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## Driven away by a rising sea level: three case-studies taken from the Dutch past

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Astrid Stobbe & Ursula Tegtmeier (Hrsg.)

# Verzweigungen

Eine Würdigung  
für A. J. Kalis und J. Meurers-Balke



## Frankfurter Archäologische Schriften

herausgegeben von

Hans-Markus von Kaenel, Rüdiger Krause, Jan-Waalke Meyer und Wulf Raeck

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## Vorwort des Herausgebers

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Die Drucklegung der vorliegenden Festschrift wurde durch das Amt für Bodendenkmalpflege im Rheinland und seinem Leiter, Herrn Prof. Dr. Jürgen Kunow, sowie durch die Abt. Vor- und Frühgeschichte des Instituts für Archäologische Wissenschaften in Frankfurt ermöglicht. Die Redaktion übernahmen Frau Dr. Astrid Stobbe und Frau Dr. Ursula Tegtmeier. Das Layout lag in den bewährten Händen von Frau Kirstin Brauneis-Fröhlich M.A., Frankfurt. Die Drucklegung erfolgte durch den Habelt-Verlag Bonn unter der Betreuung von Frau Dr. Susanne Biegert. Wir danken schließlich Frau Dr. Astrid Stobbe und Frau Dr. Ursula Tegtmeier sowie allen Autoren sehr herzlich für das Zustandekommen des Bandes!

Frankfurt, im Dezember 2011  
Prof. Dr. Rüdiger Krause



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# Driven away by a rising sea level: Three case-studies taken from the Dutch past

Corrie C. Bakels

To my dear colleagues and friends A. Joop Kalis and Jutta Meurers-Balke who are not afraid of peat and wet feet

## Introduction

The topic of rising sea levels is modern, the problem is not. The melting of polar icecaps and large glaciers as a result of global warming alarms mankind world-wide. Many a report has been written and many will follow about the impact of this process on the level of oceans and seas, and, in consequence, human populations on their shores. Rising sea levels threaten people living in low-lying areas, if not exactly bodily, then by destroying their habitat.

At present, defence is sought in building dikes to prevent flooding. But melting icecaps are not a recent phenomenon. We tend to forget that melting has taken place since the end of the last Ice Age, resulting in a continuously rising sea level. How did people cope in the past? Building dikes was not part of the technological toolkit in prehistoric times. The Netherlands belongs to those parts of the world which have such a low elevation that its inhabitants are constantly aware of the sea. In the following, three cases from Dutch prehistory will be presented (Fig. 1).



Fig. 1. Map with the sites mentioned in the text.

## First case

My first scene is set in the period between 5400 calBC and 5050 calBC and concerns the site of Hardinxveld-Giessendam 'Polderweg'. This site is situated in the combined delta of the rivers Rhine and Meuse.

The Pleistocene substratum of the region consists of gravel and sand deposits. During the last Ice Age, vegetation was scarce or even absent and the wind blew the loose sand into lower and higher dune complexes, known as river dunes. Most of these dunes are of Younger Dryas or earliest Holocene age. During the Holocene the global sea level rose, while at the same time the land subsided. The northern icecap had weighed down northern

