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SCHIPLUIDEN

A NEOLITHIC SETTLEMENT ON THE DUTCH NORTH SEA COAST *c*. 3500 CAL BC

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18 Pollen analysis and the reconstruction of the former vegetation

Corrie Bakels

Three pollen diagrams supplemented by four pollen spectra obtained for samples from wells and eight pollen spectra obtained for coprolites were used to reconstruct the vegetation at the time of the occupation of the dune. The diagrams and spectra show a treeless dune that was initially surrounded by a salt marsh and later by a freshwater reed and sedge marsh. There may have been patches of alder carr at some distance from the dune.

18.1 Introduction

Several pollen analyses were conducted with the aim of reconstructing the former vegetation on and around the dune and the changes that took place in the environment during its occupation. Samples were taken with a view to obtaining pollen diagrams for waterlogged sediments in the lowest parts of the dune's slopes and pollen spectra for the fills of waterlogged features on top of the dune. Off-site pollen diagrams were not included in the research programme. During the excavation two more promising sources of pollen were discovered: a soil profile on top of the dune and a series of coprolites. They were both added to the list of sediments and objects to be analysed.

18.2 Materials and methods

The slopes of the dune and the soil profile were sampled by driving 10 × 15 × 50 cm boxes into the sections made during the excavation. One series of samples was obtained from the northern end of trench 16 and a second one from the southern part (fig. 18.1, 16N and 16S). Samples of sediments were hence taken as far away as possible from the areas of human activity. Schipluiden 16N comprised sediment from Units 20, 10 and 02 (chapter 2) and Schipluiden 16S sediment from Units 19 and 10. By the time the latter units were sampled, the younger units had already been removed. As some parts of these units moreover appeared slightly trampled, an additional, very small trench – trench 40 – was dug especially for the purpose of obtaining a sample for pollen analysis. The trench was dug as far away from the dune as technically feasible, but even there the sediments were found to contain some discarded bones. The box taken

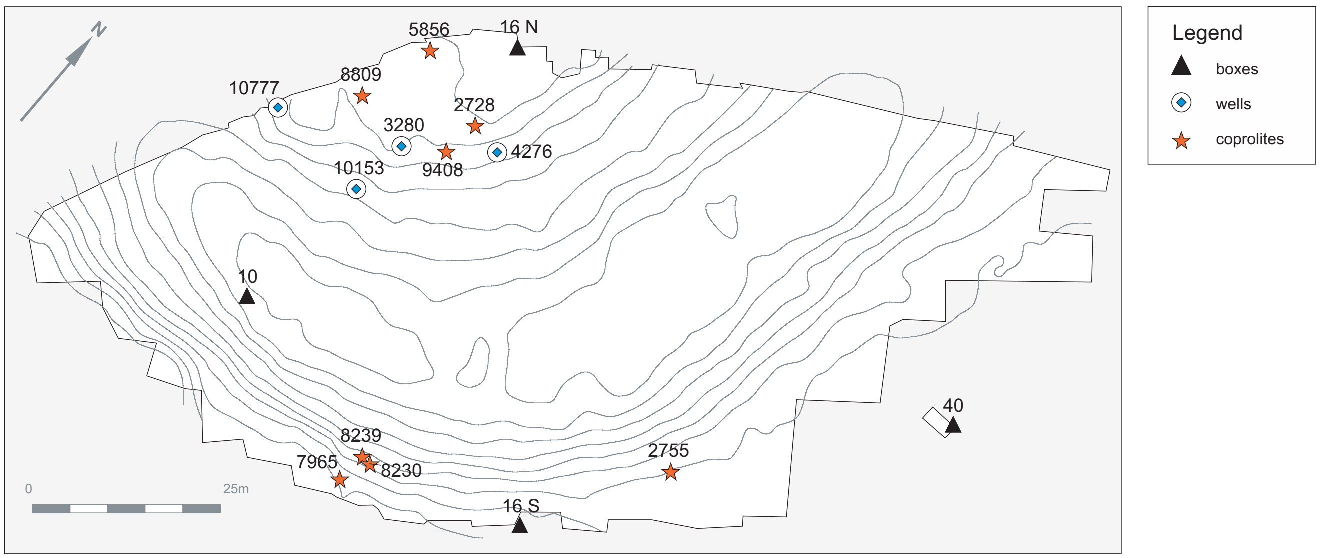

Figure 18.1 Points at which the box and well samples were taken and findspots of the coprolites.

from this trench – sample 40 – comprised sediments from Units 19, 10, 02, 01 and 00. Only the sediments of the lowest three units of this sample were analysed. The soil profile was sampled in trench 10.

The (formerly) waterlogged features on the dune were tested for the presence of pollen. Most were found to contain poorly preserved pollen or no pollen at all. Four of the pollen-containing features were selected for full analysis – *i.e*. single spectra were counted from the bases of their fills.

The coprolites were described and classified by BIAX-*Consult*, which divided them into three categories on the basis of their morphology (chapter 17). Some are mere fragments. Eight of the less damaged specimens were analysed.

