Hatting	1879	H. Petersen

Figure 2.19. *Table with the names of those who surveyed the districts of the study area during the National Survey, and when the surveys took place.*

was organised by parish. A separate map existed for each parish, on which the monuments or finds were marked, together with a number that corresponded to a list of descriptions for the parish. The sequence of numbers within each parish are known as the Sb numbers. A unique reference to a particular monument could thus be Aarhus County, Hads District, Alrø Parish, Sb 1 (which is Alrunes grave – a megalithic tomb that was lost long ago). To make this system easier to use, counties, districts and parishes were numbered as well. Therefore, Aarhus County was number 15, Hads District was number 2 within Aarhus County and Alrø Parish was number 1 within Hads District. 150201 Sb 1 thus identifies Alrunes grave. The six-digit number known as the location number is still in use and, as outlined below in section 2.2.4, also constitutes the key reference number in the catalogue of the East Jutland Project. For the record, it should be mentioned that the counties ('amter') used in the division no longer exist. They were abolished in 1970 and replaced with 16 new counties, but the old division into 24 counties is still in used for the organisation of archaeological records.

The parish records are not the only topographical archive at the National Museum. There is also a parallel archive to the parish records, in which the National Museum, on a parish-by-parish basis, stores information relating to the parishes – information that is not necessarily duplicated in the parish records. The notion that the parish records were for monuments rather than artefacts and various other types of information apparently continued to influence the employees at the museum (K. Ebbesen 1985b: 27). Attempts were made to change this, but with little effect, as the recording practice at the National Museum remained a personal matter.

This situation became even worse after the Second World War, when the focus of Danish archaeology moved away from the National Museum. The local museums, now staffed with professional archaeologists, became the new driving force of Danish archaeology. Each year, thousands of finds were recovered, but knowledge of only few of these ever came to the attention of the National Museum. The parish records hardly constituted the national archive they were intended to be.

A project to transfer the parish records from paper to digital format began in 1980, and in 1982 a body within the National Museum, DKC, was formed to implement the project (J. Christoffersen 1992: 10). It was expected that the work would be completed in 10 years, but it took 20 years for all the information to be transferred. There were three reasons for this. Firstly, the project was understaffed; secondly, detailed cross-checking of information was undertaken; and thirdly, it was decided to ask the local museums to provide information about both existing and new sites and monuments. Many museums did exactly this, which unfortunately almost brought the project to an end.

In 2002, the project moved from the National Museum to 'Kulturarvsstyrelsen' (the Heritage Agency of Denmark), a department of the ministry of cultural affairs, and from then on the situation began to change. In 2008, a contract was signed for the development of a new database system, which radically and successfully transformed 'Sognebeskrivelsen' to 'Fund og Fortidsminder' – Finds and Historic Monuments. At the same time, a merging with a database of marine finds, which had existed for some years, took place.

Apart from a modernised user interface, the new system was characterised by two major innovations. Firstly, and most importantly, the recording of information became decentralised. It is now the employees of the individual museums across Denmark who enter and update information into the system, so it is used as a tool in daily work. Secondly, digital information can now be added to the records. When a new entry has been created in the database and the compulsory fields have been filled in, a full report can be attached as a pdf-file.

The new system certainly works, but there is a caveat. I have noted that many employees add a new site as soon as a new project arrives on their table. This can, for example, be a request for an archaeological survey before building activity commences. Many of these requests end with the conclusion that there are no archaeological remains or finds. This results in a negative site, which at best has the information attached that there is no site or at worst simply remains as a site with no other information provided. I have encountered a number of examples of this type of 'ghost site' in recent years.

The collections record

The digital 'Museum Collections' was an initiative that was launched in 2004, although its origins date back to the 1940s. Originally, it was a system that was developed to record the collections of artefacts at the historical museums. It was a paper-based system, and an attempt to create a computer-based version in the 1980s and 1990s was not very successful. The system was organised according to the functional purpose of artefacts, which made it unsuitable for archaeological purposes.

The aim of the computer-based system launched in 2004 was to record all artefacts in the museums, and archaeological artefacts could now be included simply as 'Jordfund' (soil finds). More importantly, however, it is also an effective case handling system for the cultural-historical museums, where all administrative information can be recorded as well as scholarly information associated with the individual projects. Digital information can also be organised and stored in the system. If used properly, it solves the problems of concealed storage of digital information in the internal computer systems of the museums.

The system includes a web-based registration interface known as 'Regin' and it is easy to use. It is not, however, compulsory for museums to use the system, and some museums are more reluctant to do so than others. The National Museum is one of these, deciding not to use the system; nor does the museum at the time of writing have an alternative computer-based system. The staff here still use their own paper-based archiving system, and access to these records requires a personal visit.

2.2.1.2 – Private sources

Denmark is an area that is rich in prehistoric artefacts and collecting by private citizens has always provided an important source of information. Local farmers originally undertook almost all collecting of artefacts. Every farm possessed artefacts that had been found during agricultural work, and interested people often acquired these. A good example is Lindeman's collection, which ended up at Horsens Museum in 1914. Lindeman was a medical doctor, who met a large proportion of the local population during his work. He collected artefacts throughout his life, carefully numbering and cataloguing his acquisitions. A collection like Lindeman's is of vital importance for a study like this, and if the catalogue is examined, it is striking how many artefacts have the filing number HOM 12.

A collection of a somewhat different nature is the Rathlousdal collection. Emil von Holstein-Rathlou, a local nobleman at Odder south of Aarhus, created it over the years, mostly by buying artefacts from dealers, who had acquired them from farmers or from regular plundering of barrows. Only few of the artefacts were of a local origin and obtained from the farmers near Rathlousdal, and Holstein-Rathlou neither numbered his artefacts nor kept a catalogue. In cases where he knew where an artefact had come from, he wrote the name on the artefact, but apparently seldom knew such information (J. Laursen & E. Schmidt 2013: 94). The Rathlousdal collection, now kept at Moesgaard Museum, contains an exquisite group of artefacts, but its archaeological value is limited due to the lack of associated contextual information.

In addition to the collections of Lindeman and Holstein-Rathlou, two other major collections of this type are involved in the current study. One is barrister Arendt's collection at Museum Skanderborg and the other is bank manager Donner's collection. The latter, which is a local collection centred on Horsens, was sold at auction in 2004. Before the auction, Museum Horsens thoroughly recorded and photographed it. Information from a few other private collections of this nature is also found in the catalogue, primarily in connection with finds from Stensballe Sund.

More recently, people that are keenly interested in archaeology began to establish an entirely different type of private collection. These artefacts are actively collected through systematic fieldwalking and the collections are generally well documented and of a great value to studies like this one. I have been in contact with many people who have both small and large collections, almost all of whom can state exactly where the artefacts come from. These people are all anonymous in the catalogue, and are simply referred to as private citizens. There are, however, exceptions to this rule, based on the person's association with archaeology.

Jens Bagge has for many years collected artefacts near his ancestral farm, which he now owns, and along both the northern and southern side of Horsens Fjord. His collection is well recorded, and includes the precise locations of the finds. More recently, he has created a museum (Tremhøj Museum) for local archaeology in a former stable at the farm. The museum contains his own collection, but he also encourages others, who have found artefacts in the area, to contribute them to the museum and has thus created a substantial collection of local heritage.

Finn Dahlhof Knudsen (†), who lived in Horsens for all of his life, collected artefacts from when he was young. The quantities of artefacts that he managed to collect are very impressive. Various archaeologists have produced descriptions of the artefacts and he is well known for this collection, which is now in the custody of Horsens Museum (HOM 769).

The brothers Jan and Jens Jensen collected artefacts as children around Tåning and later in their youth around Serridslev, where they were also often in contact with Museum Horsens. Their collection from these two areas is large and well recorded. Jan Jensen was subsequently employed by Museum Horsens as an excavator, and is now 'collecting' as part of his job.

Mikael Nissen, who all his life has lived in Snaptun south of Horsens Fjord, started collecting artefacts as a boy around 1980. Since then, he has accumulated a huge collection, mostly from Glud Parish, but also from other places along the fjord. The collection is extremely well recorded, with every artefact numbered and its location marked on detailed maps.

As a boy, Poul Erik Fisker started collecting artefacts along both the southern and northern side of Horsens Fjord. As well as a collector, he was also a keen surveyor, who noted many details and interpreted them correctly based on what he had read. He reported his collecting and observations to the museums. The latter included several locations of destroyed megalithic tombs as well as the causewayed enclosure at Bjerggård. When I met him at the time, I thought that he would go on to study archaeology, but he later pursued a career away from archaeology and the Horsens Fjord area.