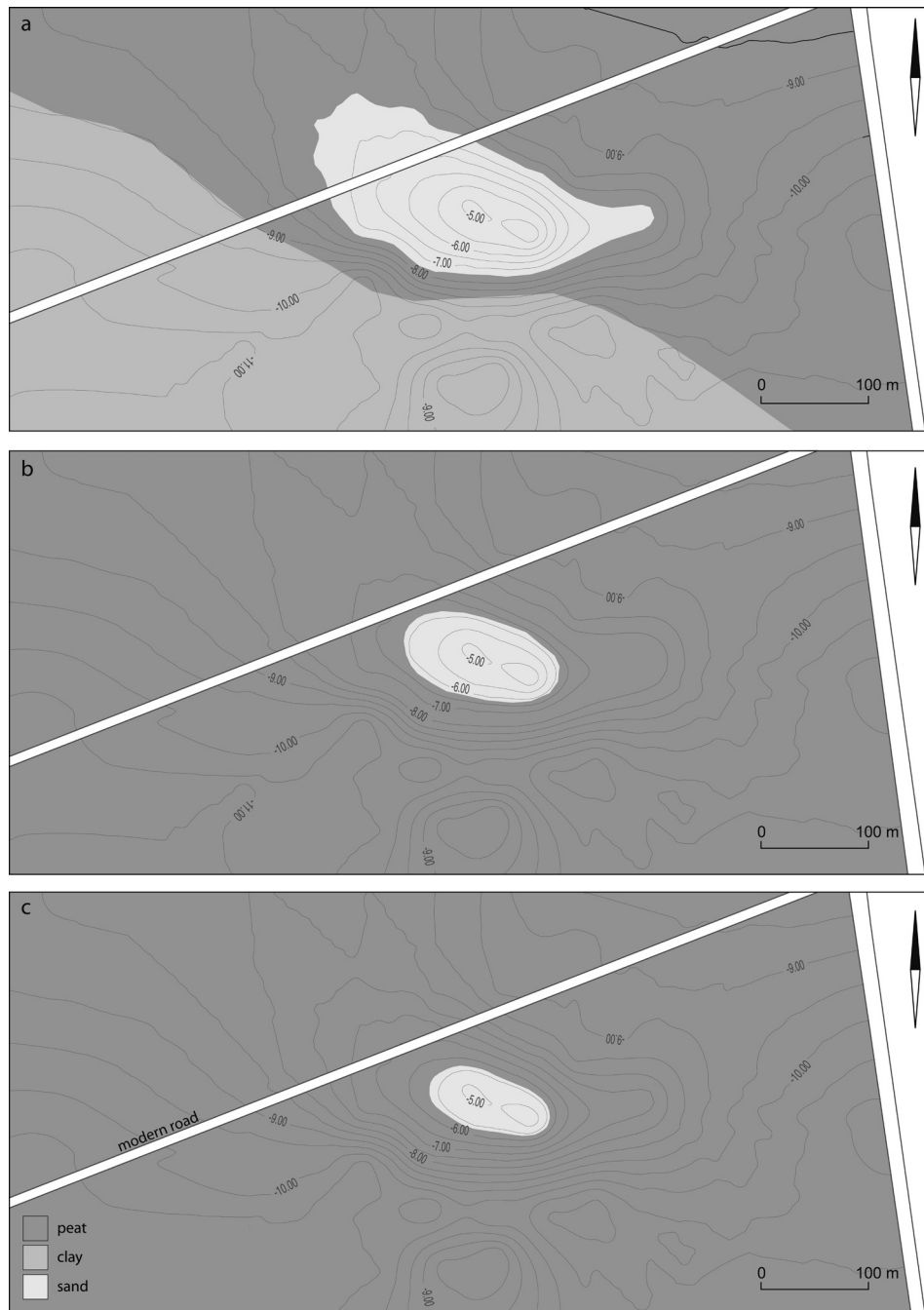


Fig. 2. Hardinxveld-Giessendam 'Polderweg'. The shrinkage of the dune. a: the dune (sand) during the first phase of occupation; b: during the transitional phase 1/2; c: during the second phase. (After: Out 2009)

Europe during the Ice Age and the reduction in ice restored the balance, causing northern Europe to rise and more southern parts like the Netherlands to sink. The net result is that fluvial and deltaic deposits buried the Pleistocene subsoil but for the higher river dunes. The steady rise of the water table, keeping pace with the sea level rise, and the repeated clogging of drainage channels by sediment, caused extensive peat growth. The river dunes rose above this landscape as dry spots in an otherwise marshy land.

People need dry areas to live on and it is therefore not surprising that the river dunes were the places to settle on. Hardinxveld-Giessendam ‘Polderweg’ was such a dune. During the period mentioned above it was used by

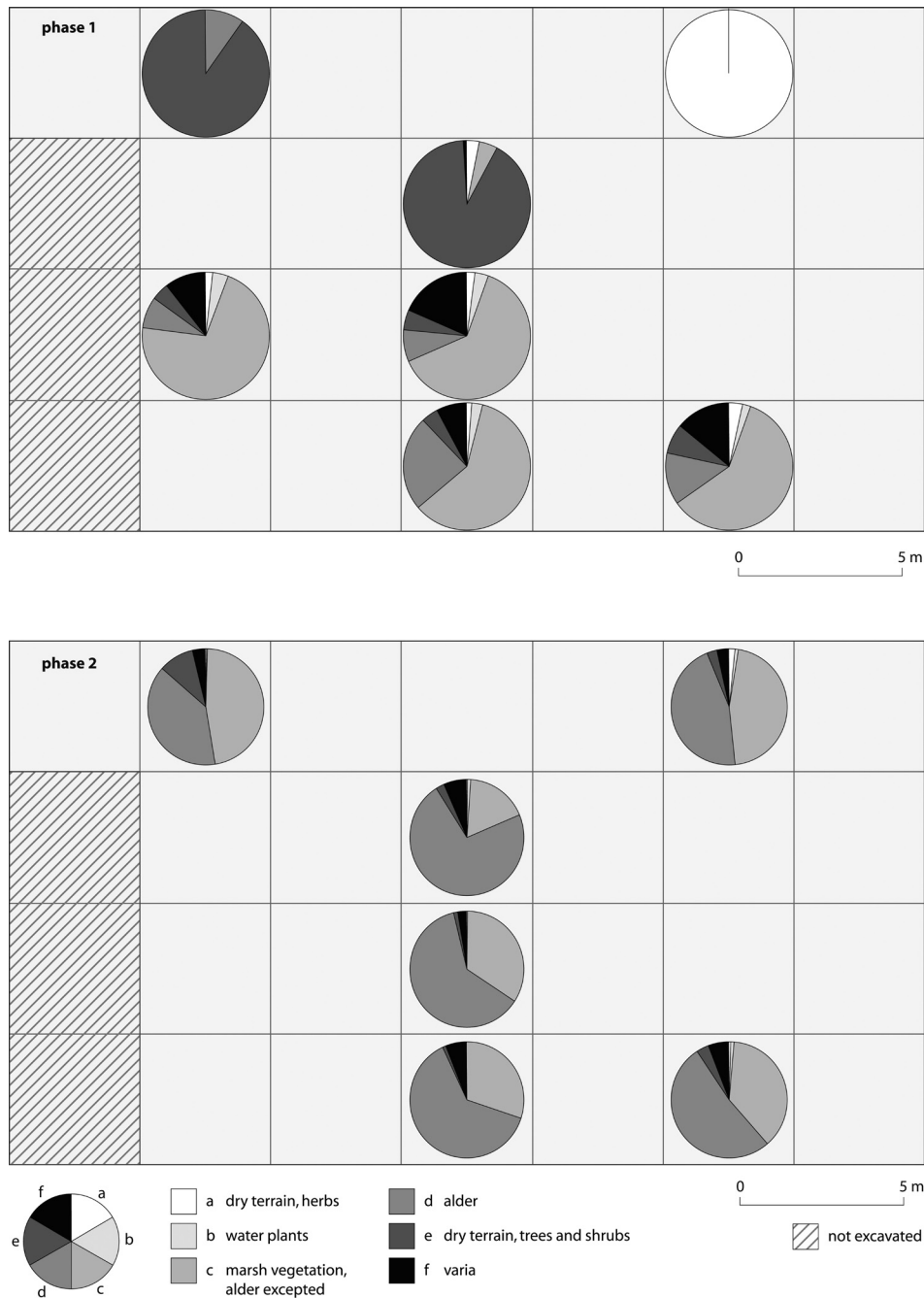


Fig. 3. Hardinxveld-Giessendam ‘Polderweg’. The frequency of seeds and fruits in samples taken at different levels on the slope of the dune. Species are combined in ecological groups. The top of the figure points towards the top of the dune. (After: Bakels/van Beurden 2001)