In his youth, Per Borup collected artefacts around his home in Gylling and on the island of Alrø. His large collection primarily came from two settlement sites, one at Gylling (150205-15) and one on Alrø (150201-2), and forms the basis of our knowledge of these two sites. The collection is now at Moesgaard Museum (FHM 4187). Per Borup went on to study archaeology at Aarhus University, and he is now employed as a museum inspector at Horsens Museum. In this position he is responsible for many of the finds that are included in this study.

2.2.2 – The validity of data

There are a number of different types of problems which are associated with the validity of data, many of which I will address as they arise. Here, I will exclusively deal with the problem of how well the distribution and density of the collected data reflects the true distribution and density of what lies in the ground.

I have recorded 943 find contexts (Fig. 2.20), and it is obvious that they are not evenly distributed across the study area. There is a massive concentration around Horsens Fjord and two more dispersed distributions, one inland to the northwest and another to the east along the coast of the Kattegat, with more or less empty areas in between.

Many of the finds to the east in Voer District come from a survey that Jan Skamby Madsen (1979; 1984) undertook in 1978 (Fig. 2.20). An interesting aspect of this survey is that he advertised in a local newspaper for people with artefacts in their possession to contact him. The response to this was impressive, with people who had collected artefacts locally, mostly from their own fields, dominating. This approach probably produced a sample that was completely unbiased in geographical terms. Compared to the find locations otherwise recorded from Voer District, there are only minor discrepancies. As far as Voer District is concerned, this indicates that we have a reasonably representative geographical distribution.

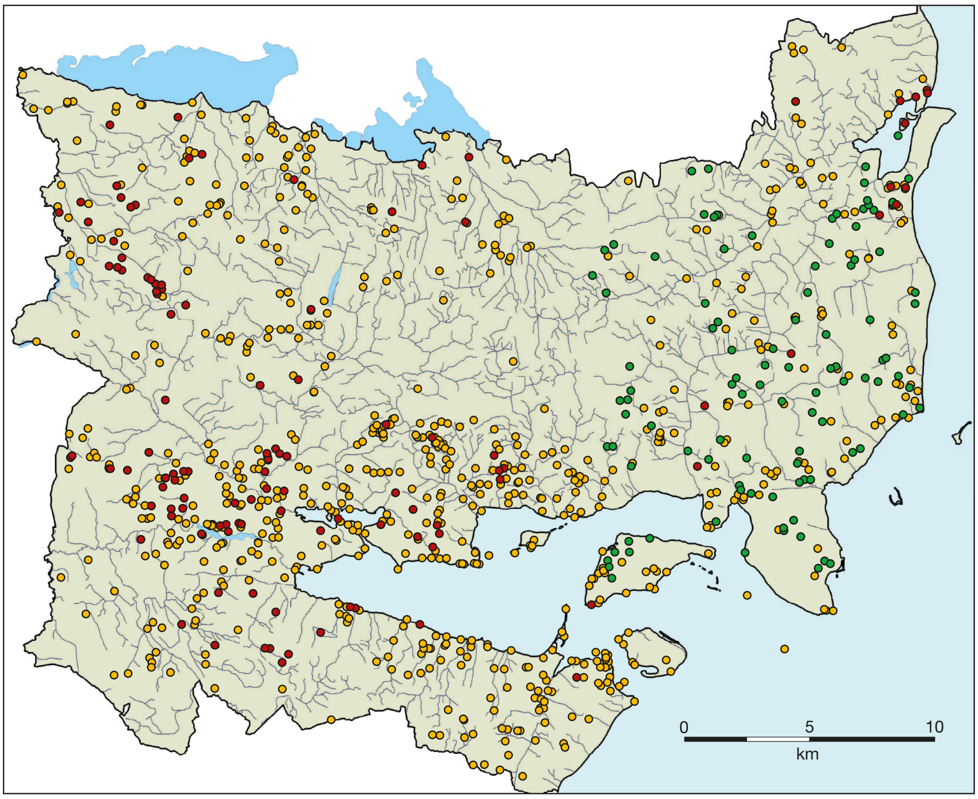


Figure 2.20. *A map showing the 943 recorded find locations from the study area. 116 of these are associated with archaeological excavations (red) and 102 are known from a survey by Jan Skamby Madsen in 1978 (green).*

When it comes to the 'empty' area between the finds in Voer District and the group of finds to the northwest, the information is limited. Only limited numbers of finds from other periods have been recovered, and it is within the same flat, undulating land around the watersheds that significant amounts of water accumulate (Fig. 2.7). The lack of finds may simply be due to an unsuitability of the area for agriculture in the undrained conditions, but this assumption is very difficult to prove.

116 excavations within the study area (Fig. 2.20) have produced Neolithic material, and these are not evenly distributed. Most centre on the town of Horsens in the inner part of Horsens Fjord, where they reflect the modern development of the town and the numerous rescue excavations involved in this. Excavations to the south of the town have, to some degree, produced Neolithic artefacts where none were previously known, but in general, the excavations in the Horsens area have not resulted in a distribution pattern that is different from that of other finds categories.

To the northwest, in Østbirk and Voerladegård parishes, there is a cluster of excavations that stand out due to their frequency compared to other categories of find circumstances. These consist of earlier and more recent excavations of SGC barrows as well as recent rescue excavations in the small town of Østbirk. They emphasise how little we actually know about this area. There are many, mostly ploughed-out barrows, but few have been excavated, and only through excavation can we obtain any significant knowledge of them. The rescue excavations at Østbirk have opened up a completely new insight into Late Neolithic settlement activity in the area, where other categories of find circumstances have provided very little information (P. Borup 2018). There is little doubt that finds and information about their contexts in the northwest part of the study area are less representative than is desirable. The cluster of find locations, however, appears to be real in itself. There are so far no indications that the gap which exists between this cluster and the numerous finds around Horsens Fjord is a result of biased sampling. As will become clear, it actually makes sense in connection with cultural formations in the area.

The small number of excavations in Hads Herred to the east can mainly be explained by the lack of archaeological staff at Odder Museum. This was also the reason why the responsibility for archaeology was transferred to Moesgaard Museum. Until recently, however, a low rate of economic development in the area as a whole has resulted in only a modest amount excavation activity. A small group of excavations have though been undertaken around Norsminde Fjord to the northeast. These are, with one exception, all targeted, research-based excavations undertaken by Aarhus University.

Collecting by private citizens has produced a very large proportion of the find locations. In most cases, each individual has contributed with just a few locations, which are invariably close to where the person lives. There are exceptions, however. For some people, collecting has become a leisure pursuit, and in this case the collecting pattern often becomes more systematic and targeted. As examples of this, I will take a closer look at four of the collections mentioned in the previous section: those of Finn Dahlhof Knudsen, Jens Bagge, Jan and Jens Jensen and Mikael Nissen. These examples demonstrate what a significant impact the collecting of individuals can have on a project like this one.

Finn Dahlhof Knudsen began to collect artefacts together with a work colleague. As the collecting progressed, they named the sites based on where they collected and marked them on maps. They kept the artefacts from each site separate, but unfortunately never numbered them. The colleague had another passion, butterfly collecting, and he eventually chose this. Finn Dahlhof Knudsen took over all of the artefact collection and continued to collect until he was in his late seventies. He mostly collected in Hansted Ådal, immediately to the west of where he lived in Horsens, but occasionally collected along the fjord as well (Fig. 2.21).

The artefacts from the sites in the low-lying parts of Hansted Ådal mainly constitute the basis of our knowledge of the Neolithic settlement in this particular area. Small excavations have been carried out at some of the sites, but in general, the results have been limited. A significant problem with the collection, however, is the lack of numbering of the artefacts. Therefore, we cannot always be certain whether an artefact came from a given site or somewhere in its vicinity, nor can we be certain that artefacts have not 'wandered' from one site to another over time or left the collection altogether. Various archaeologists have described the collection on several occasions, and some of the artefacts described are no longer present in the relevant part of the collection.