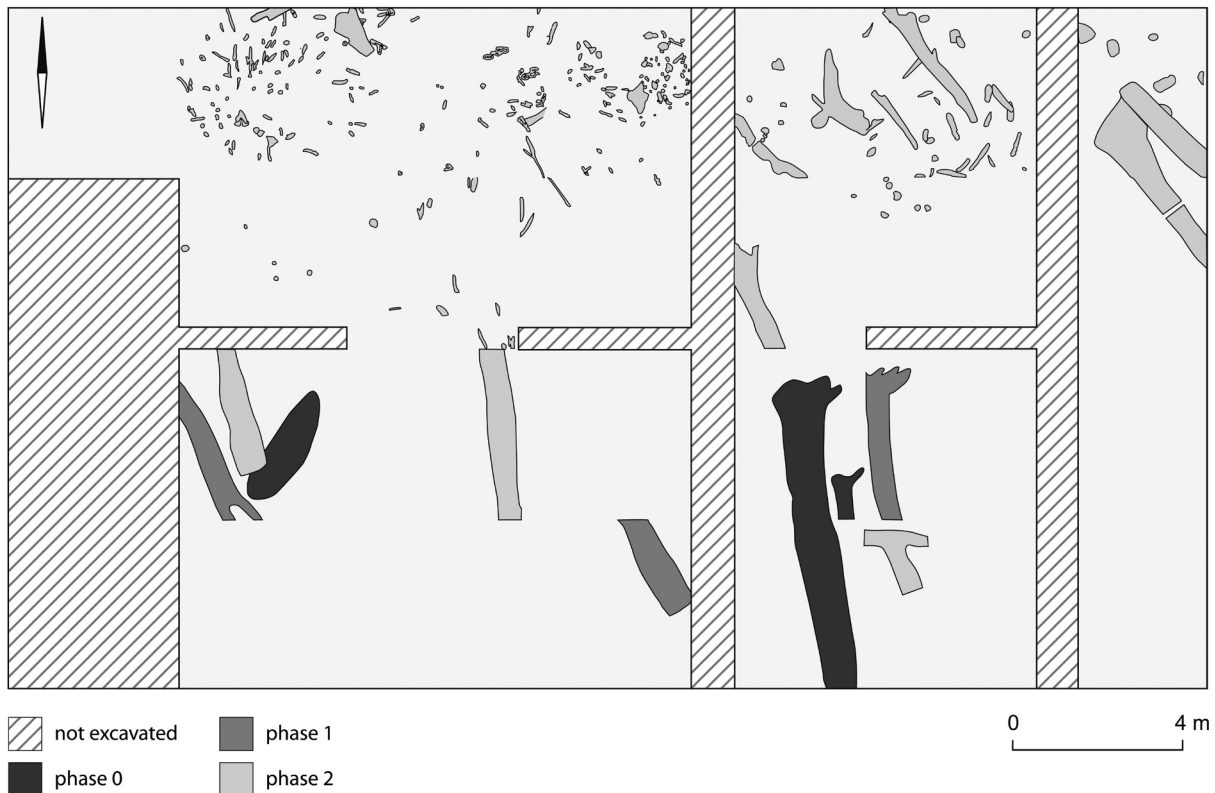


Fig. 4. Hardinxveld-Giessendam 'Polderweg'. Tree trunks as found in the excavation pit on the slope of the dune. The top of the figure points towards the top of the dune; the younger trunks (phase 2) lie highest. (After: Hamburg/Louwe Kooijmans 2001)

hunter-gatherers as a winter base camp, with a main occupation in late winter and additional occupation in early autumn, or a continuous occupation from September to March (Louwe Kooijmans 2001).

Settlement started c. 5400 calBC (Out 2009, 7). As the sea level rose, and with it the water table, the marsh crept up the slopes of the dune resulting in a shrinking of the dry surface (Fig. 2). The gaining ground of the wet with its wetland vegetation is clearly seen in the assemblage of fruits and seeds recovered from different levels on the slope of the dune during excavation (Fig. 3). The original dry land vegetation gives way to alder carr. Large oak trees toppled over because their roots were rotting away. The base of their trunks point towards the top of the dune, the crown towards its foot (Fig. 4). In the course of time the dune became less and less interesting to settle on. Archaeological research showed that after 5200 calBC the main centre of activity shifted to a larger dune nearby: Hardinxveld-Giessendam 'De Bruin' (Louwe Kooijmans 2003). But even this dune shrank in size and around 5050 calBC both dunes were covered completely by peat and thus ceased to be inhabitable.

Most river dunes shared this fate. The loss of river dune habitat was a gradual process, people did not have to abandon it within one generation. Nevertheless, they lost to a rising sea level.

## Second case

My second case concerns a much later period, 350 calBC – 100 calBC. In the first half of the Holocene the rise of the sea level was rather fast, c. 2 m per century, but during the second half the process slowed down. At the same time coastal barriers were formed which impeded the drainage of the hinterland. Together with the still, though slower rising water table this resulted in considerable peat growth. The wetlands in the Rhine-Meuse

delta became completely covered with peat. Originally this peat was eutrophic peat with alder carr as the last seral stage. But rainfall was obviously high enough to enable the formation of ombrogenic, oligotrophic *Sphagnum* peat on top. This process took place in the cores of larger peat areas and resulted in slightly raised surfaces. Where an area was dissected by river branches and creeks, the formation of oligotrophic peat was checked by the influx of nutrient-rich water.

Living peat is not suitable for human occupation, but draining 'kills' the peat and natural drainage occurs during periods of enhanced activity of the sea. Periodic invasions of the North Sea, which is the sea in question, are characteristic of the second half of the Holocene. They are called phases of transgression. An aggressive, invading sea clears clogged waterways and thereby drains the hinterland (though many wouldn't expect this effect). Such a drainage occurred during the pre-Roman Iron Age in an area between the towns of Delft and Rotterdam, where people started to settle on top of the peat around 350 calBC.

The settlers left traces of isolated houses (single-dwelling sites) of which mainly floors have been preserved (Abbink 1993). The original superstructures must have consisted of a wooden frame, wattle-and-daub walls and a thatched roof, but these have not been preserved except for some wooden poles protruding from the floors. The floors are very thick, reaching thicknesses of up to 150 cm. Layer upon layer of plant matter alternating with animal dung were placed on top of each other, apparently in an effort to cope with a surface sinking to a lower level because of the shrinking of the peat below. Floors are preserved in an unusual way. They appear as chunks lying at angles of up to 90° to the original surface, buried in the soft subsoil (Fig. 5). Obviously the chunks are toppled over, just as the roots of a tree toppled over in a tree fall (Abbink 1993; Koot 1994). The chunks include the old surface of the spot on which the house was built and this enabled us to reconstruct the local vegetation through pollen analysis.

Because a single-dwelling site proved to consist of a succession of dwellings, built in the same restricted area though not on top of each other, the history of the local vegetation can be followed by analysing a series of

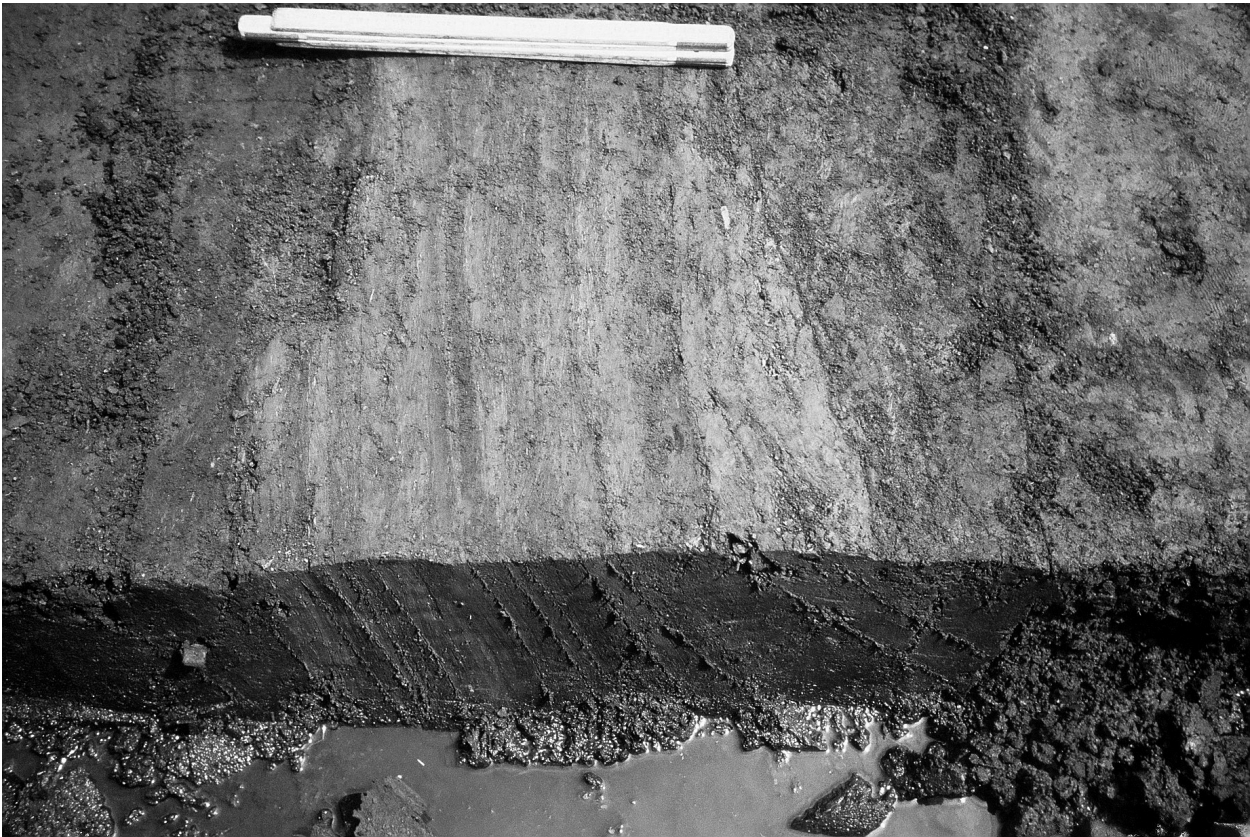


Fig. 5. Duifpolder. Chunk of floor lying at almost 90° with respect to the recent (and former) surface.  
(Photo: Corrie C. Bakels)