Jens Bagge started collecting close to his home north of Horsens Fjord, recording a dense cluster of find locations around the farm (Fig. 2.21). The collecting in this area was so intensive that the resulting material must be representative of what exists here, but

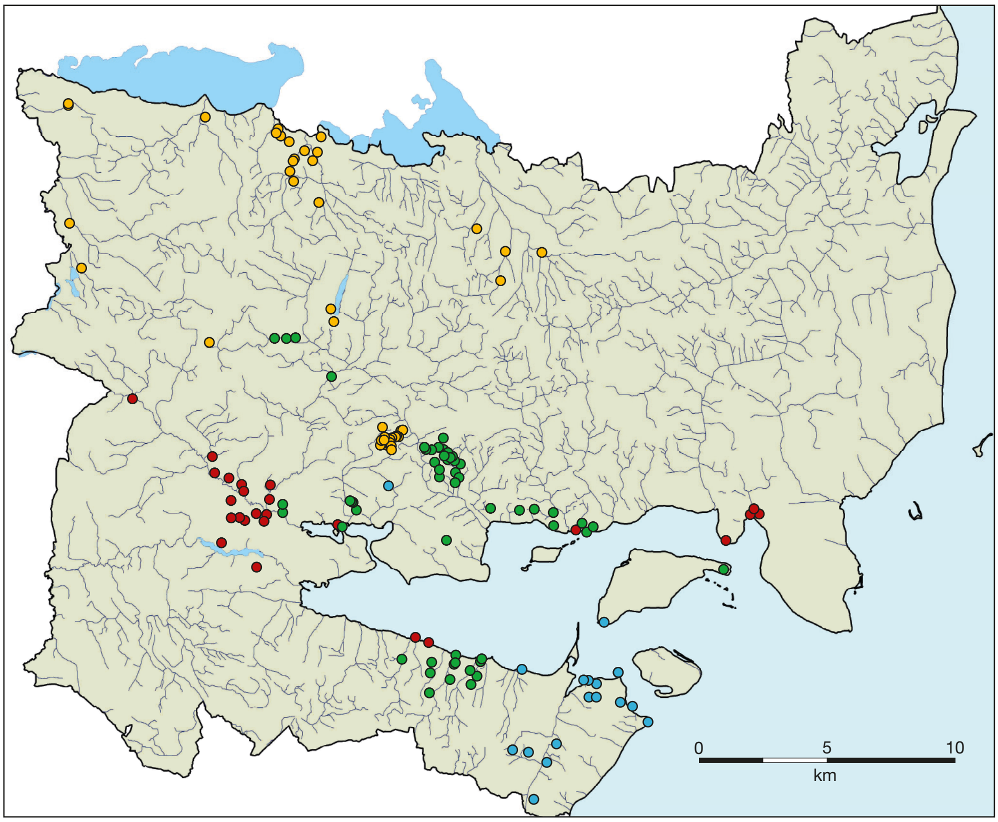


Figure 2.21. *Map showing the find locations for Neolithic artefacts from four private collections. Red: Finn Dahlhof Knudsen; Green: Jens Bagge; Yellow: Jan and Jens Jensen; and Blue: Mikael Nissen.*

the cluster has of course been created by the focused collecting. Later, he began to collect south of the fjord, around the experimental farm where he works as an agronomist. This has opened up a window into a FBC settlement area that was previously hardly known. He has also actively collected in other areas, primarily along the fjord.

From when they were quite young, Jan and Jens Jensen started collecting around their home in Tåning, in the northernmost part of the study area. A cluster of find locations reflects this (Fig. 2.21) and provides us with a rare picture of what can be found by surface collecting in an area from in which there was previously relatively little material. They have also collected in various other places in the northwestern part of the study area. When later on they moved to Serridslev close to Horsens, this resulted in a new cluster of find locations.

Mikael Nissen mainly collects artefacts near where he lives (Fig. 2.21). From the start, he has numbered every artefact he has brought home and marked the exact location of the artefact and its number on detailed maps. In this way, he has created a unique documentation of his collecting. Most of his collection consists of Mesolithic artefacts from submerged sites in the fjord (not shown on the map), but he has also collected Neolithic artefacts on land, and for instance located and carefully documented two large FBC settlements.

Most of the collecting mentioned here is from the fjord area and is certainly instrumental in making this region appear densely populated. The question then is whether the dense distribution of find locations in the fjord area merely reflects intensive recording and collecting or actually reflects an underlying high population density. The first thing to note is that the fjord area is to a great extent where people live today. As there are many people, this increases the likelihood that there are individuals who are interested in collecting artefacts and telling others about this. Rescue excavations, which are automatically undertaken in such densely populated areas, also reinforce the picture. It is undoubtedly the case that densely populated areas produce more finds than less densely populated areas. Only an action like Jan Skamby Madsen's advertisement in a local newspaper can reverse this; today this would probably occur on Facebook or similar social platforms.

The density of find locations in the fjord area must be an overrepresentation, while the density of find locations in the northwestern part of the study area is too low. The number of find locations is only part of the equation, however. We also have to examine the number of artefacts collected. Figure 2.22 shows

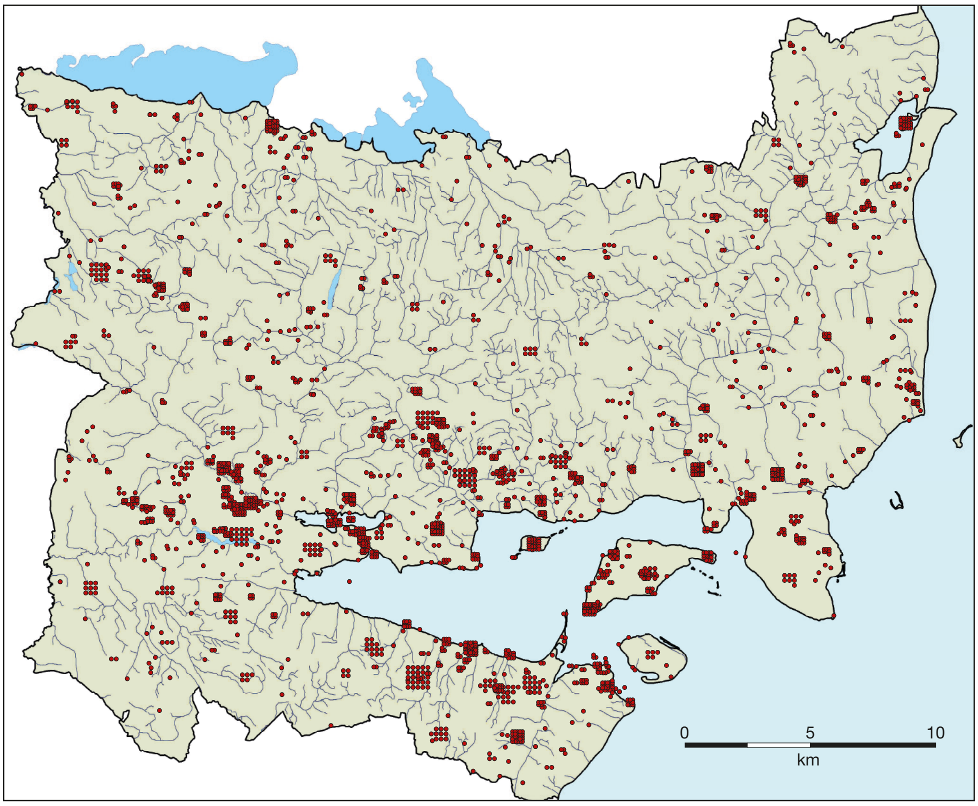


Figure 2.22. *Map showing the location of 2,690 individually recorded and typologically datable flint and stone tools. Dots with the same coordinates are partially dispersed. The large blocks of dots are the result of a grid-based dispersal of artefacts, recorded either at cadastral township level or from major settlement sites.*

the distribution 2,690 typologically datable artefacts of flint and stone. The map clearly indicates that the fjord area does not only have a high density of find locations: it also has an extremely high density of finds, many of which come from sites where large numbers of artefacts have been collected. This may of course also be a result of the focused collecting in the fjord area, but this is only partially the case. Many of the sites where numerous artefacts have been found are remarkable in their own right. There are often staggeringly large quantities of material on the surface. The sites are 'real' and not the result of a collecting pattern. As will become evident later in this publication, the population density in the fjord area was higher than inland. Only towards the end of the Neolithic does the population become more evenly distributed.

2.2.3 – Recording and classifying data

2.2.3.1 – Find contexts

The circumstances in which artefacts are found are crucial to our understanding of their cultural background. There are two aspects that are important to our assessment of the circumstances in which the objects are found: where and what. We need to know where the finds were recovered and what kind of context they came from. In the case of artefacts that are not found during an excavation, neither of these questions may be easy to answer. We have to assess the circumstances and then attribute the individual artefacts to a number of predefined classes of contexts in which they are found.

Where does it come from?

'Where' to me means a geographical reference in the form of a set of coordinates. The only problem is, how imprecise shall I allow the coordinates to be? This is influenced by the scale of the maps used. If the map covers all of Denmark, a coordinate for the midpoint of a parish is easily sufficient, but here we are working on a more detailed scale. I have decided that the midpoint of a cadastral township is acceptable as long as the map covers the whole study area, which is thus the cut-off point for allowing artefacts to be used in the study.