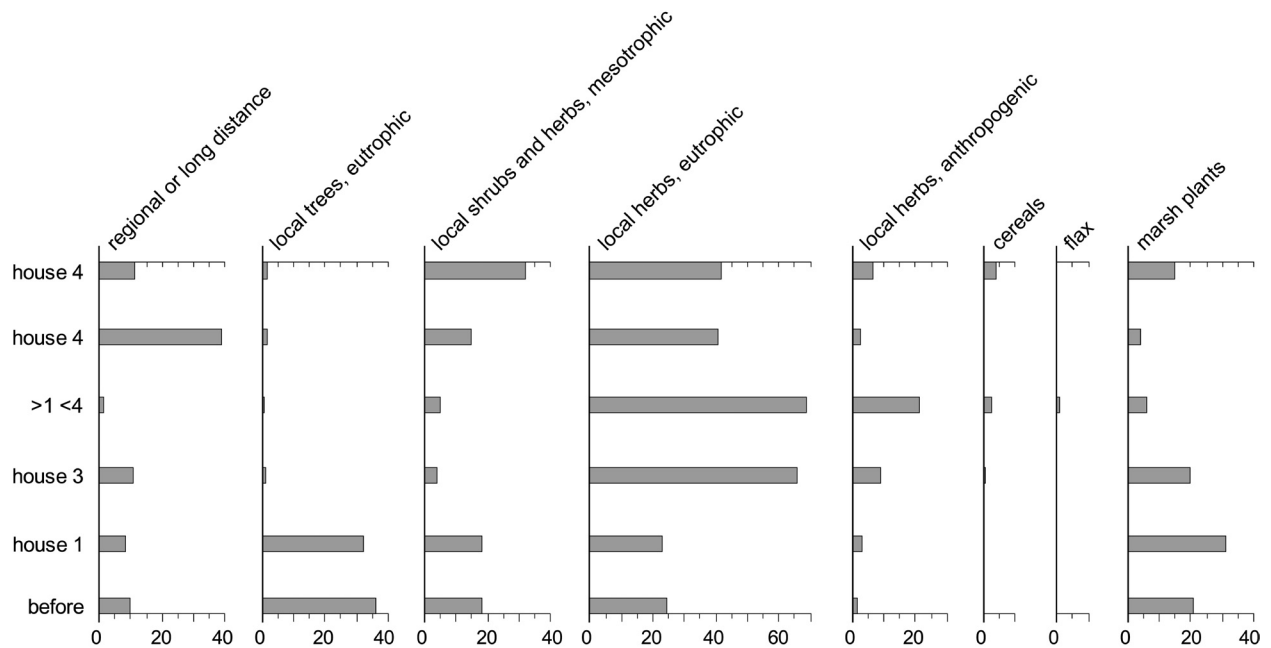


Fig. 6. Duifpolder. Pollen spectra obtained from former surfaces.

old surfaces (Bakels 2008). The locality of Duifpolder may serve as an example (excavation by C. Koot, pollen analysis by I. van Amen).

In Duifpolder people did not settle on top of a dried-out *Sphagnum* peat, but chose a place not far from a creek, where the peat was eutrophic in character. This was confirmed by macroremains analysis. Figure 6 depicts a selection of the pollen types encountered during pollen analysis. Pollen values are given as percentages based on a Total Pollen sum for which some 1000 pollen have been counted. The lowest spectrum represents the pollen rain deposited some decades before the construction of the first house. Local trees are alder and ash. A considerable percentage of herbs shows that the area was already open and the share of so-called anthropogenic indicators (after Behre/Kučan 1986) indicates that this clearing was presumably man-made and used before actual settlement. The relatively high amount of pollen of small trees, shrubs and herbs growing under mesotrophic conditions possibly represents the more inland vegetation. Dominant in this sector are birch and bog myrtle.

The surface on which the first house was built presents the same picture. After abandonment it was followed by a second house, and a third, and an undefined part of another structure younger than the first house but older than the fourth. From the fourth house two different chunks of floor could be sampled. Local trees vanish from the records, possibly because they were used for building and other purposes. The remnants of the poles revealed them to be alder and ash. Cereal and flax pollen on the old surfaces point towards local handling of these crops, which is moreover proven by the occurrence of their macroremains in the floor layers. Formerly it was presumed that such crops were not grown in the immediate surroundings of this kind of settlement, but on more distant, wide levees of large river branches (see for instance Brinkkemper 1991, 132 on this subject). However the regular presence of pollen and macroremains at sites such as Duifpolder suggests that cereals and flax were indeed grown on the dried-out peat.

The fourth house is the last structure on this site. The habitation of the area between Delft and Rotterdam ended around 150/100 calBC and spans therefore some two and a half centuries at most (van den Broeke 1993). People came, used local wood, grew crops, tended livestock (known from the bones and animal droppings left at the sites), and disappeared again. The reason for abandonment of the area is that the activity of the sea slowed down. Creeks silted up, hampering drainage again, and peat formation started afresh. The Iron-Age inhabitants lacked the technology of large-scale artificial drainage and the area became too wet for them. The area was not occupied again until the Middle Ages.



Fig. 7. Ard-marks at Wateringen. (Photo: Corrie C. Bakels)

### Third case

My third case brings us nearer to the actual coast, to an ancient coastal barrier formed in the mid-Holocene. It is located in the surroundings of Wateringen near The Hague. At one time it was a true beach barrier, but later changes in the sedimentation regime of the sea caused the coast to shift westward and the barrier ended up as an inland sandy ridge, 52 to 60 m wide, running southeast–northwest and flanked by depressions which previously were the strand flats. The southern flat was occupied by a tidal creek. The ridge is part of the so-called Older Dunes, but is at present no longer visible due to a cover of marine sediments laid down during transgressions of the sea in historic times.

Excavation of part of the ridge by C. Koot revealed that the ridge bore traces of human presence during the period 450 calBC – 400 calBC, which falls within the pre-Roman Iron Age.

The fifty years of occupation can be divided into two phases. The first phase is characterized by ard-marks and some pits (Fig. 7). The ploughed area covered a single area of at least 60 by 76 m. The second phase revealed only pits. These pits were originally water holes dug to reach the reserve of freshwater under the ridge, but were backfilled with sediment and all kinds of waste. Both phases were the object of botanical research.

The old arable did not contain macroremains but small fragments of charcoal. Pollen analysis brought some pollen grains of Cerealia-type, but as this coastal environment has also a fair share of wild grasses with comparable pollen types, the Cerealia pollen may not represent the actual crop grown. However, remains of crop plants were retrieved by A. E. de Hingh from the waterlogged contents of the contemporary pits. They include carbonised hulled barley (*Hordeum vulgare*), emmer wheat (*Triticum dicoccum*) and opium poppy (*Papaver somniferum*). Not carbonised is a possible crop plant, i. e. rapeseed or turnip (*Brassica rapa*). Examples of field weeds are *Fallopia convolvulus*, *Vicia hirsuta*, *Chenopodium album*, *Persicaria lapathifolia* and *Atriplex patula/prostrata*. It is not certain that the crop plants were actually grown on precisely this field. They were obtained from the fill of pits in which sherds and other household waste were discarded. Nevertheless, they were produced by the