The where question is primarily a matter of putting a dot on a map, combined with an assessment of how precise that mark is. The information is often insufficient and may not always be correct. To make our records of the finds usable, however, we have to make decisions and attribute the finds to particular positions on a map within a certain margin of error. In this study, I use three categories of map positions (Fig. 2.23), which are described below.

A *precise position* is estimated to be within 200 m of the actual find spot. The margin of error may seem too great for providing a precise position, but as the general maps used in this study vary between 1:50,000 for the parish maps used in the catalogue and 1:450,000 for the maps of the total study area, the margin of error becomes negligible. In the case of most of the finds categorised as having a precise position, this is much more accurate than 200 m, but even on excavations, the precision can be in excess of 100 m, as in most cases it is practical to use a central coordinate for all finds from the excavation. In the catalogue, a set of coordinates without additional information indicates a precise position.

An *approximate position* is a category with a variable margin of error. Typically, the available information is that an artefact came from the fields of a particular farm. In some cases, this means a margin of error of no more than 2-300 m, but in others, it can be as much as 500 m. We may also know that an artefact came from a particular bog or wood, but not exactly where. Once again, the margin of error is variable depending on the size of the bog or the wood. The margin of error, however, seldom exceeds the 500 m that is stated here. In the catalogue, 'approximate position' is added to the set of coordinates provided.

A *cadastral township position* indicates that an artefact came from the fields of a particular cadastral township. A cadastral township originally comprised the fields that belonged to a village community, or the fields that belonged to a major farm or estate. Even today, when the farms have moved from the villages into the countryside, with a redistribution of the fields between them to achieve more efficient land use, the land is still part of the original, village-based cadastral township system.

Due to their background in village communities, the cadastral townships have always been an important identifier of peoples' affiliations, and hence also an indicator of where something came from. In the older museum records, the provenance of an artefact mostly appears as the name of a cadastral township, often with the word 'mark' (field) added, emphasising that it came from the fields of the cadastral township.

The size of the individual cadastral townships varies considerably, as do their shape. The table in Figure 2.24 contains a list of the size in km^2 of each of the 180 cadastral townships that are included in the study area. There is no simple and straightforward way to convey the margin of error associated with a township. The largest unit is 14 km^2, the smallest 0.5 km^2 and the median value is 3.4 km^2. In many cadastral units, there is a distance of less than 1 km from the centre to the periphery, but in the case of others, this distance can be much greater, and as much as 5 km. In the catalogue, no coordinates are provided for finds from cadastral townships.

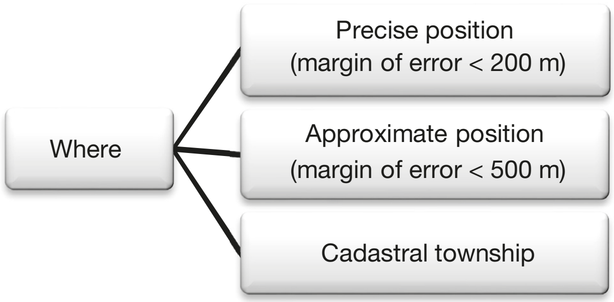


Figure 2.23. *The classification of location.*

Cadastral townships correspond with parts of *parishes* (ranging from one to eleven townships in a parish within the study area), but the parish is not a superstructure for the cadastral townships, as functionally and legally the two have nothing to do with one another. It was merely a matter of the Church being practical, when it used the cadastral townships to define the boundaries of the parishes, and there are actually examples of cadastral townships which are split between two parishes. Within the study area, Søby is split between Gosmer and Gylling parishes and Bisholt is split between Glud and Skjold parishes.

The name of a parish usually corresponds to the name of one of its cadastral townships. This creates a problem, as it is hard to know for certain whether a stated provenance that uses the common name of a parish and a cadastral township, refers to one or the other. According to normal practice, it is most likely to refer to the cadastral township, but as from early on archaeologists used the parishes to organise their records, we cannot be sure that in these they did not opt for the parish name.

I use parishes to organise the descriptions in the catalogue as well, but I do not use parishes as a unit for records, as the margin of error would become too great. In general, I assume that the names given refer to the cadastral townships. This seems to be mostly justified, but in some cases it is obvious that the records may actually refer to the parish. In the catalogue, it is stated if an attribution may be incorrect.

What kind of context is it?

It is customary to distinguish between *settlements*, *burials*, *deposits* and *stray finds*. I also use these basic categories here, as well as *causewayed enclosures*. For more detailed descriptions and interpretations, however, each of the main categories need to be subdivided.

Parish ID	Parish	Cadastral township	Size in sq km
150201	Alrø	Alrø	7.6
150202	Bjerager	Bjerager	4.1
		Boulstrup	2.1
		Dyngby	4.7
		Hylken	1.4
		Rørth	2.2
150203	Falling	Aakjær	9.0
		Aalstrup	2.6
		Amstrup	4.8
		Falling	2.8
		Feldshøj	0.5
		Lundhoff	1.7
150204	Gosmer	Dybvadgård	0.8
		Fensten	6.2
		Gersdorflund	4.2
		Gosmer	2.0
		Smedrup	1.8
		Søby	1.5
150205	Gylling	Gylling	13.7
		Gyllingnæs	6.3
		Lerdrup	3.3
		Søby	2.1
150206	Halling	Halling	4.4
		Spøttrup	1.5
150207	Hundslund	Hadrup	3.4
		Hundslund	2.2
		Kærsgårde	1.0
		Oldrup	7.4
		Oudrupgård	1.3
		Skablund	2.1
		Sondrup	4.9
		Svinballe	1.9
		Tendrup	1.2
		Torup	1.2
		Trustrup	3.2
150209	Nølev	Assendrup	3.0
		Nølev	4.6
150210	Odder	Balle	4.1
		Fillerup	7.3
		Morsholt	2.3
		Odder	12.2
		Ondrup	3.1
		Rathlousdal	2.6
		Rødstenseje	2.5
		Snærild	3.3
		Svorbæk	1.2
		Tvenstrup	3.0
150211	Randlev	Randlev	8.1
150212	Saxild	Kysing	4.0
		Rude	5.1
		Saxild	7.6
150213	Torrild	Fensholt	2.5
		Krogstrup	2.1
		Torrild	13.6
150214	Ørting	Ørting	8.9
150405	Malling	Ajstrup	7.7
		Krekær	1.9
		Malling	6.4
		Neder Fløjstrup	3.0
		Pøel	3.4
		Starup	1.5
		Synnedrup	1.5
		Vormstrup	0.6
160204	Fruering	Gjesing	5.4
160303	Horsens	Horsens	7.3
160306	Tamdrup	Enner	5.1
		Kørup	3.1
		Lund	7.3
		Molger	2.0
		Tamdrup Bisgård	2.0
		Vinten	5.7
		Vrønding	7.2
		Årupgård	0.8
160307	Underup	Naldal	1.6
		Torp	3.9
		Underup	4.7
		Vorbjerg	2.3
160411	Voerladegård	Dørup	7.7
		Gantrup	4.9
		Hem	4.0
		Møldrup	3.5
		Voerladegård	6.2
160501	Gangsted	Aggestrup	1.1
		Ballebo	1.9
		Elbæk	1.6
		Gangsted	5.6
160502	Hansted	Egebjerg	6.5
		Hansted	7.6
		Hanstedgård	1.3
		Kannerupgård	0.9
		Rådved	6.5
160503	Hylke	Brørup	4.8
		Båstrup	5.6
		Hylke	4.1
		Jordbjerggård	1.3
		Nissumgård	1.7
		Ringkloster	2.1
		Tammestrup	1.4
		Ustrup	4.3
160504	Kattrup	Borupgård	2.6
		Kattrup	5.1
		Møballe	1.7
		Overby	2.8
		Testrup	2.2
160505	Lundum	Lundum	6.7
		Lundumskov	3.8
160506	Nebel	Bleld	3.2
		Nebel	2.7
		Serridslev	5.2
		Serridslevgård	2.4
160507	Ovsted	Bjødstrup	1.0
		Ejer	6.2
		Elling	4.3
		Ris	4.3
		Tammestrup	2.4
		Tebstrup	6.2
160508	Søvind	Brigsted	4.6
		Søvind	2.0
		Toftum	2.7
		Tyrestrup	3.3
		Vorsø	0.6
		Ørbæk	2.1
		Ås	6.8
160509	Tolstrup	Eldrup	1.8
		Gedved	6.7
		Tolstrup	2.6
160510	Tåning	Havreballegård	2.0
		Horndrup	5.3
		Tåning	7.3
160511	Vedslet	Assendrup	1.7
		Grumstrup	10.0
		Vedslet	4.4
160512	Vær	Blirup	1.5
		Haldrup	4.7
		Meldrup	0.7
		Stensballe	4.2
		Stensballegård	4.3
		Vær	1.1
160513	Yding	Såby	3.8
		Yding	11.0
160514	Ørridslev	Hovedgård	3.1
		Tvingstrup	6.3
		Ørridslev	4.8
		Ørskov	3.3
160515	Østbirk	Birkenæs	1.8
		Monbjerg	4.9
		Lillerup	2.4
		Purup	2.0
		Sattrup	4.0
		Urup	5.0
		Vestbirk	5.2
		Østbirk	7.3
170104	Glud	Bisholt (østre)	2.7
		Glud	4.5
		Sønderby	5.0
		Østrup	9.3
170105	Hjarnø	Hjarnø	3.1
170110	Skjold	Bisholt (vestre)	2.6
		Brund	3.3
		Skjold	4.3
		Stourup	3.9
170112	Uth	Boller	8.5
		Sejet	5.9
		Ustrup	3.7
		Uth	3.1
170403	Hatting	Bygholm	4.7
		Bygholm Nørremark	4.8
		Eriknaur	5.9
		Hatting	14.3
170405	Korning	Korning	6.5
		Merring	1.8
		Merringgård	1.5
		Ussinggård	3.0
170409	Torsted	Torsted	5.7
		Ørnstrup	3.3
170410	Tyrsted	Dagnæs	2.7
		Dallerup	3.1
		Tyrsted	8.3
170412	Ølsted	Bottrup	3.2
		Oens	4.5
		Ølsted	7.2

Figure 2.24. *Table showing the 180 cadastral townships in the study area, together with their size and the parishes they belong to.*

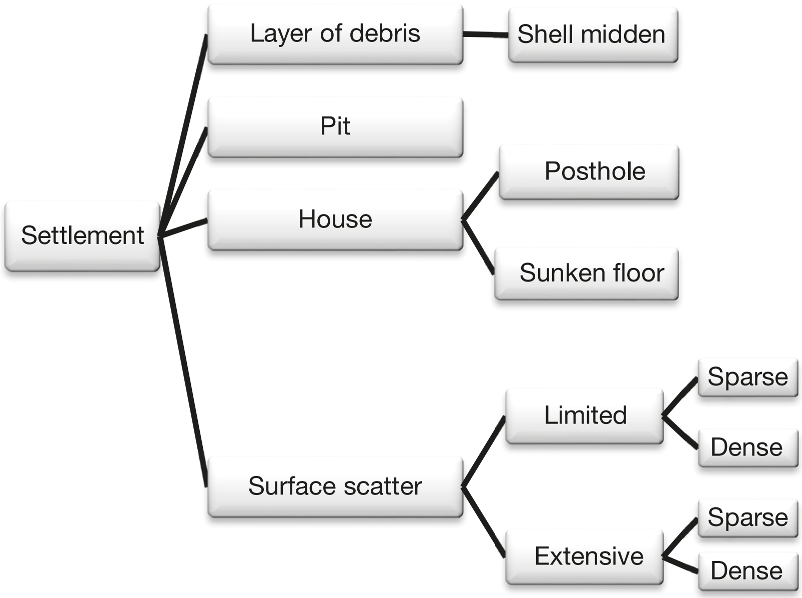


Figure 2.25. *The classification of settlements.*

Settlements

I use the term settlement for the physical location where people lived, where their houses stood and where their daily activities took place. For the broader meaning of settlement, expressions such as settled area or residential area, are used. A subdivision of the settlement category partly depends on the nature of the evidence. The difference in level of observation clearly plays a major role in our ability to categorise a settlement. A basic set of categorical elements must thus reflect this (Fig. 2.25). Furthermore, it should be noted, as will become apparent in chapter 11, that the nature of settlements varies considerably over the course of the Neolithic, from a village-like structure during the FBC to dispersed farmsteads in the LN. Thus, the uniform symbol used for the category 'settlement' on distribution maps has to be interpreted differently, depending on the cultural setting.

Layers of debris: These are deposits, usually dark coloured by decayed organic material and charcoal, containing quantities of debris and discarded artefacts. We often find these types of layers in depressions in the terrain, where they lie undamaged by modern ploughing, or at the bottom of slopes, where they are covered by down-slope soil erosion. In some instances, they can be interpreted as in-situ remains of primary activities. In others, they clearly represent secondary dumping areas for refuse. Layers of debris are usually evidence of intensive settlement activities, often of long duration. One type of layer, *shell midden,* is noted separately. This is a conspicuous type of dump due to its size and it constituting evidence of a single dominating economic activity.

Settlement pits: Pits of varying sizes and shapes are found at most settlements. The function of the individual pits is difficult to determine, and in general, I have regarded it as sufficient to note that they are pits, without attempting to propose functional interpretations. The fills of the pits contain cultural material, to varying degrees introduced either by chance, by deliberate adding in backfills or as remains of the primary activities in the pits. In many cases, settlement pits are the only evidence for the presence of a settlement, because overlying layers of debris have been ploughed away. Where many settlement pits are found together within a given area, this is presumed to be evidence for a major settlement. In examples where there are only one or a few pits, it depends on the extent and nature of the excavation whether they are interpreted as indicating the presence of a small, short-term settlement.

Postholes/houses: Houses identified from postholes are perhaps the most concrete, but also most elusive, evidence for a settlement. Postholes are found in almost all excavations, and often in large numbers, but are difficult to date, and when dated (mostly using ^{14}C) this often produces the most unexpected results, which have little to do with other cultural evidence from the excavation. For large parts of the Neolithic (EN and MN), there are very few postholes/houses within the study area that are securely dated. A number of houses have been identified from the late part of the Neolithic (LN), based upon the recurrent appearance of *sunken floors* as well as their posthole arrangements. The dates for these houses are based on material from the sunken floors, postholes and associated pits, as well as ^{14}C dates. I do not mention postholes/houses unless there are good reasons to believe that they are of Neolithic date.

Surface scatters: Surface scatters are a means of defining a settlement without excavation. This is very difficult material to work with, because precise information about individual scatters is rarely available, and also because it is difficult to translate a scatter into a specific settlement type. We can categorise scatters using the following terms: *extensive* for those that cover a large area; *limited* for those that cover a small area; *dense* if there is a high density of artefacts; and *sparse* if there is a low density of artefacts. We can also quantify a surface scatter by estimating how large an area it covers and how high the density of artefacts is, but this is only possible in a few cases, as it requires a systematic survey.

Burials

The concept of burials covers both the graves themselves and structures associated with the graves (mounds, mortuary houses, etc.). As burial customs are culturally specific, it is not possible to use a common classification covering all periods. Therefore, different sets of features apply to the FBC earthen long barrows, the FBC megalithic tombs (and their subsequent reuse), the SGC single grave burials and the varied burial customs of the LN. For practical reasons, a major distinction is made between FBC burials on one hand and SGC/LN burials on the other (Fig. 2.26).

FBC burials: The FBC *wood-built graves* are *coffins* or *mortuary houses* placed in *rectangular* (or *trapezoidal) mounds* or *enclosures*, flanked by *lines of posts or palisades* and terminating in *facades*.