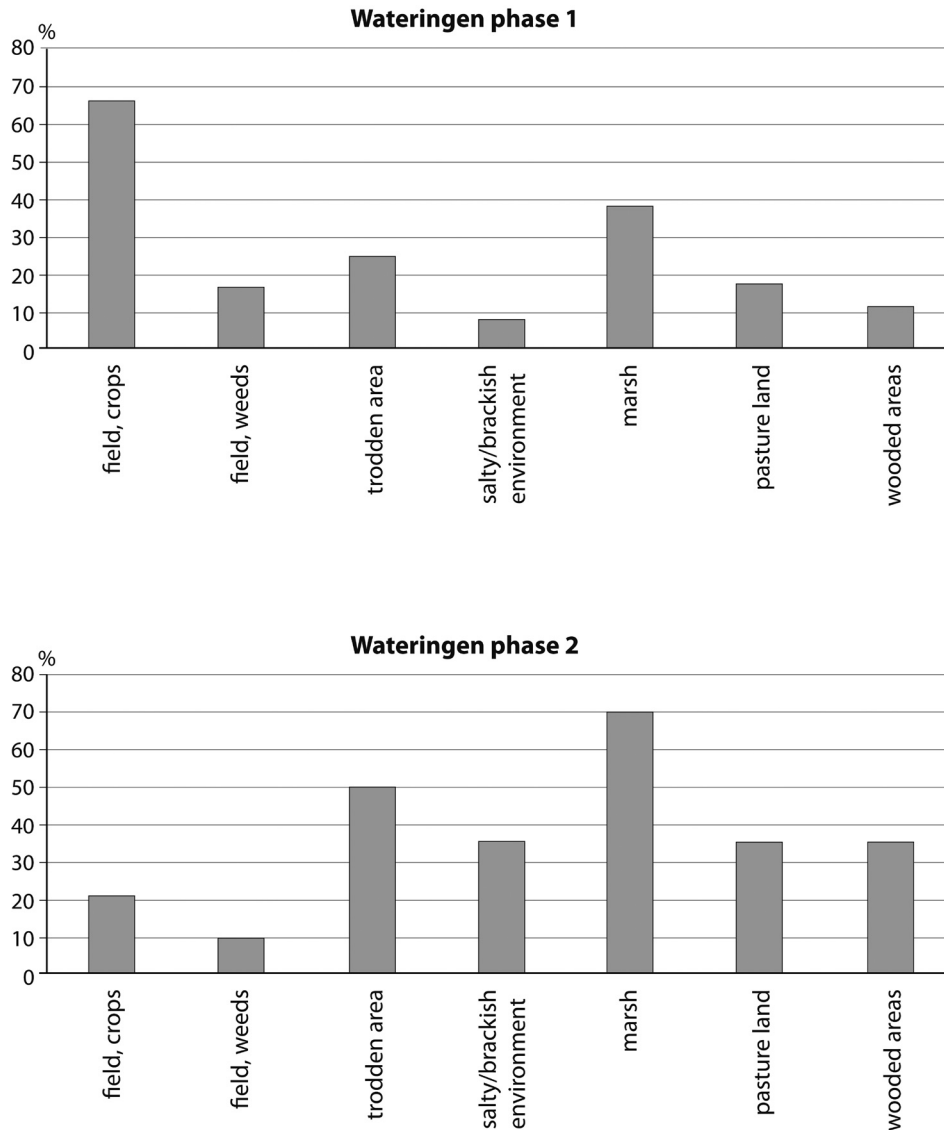


Fig. 8. Watingen. The frequency of seeds and fruits in samples from the two phases. Species are combined in ecological groups. N samples is 29 for phase 1 and 14 for phase 2.

people who exploited this field. The immediate surroundings of the site were of a quite different nature, rather wet, and not suited to the growing of crops. Therefore it is quite likely that such crops were cultivated on the field with the ard-marks.

The younger phase offers a different picture. The contents of the pits shows the presence of a lightly grazed vegetation. Part of the plants indicate a brackish environment, others do not (Fig. 8). It seems that parts of the ridge, perhaps the lower parts of its slopes, were affected by a periodic flooding by salt or brackish water. The flooding was due to an increased activity of the tidal creek. The surface for growing crops in a reliable way may have become too small, and this may have been the reason why the field was abandoned and given over to livestock.

The only crop plants retrieved from the younger pits are flax (capsules, *Linum usitatissimum*), and gold of pleasure (*Camelina sativa*). There are even doubts whether gold of pleasure had the status of a crop, because its remains were not found independently but were always associated with flax. The plant may have grown as a weed in a flax field, although it is known to have been a crop plant in its own right during the Iron Age (Bakels 1991; Knörzer/Gerlach 1999). The flax cannot have been grown on the spot, because the field did not longer exist, but it may have been cultivated nearby. Flax is rather salt-tolerant (van Zeist et al. 1976; Bottema et al. 1980).

Its remains may have arrived with domestic waste, but another explanation is that its presence is due to field retting. In that case the ridge, used as a pasture now, may also have been used for the spreading-out of flax in order to further retting by the impact of rain and dew.

After the short period during which the ridge was grazed, the terrain had to be abandoned altogether. Increased flooding ended in the deposition of clay on top of the ridge and that meant the end of human activities. The site at Wateringen provides evidence that within a time span of fifty years people had to change their use of the land. They had a field, had to abandon this because of an increasing influence of the sea, turned to tending livestock there, and, finally, had to abandon it for good. They lost to the sea.

## Conclusion

The three examples presented in this article show that in the past people could not cope with a rising sea level. It was not so much the sea level itself as the resulting rise of the water table. At present the problems arising from both processes are warded off with dikes and artificial drainage, but an effective defence requires the application of technological skills on a large scale. The problems also require people to be working together on a regional scale. Both factors were obviously lacking in Dutch prehistory. On a local scale people reacted by raising the surface they lived on, a process which led in some regions to the growth of dwelling mounds. The examples best known are the so-called *terpen* in the northern parts of the Netherlands which were constructed from the 6<sup>th</sup> century BC onwards. But people could not raise an entire environment. When the environment became too marshy or suffered too often from floods they had to leave.

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