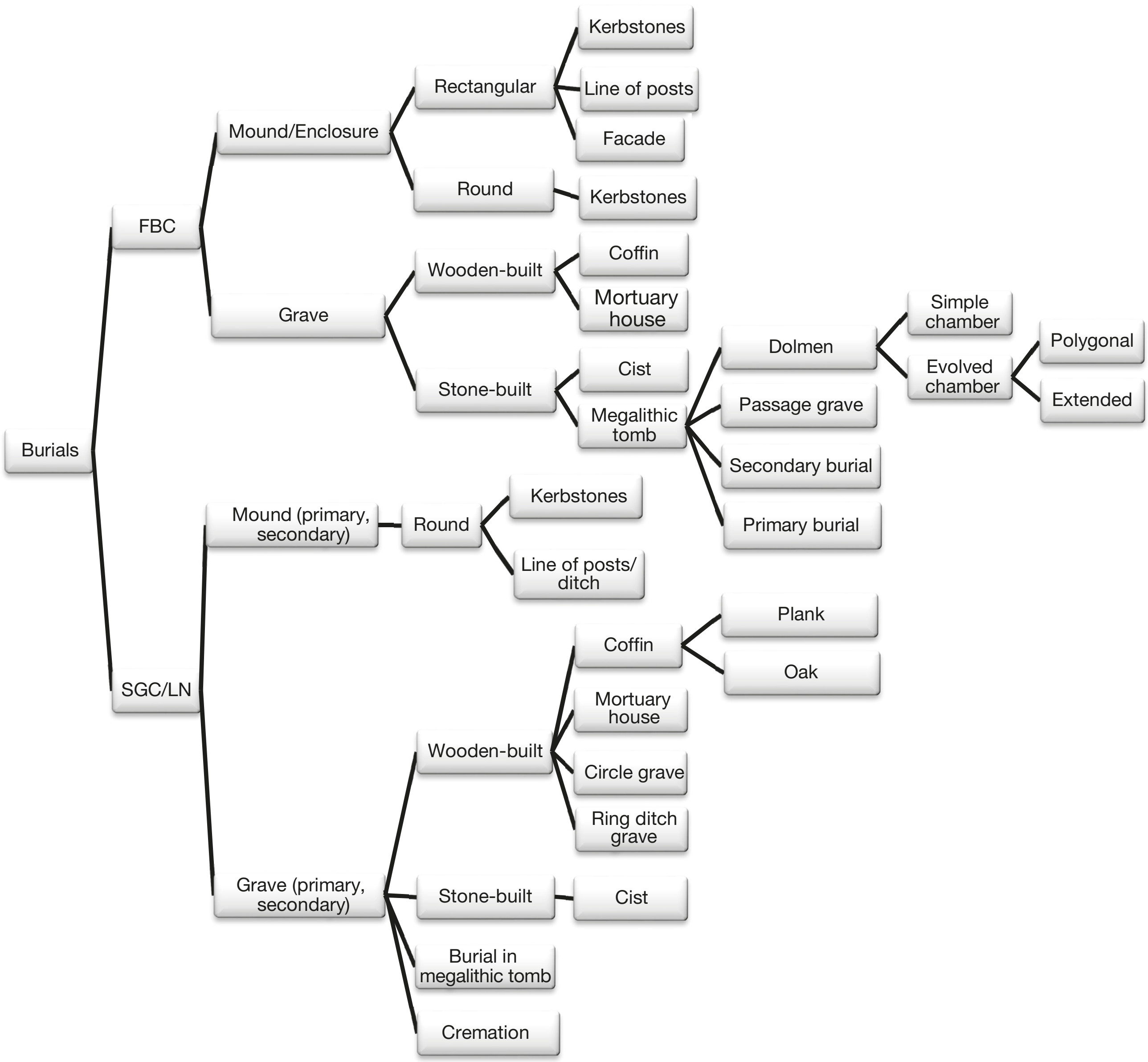


Figure 2.26. *The classification of burials.*

Megalithic tombs are stone-built chambers that often, but not always, are placed in *rectangular* or *round mounds* flanked by massive *kerbstones*. The type of chamber allows us to approximately differentiate between early and late tombs, but unfortunately, as most megalithic tombs in the study area have been totally destroyed, the shape of the chamber is often unknown. Here, a distinction is made between *simple dolmens, evolved dolmens* and *passage graves*.

Simple dolmen chambers are square chambers with one upright at each end, one or two uprights on each side and usually one large capstone. Some chambers are situated in the centre of the barrow, in which case all uprights are normally the same height, and the chamber is completely closed. In eastern Jutland, however, it is more common that the chambers are situated at the side of the barrow. Here, the upright at the end, facing the side of the barrow, is of half height, leaving just enough room for a person to enter the chamber.

Evolved dolmen chambers, often with a short passage, are of two types. *Polygonal chambers* usually have five uprights placed at angles to one another covered with a single large capstone. *Extended chambers* have chambers that become wider towards the back, with two or more uprights on each side, a typically very large upright at the back end and two or more capstones. The passage of both types often consists of one upright on either side of the chamber entrance, where there is an entrance stone, usually of considerable height.

Passage graves have round, oval or rectangular chambers and a typically long passage with several uprights on each side covered with capstones, except for the outmost pair of uprights. The chambers have many uprights and are covered with several capstones. In Danish terminology, only chambers with the longest axis perpendicular to the passage are true passage graves ('Jættestuer'), whilst the rest are regarded as dolmens. This is an unfortunate distinction, as there appears to be no functional or chronological difference between the two. A more detailed introduction to the various FBC burial forms can be found in P. Eriksen & N.H. Andersen 2014.

New interments were regularly placed in the megalithic tombs following the primary burials. When FBC artefacts are found in the chambers dating to the first part of MN A, these are classified as *primary FBC burials*, whereas FBC artefacts dating to the latter part of MN A are regarded as *secondary FBC burials*. In general, however, it is not possible to be particularly specific about the nature of these burials.

SGC/LN burials: The burials from the SGC are radically different to those from the FBC. They typically consist of burials of individuals in tombs inside barrows, although inhumation burials not covered by a barrow are also found. In general, burials were placed in *wooden coffins* covered by a *round mound*, initially in *plank coffins* and later in *oak coffins*. A line of *kerbstones*, consisting of small stones, often encircles the mound, but *lines of wooden posts* or *ditches* are also found. When a new grave was added to a mound, the latter was often enlarged. There are thus *primary graves* and *primary mounds*, as well as *secondary graves* and *secondary mounds*.

In the earlier part of the SGC, there are some particular grave types: *ring ditch graves*, *circle graves* and *mortuary houses*. All of these apparently contained plank coffins, but a different set of features dominate our interpretation of them. A *ring ditch grave* is a grave in which a ditch containing wooden posts surrounds the burial area. The dominant feature of a *circle grave* is a large, circular burial pit, which contains a plank coffin. Early excavators mainly only noted the pit surrounding the plank coffin, but in more recent excavations, a circle of posts has often been found along the edge of the burial pit, suggesting parallels with the ring ditch graves. Around some graves, a setting of posts has been noted, very likely the traces of a *mortuary house*. There is no clear pattern to these post settings, but their interpretation as a house structure seems reasonable. SGC burials in megalithic tombs also occur, but apparently always as individual burials in wooden coffins inside the chambers. I will refer to these as *burials in megalithic tombs*. Regarding the various types of SGC graves, see Eva Hübner 2005.

The graves from the LN are generally more diverse than those from the previous periods, although the burials themselves are of uniform appearance. They mainly involve inhumation graves of individuals, but the situations in which they are found cover a broader spectrum. Burials in wooden coffins placed in mounds are probably the most frequent burial form within the study area. This is a direct continuation of the burial tradition of the SGC, with the use of oak coffins now dominant. Some of these graves were dug deep into the ground, and may not have been covered by a mound, but there is usually no way of telling, and I therefore lump them all together under the heading *wooden coffins*. A specific and apparently quite common grave type is cists constructed of thin stone slabs. These stone cists are 2-4 m long, less than 1 m wide and 60-70 cm high. They normally have four to seven slabs on each side, and one slab at each end, and are covered by three-five slabs. I refer to these as *stone cist graves*. Burials in megalithic tombs are common during the LN. In fact, in most of the megalithic tombs that have been investigated, LN artefacts are present. I will refer to these as *burials in megalithic tombs*. In a few cases, there is also evidence of *cremation burials*, or at least burials in which cremation activities of some sort were involved. The evidence is not good enough for us to be precise about the exact nature of these burials.

Depositions

Depositions involve the deliberate act of laying down artefacts in the ground with the intention that they remain there, either for a period of time or indefinitely. They may either consist of a hoard stashed away and intended to be recovered, or an offering laid down for good to the higher powers or ancestors. In most cases dealt with in this study, it was probably the latter situation that applies, but there is no direct method of separating the two, and I will therefore not attempt this here.

To some extent, however, the circumstances of depositions can be categorised (Fig. 2.27). It can usually be decided whether artefacts come from *dry land depositions* or *wetland depositions*. In addition, we can divide wetland depositions into *freshwater depositions* and *seawater depositions*. Regarding dry land depositions, we know that at least three different situations were deliberately chosen: *pit depositions* where the artefacts were subsequently covered with soil; *depositions at or below a stone*; and *layers of pottery or flint tools* mostly in front of megalithic tombs.

As well as the specific information concerning the circumstances of the finds, qualitative information from the artefacts themselves can also be used to differentiate between dry land depositions and wetland depositions. Flint deposited in mires and other freshwater areas often has a red patina from the iron content in the water. Therefore, red flint artefacts of a quality that indicates deliberate deposition are very likely to be wetland deposits. Not all red flint necessarily comes from wetland areas, however. For example, flint found on poorly drained land with a significant clay content often becomes red as well. Flint and other artefacts deposited in saline water may in some cases have a black patina, added by the mud that has surrounded them, whilst in other cases, the objects may have become white due to the water's high salt content.

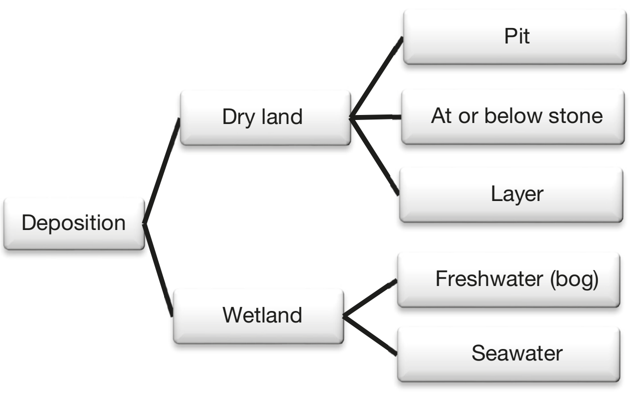


Figure 2.27. *The classification of depositions.*

Causewayed enclosures

This type of context or structure is at a generally higher level of abstraction than the other types. It does, however, have one tangible element which is required from the records: *the ditch segments*. The ditch segments are the individual elements of the row of elongated ditches that constitute the periphery of the enclosure. In addition, we use the concept of *recut* for the frequent, renewed digging into former ditch segments.

Stray finds

These are simply finds that we cannot attribute to settlements, graves or depositions. It is therefore not a category of a particular finds type, but rather an indicator of unclassified finds.

2.2.3.2 – Artefacts

Recording

The standard procedure when recording artefacts is to set up a classification system and then record the artefacts with reference to this, supplemented by measurements and/or descriptions. I have also followed this procedure, but in addition, I found it necessary to systematically produce visual records of the artefacts. The reasons for this differ for the pottery on one hand and flint or stone tools on the other.

In the case of pottery, form and decoration are the two things that normally should be recorded. Both of these can and should be classified, but decoration is especially difficult to record using classification, due to the very individual character of the ornaments as well as the high degree of fragmentation of the pottery vessels. I have worked with pottery a lot over the years and have always found that only by using visual representation can the material be properly analysed.

Pottery can be visually represented in both drawings and photographs. Personally, I have always preferred drawings, but in the present study, photos were the only option that was available. I wanted to produce an almost complete visual documentation of the decorated sherds and had to do this at the same time as I recorded the material. I did not, in any case, have sufficient funding for illustrators.

In the past, film-based cameras meant that complete photographic recording was not feasible, but today with digital cameras this has proved to be an ideal approach. Taking photographs of sherds and pots individually, removing the background from the photos, and subsequently combining the individual photos into illustrations, is a straightforward process.

I had one problem though: how to record the shape of the pottery vessels. The only way would be to reconstruct and draw the profiles of the pots, and then later combine the profiles with the photos. This is an approach that was successfully used by Niels H. Andersen (1999b) on the material from Sarup. As I could not take the material to somewhere with drawing facilities, I would have had to reconstruct and draw the profiles in the cramped environment of the museum storerooms and then redraw them at a later stage, before combining them with the photos. I considered doing this, but abandoned the idea as I realised how much extra time it would take. The lack of profile drawings is an obvious weakness of the catalogue.

In the case of the flint and stone artefacts, the background for producing illustrations of all items is slightly different. It can probably be best explained with an example. In the late 70s, Jan Skamby Madsen, who is mentioned above, undertook a survey of the Neolithic material in Hads District (1979, 1984). He recorded the artefacts using the available classifications. The recording was undertaken before Poul Otto Nielsen's flint axe studies became available (P.O. Nielsen 1978, 1979), and therefore the classification into the different types of Early Neolithic thin-butted flint axes and indeed the notion of category B thick-butted flint axes did not exist (for the division into category A, B and C axes used in this study see section 5.4.1.1). Jan Skamby Madsen recorded the thick-butted flint axes as of either Lindø type, St. Valby type or SGC type, which was the norm at that time. Some of the axes classified as Lindø and St. Valby axes were certainly either category B or C axes, but we do not know which, because sketches of the axes that might have solved this problem do not exist.

Many of the flint and stone artefacts in this study, as also was the case in Jan Skamby Madsen's study, are in private possession, which means that they are or in time will become unavailable to other researchers for reclassification. I have often encountered the same problem in museum archives. An archaeologist has noted artefacts in private possession, and left a note in the archives with a list of artefact types, but no illustrations. Such records are of little use. It is imperative that artefacts are drawn or photographed, and that

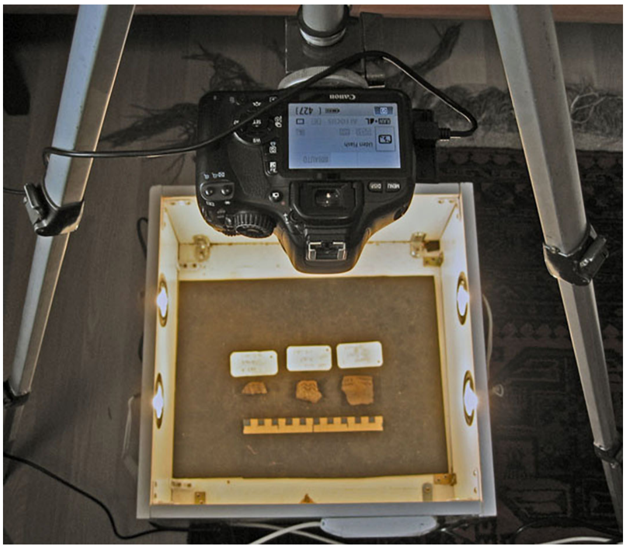


Figure 2.28. *Mobile photographic apparatus that can be used on any floor. The photos in the catalogue have all been photographed in this way.*

all significant items are shown from both the wide and the lateral sides. This is what I have done in the catalogue, which ensures that objects in the catalogue can be reclassified in the future.

I have photographed the artefacts in a homemade square box, with lights placed on three sides of the box and the camera mounted on a tripod above it (Fig. 2.28). The camera is connected to a laptop computer from where it is controlled, and to which the pictures are automatically transferred and stored. I normally photograph artefacts with light from three sides to reduce shadows, but in the case of decorated pot sherds, I dim the light on one side to create more contrast on the decoration. The apparatus is easy to move and I can place it on a floor anywhere, making the recording flexible. Photos are stored on the computer in raw format and later transformed to a 16-bit, uncompressed TIF format. In the beginning, I had some problems controlling the colours of the photos, which is obvious from the catalogue, but most of the photos are of acceptable quality.

Classification

Most typologies in archaeology aim to track variations in time and space. For each type we identify, or rather create, we try to establish its date and spatial distribution. The spatial distribution is the easy part, whilst the dating is more problematic. Through combinations of finds, and to a lesser degree stratigraphy, we try to associate our type with other types, preferably those defining the chronology used or at least those firmly dated within it. The combinations of finds are often too few in number and perhaps too uncertain to secure a reliable date. There are thus imprecise dates for many artefact types. In a study like this one, in which it is desirable to date every item as precisely as possible, the problems do not stop there.

Most typologies are based on studies of 'typical objects' in museum collections. As 'typical' these can be securely classified, but this also leaves out significant quantities of atypical material. The desire to date everything often means that atypical specimens are placed into the established typologies and thus sometimes mistakes can be made.

We generally define classifications using complete artefacts, but most of the material in a study like this one is fragmented. In order to classify fragmented objects, it is often necessary to mentally reconstruct them, and this demands overall knowledge of these artefacts. Pottery in particular can be problematic. Fragments are often tiny, yet even a very small sherd with only parts of the decoration preserved can be enough to determine the form and decoration of a pot with great precision. This requires an in-depth knowledge of this particular kind of pottery. The problem is of course that the person who classifies the material becomes a key factor in terms of the correctness of the classification, and few people have the in-depth knowledge that is required.

I have a very detailed knowledge of FBC pottery and can work very effectively with this material. I do not have the same in-depth knowledge of SGC pottery, however, and therefore cannot analyse it with the same degree of accuracy. This difference in ability may introduce an imbalance into the pottery classifications, which although not hugely detrimental, may nevertheless make the results less reliable than they could be under optimal circumstances. With respect to flint artefacts, I am also quite capable of classifying these, certainly better than most, although several people I know are more skilled in classifying flint artefacts.

We can accept that the person who classifies is a key factor in the quality and reliability of the investigation, but then there is another problem. Part of the material recorded is not available for inspection. On various occasions, archaeologists have come across artefacts that are privately owned. They routinely note what and where in the records, as well as classifying the artefacts, but can we trust this classification? We have to judge the ability of a person to classify correctly, and it is important to know when the classification took place, because we have to consider what the 'correct' classification was at that time. A thick-butted flint axe classified in 1975 as of St. Valby type may well have been a category A axe of St. Valby type, but as mentioned above, it could actually have been a category B axe, because the article that enabled this distinction to be made was not published until 1979.

2.2.3.3 – Maps

The mapping system and maps used in a study like this one are crucial. A key objective is to produce maps that illustrate the physical and natural background of the settlements in the study area and at the same time facilitate the production of simple distribution maps. MapInfo is the system used here, primarily because it is, or rather was, the system used in Danish archaeology. It is an effective mapping system, but it is not a Geographic Information System, and is thus not suited for predictive modelling. I considered this problem, but decided to stick with MapInfo, as I did not intend to use regular predictive modelling.

Creating a base map of the study area, for use as a backdrop for the distribution of sites and artefacts, proved to be a challenging and time-consuming task. I wanted to produce a map that reflected the primeval landscape as precisely as possible. This meant that I had to go back to sources prior to the modern development of the landscape. This was especially important with respect to two parameters: contour lines and waterlogged areas.

When the contour lines on a modern map are examined it becomes obvious that cuts and embankments for roads and railways, as well as gravel quarries, are highly visible. These elements immediately catch the eye. I required a set of contour lines which predated such disturbances. These exist on the so-called 'Høje Målebordsblade' – a set of ordnance survey maps at 1:20,000 produced between 1842 and 1899 (Fig. 2.29). The maps covering the study area date to around 1870-80. The contour lines are at 5 feet (Danish) intervals, corresponding to 1.57 m. The measurements are apparently very precise and the maps are of high quality. The only problem is that the contour lines do not exist digitally. To create a contour map, they had to be manually traced, which was time consuming, especially because the area includes the highest part of Denmark.

Drainage work carried out since the mid-19th century has profoundly changed the Danish landscape, making previously waterlogged areas available for agriculture (section 2.1.1.1). If the above-mentioned ordnance survey maps are compared with current maps, it is immediately obvious that there is a huge difference in the extent of wetland areas. By the late

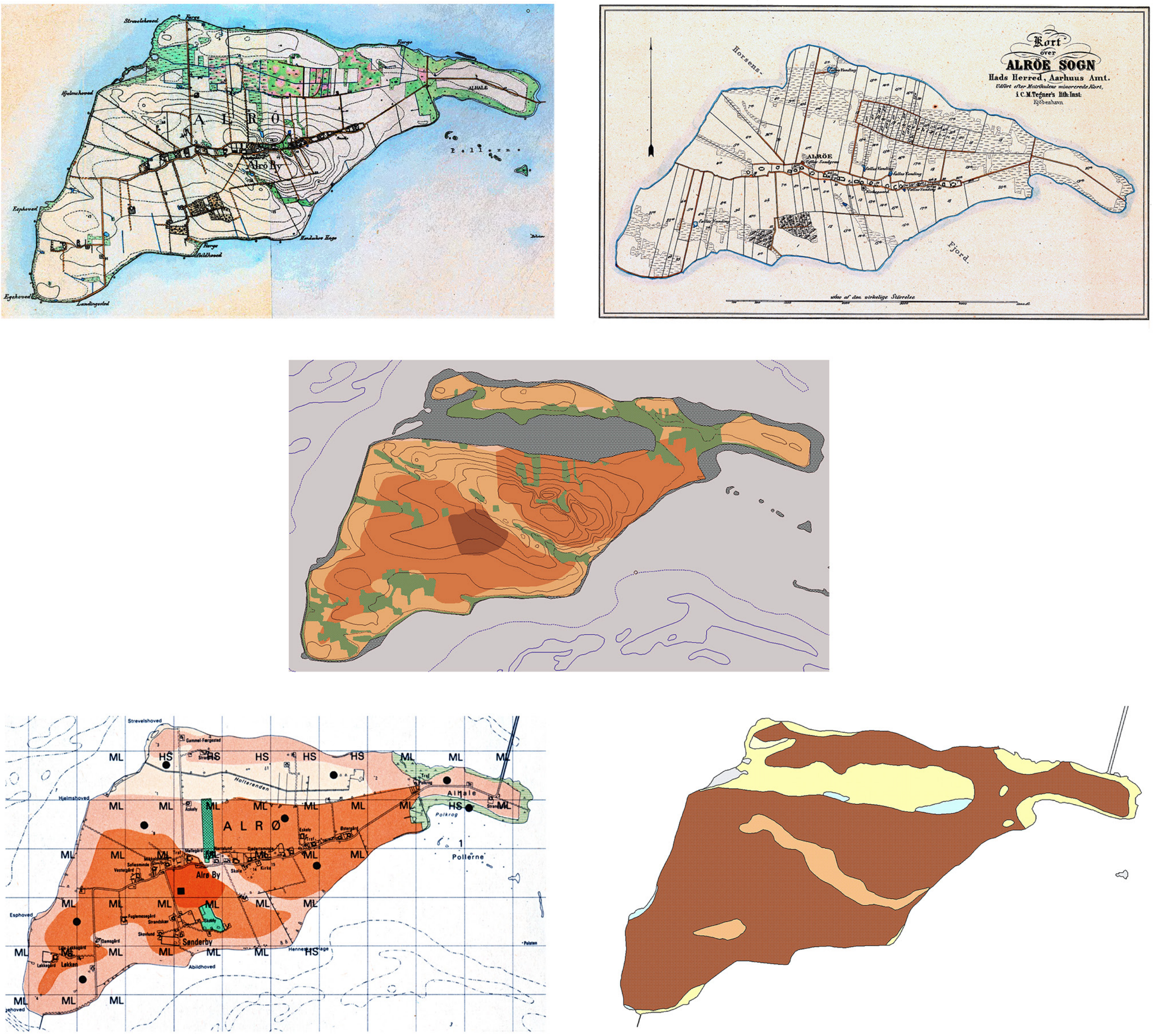


Figure 2.29. *The sources for the general map of the study area, using the island of Alrø as an example: Ordnance Survey maps from the 1870s and 1880s (top left); economic maps of parishes from the 1830s and 1840s (top right); land use soil maps from the 1970s (bottom left); and geological survey maps from the 20th century (bottom right). The finished map in the centre combines information from all these maps.*

19th century, drainage on a major scale had already taken place, however, so I had to go even further back to find an undrained landscape. The earliest maps showing land use information date to the late 18th century. The so-called 'Original 1 kort' are detailed maps of cadastral townships with the individual fields of the farms marked. From these, it is possible to reconstruct the extent of the waterlogged areas, but to do so for the 180 cadastral townships of the study area would be too time consuming. I decided instead to use the so-called 'Minorerede sognekort' from the 1830s and 1840s. These are primarily economic parish maps drawn at 1:20,000, showing roads, houses, fields, forests and wetland areas (Fig. 2.29). I used these maps in conjunction with the ordnance survey maps to reconstruct the waterlogged areas.

For mapping soil types, a geological map would be the most obvious choice. Unfortunately, a detailed map of topsoils covers only part of the study area. Using this would have resulted in a large blank area. I have instead decided to use 'Den danske jordklassificering' – the Danish Soil Classification (H.B. Madsen et al. 1992; section 2.1.1.1). The soil classification maps were produced in the 1970s. They show up to eight different soil types of agricultural relevance (Fig. 2.29). I have used five of these categories: sand, clayey sand, sandy clay, clay and heavy clay. A sixth category – humus – is substituted by the waterlogged areas recorded from the historical maps. The inherent weakness of the soil classification maps is that they are generalisations. They provide average representations, and thus completely overlook local variations, such as pockets of sand in clayey areas. I have used the detailed geological maps ad hoc, where they are available. Thus, for example, I have used the distribution of marine sand to map the maximum extent of the sea (Fig. 2.29).

2.2.4 – The catalogue

As with the sites and monuments records, the basic organising units of the catalogue are the parishes, where the primary code of each site consists of the 6-digit number, which refers to the parish from where it comes, followed by a number within the parish. The numbering of sites within the parishes is not the same as the Sb number of the sites and monuments record, but one that is unique to this study. Each site can possess any number of contexts numbered sequentially using capital letters, and each context may contain any number of artefacts numbered sequentially using digits. An example of a complete reference to an artefact in the catalogue is therefore as follows: (160508-35 E27), which is a funnel neck beaker (27) from ditch V (E) at the causewayed enclosure at Toftum (35), Søvind Parish (08), Voer District (05), Skanderborg County (16). Such bracketed references to the catalogue are often found in the text of this publication.

The catalogue is organised into sections on a parish basis, with the parishes arranged according to counties and districts. At the beginning of each section is a map of the parish, on which all the recorded sites and their numbers are marked. The features and contexts of each site are, as far as possible, described, and the artefacts are listed, described and in most cases visually depicted.

The catalogue was published digitally in 2019, and will remain digital. It was available from the author's home page, but will be available online as volume 2 of this publication. References to this can be found in the contents section.