Pollen was extracted in the usual way, by subjecting the sediments to KOH and HCl treatment, heavy liquid separation and acetolysis with the addition of a Lycopodium tablet. Before treatment, the clastic sediments in the boxes were cut into 1-cm-thick slices and the more compressed peat sediments into 0.5-cm-thick slices. Matter from the interior of the coprolites was subjected to treatment with 85% phosphoric acid, heavy liquid separation and acetolysis (Vermeeren/Kuijper 1993). The laboratory work was carried out by W.J. Kuijper. The pollen grains from the sediments were identified and counted by K. Verhoeven and those from the coprolites by the author. The grains were identified with the aid of the keys of Faegri *et al*. (1989), Moore *et al*. (1991), Punt *et al*. (1976-1995) supplemented by Reille (1992/1995/1998), several type lists set up by Van Geel and the reference collection of the Faculty of Archaeology of Leiden University.

The soil profile proved to be sterile. The pollen from the sediments and that from the coprolites will be discussed separately below.

18.3 Pollen from the slopes and the top of the dune

The research programme allowed for only a limited number of spectra. Nevertheless, three pollen diagrams were drawn and four spectra were obtained for the bases of the primary fills of the sampled well features. The pollen sum is a Total Pollen sum. Most of the tree pollen must have come from far away, transported by water and long distance air currents. In the period of occupation, trees such as *Picea* and *Abies* were not to be found in the Netherlands and *Pinus* was extremely rare. It is assumed that *Tilia* and *Ulmus* will not have done well in an environment close to the sea. It is likewise doubtful that *Quercus* and *Corylus* grew in such an environment, and this is indeed confirmed by the results of the wood analyses (chapter 21). An Arboreal Pollen sum was feasible, but would not have clearly shown to what extent the dune was covered with trees or shrubs. An Upland Pollen sum posed the problem of which herbs to exclude. Therefore all pollen and spore taxa were included in the sum. The most significant parts of the diagrams are shown in figures 18.2-4. The data that are not shown confirm the illustrated parts of the diagrams (table 18.1).

18.3.1 Diagram Schipluiden 40

The Schipluiden 40 diagram, which was obtained for a sample taken around 20 m to the east of the dune, includes comparatively little tree and shrub pollen. This diagram relates to Unit 19 (clay), which was formed in occupation phase 1, and Unit 10 (peat), formed in occupation phase 3. The main components are *Pinus, Alnus*, *Quercus* and *Corylus*. The *Pinus* values obtained for Unit 19 are slightly higher than those obtained for the phase of the growth of the peat of Unit 10. The reverse holds for the other three species. The *Pinus* pollen is assumed to have been transported from a source much further away than the pollen of the other species. Even so, the values of all the trees and shrubs are too low to allow a reconstruction of a vegetation comprising trees and shrubs on or in the immediate vicinity of the dune. There may have been some insect-pollinated shrubs, shedding very little pollen, but the main vegetation consisted of herbs. The herb pollen dating from the phase when clay was laid down in the tidal marsh is dominated by Chenopodiaceae and Asteraceae tubuliflorae. Pollen of this type is released by for example *Salicornia* species, *Suaeda maritima* and *Aster tripolium*. These plants are the main members of halophytic vegetations thriving in the lower parts of salt marshes. *Plantago maritima* also grows in such areas. Such a halophytic vegetation was clearly to be found on the southern side of the dune in occupation phase 1. Asteraceae liguliflorae, Apiaceae and Brassicaceae have been included under the heading of 'salt marsh', but which species they represent is not clear.

Peat formation started some time after the deposition of the clay of Unit 19. A vegetation releasing Poaceae and *Solanum dulcamara* pollen took over. It may have been a slightly brackish marsh vegetation comprising *Phragmites australis* and liana *Solanum dulcamara*, which is also tolerant of salt. Peat growth continued under a vegetation dominated by Cyperaceae (sedges), which also included plants such as *Sparganium* species, *Typha latifolia* and *Iris pseudacorus*. They are indicative of a freshwater environment. Indicators of open water proper are absent. During occupation phase 3, the low-lying areas bordering the southern slope of the dune were marshy without significant pools of open water.

The picture that emerges for the vegetation on the dune is less clear. It may have been pasture-like. Some of the Poaceae and Cyperaceae may have grown on the dune. Pollen percentages of upland herbs are very low. Some *Plantago lanceolata* and *Artemisia* may have been part of the local vegetation.

section or feature Unit	40 19S	40 10	40 2	16 S 19S	16 S 10	16 N 30	16 N 10	16 N 2	3280	4276	10153	10777
Alisma	–	–	–	–	–	•	–	–	–	–	–	–
Caryophyllaceae	•	–	–	•	•	–	–	–	–	–	–	–
Cuscuta	–	–	–	–	–	•	–	–	–	–	–	–
cf Epilobium	–	–	–	–	–	–	•	–	–	–	–	–
Ericales	–	–	–	•	–	•	–	–	•	–	–	–
Fabaceae	–	–	–	–	–	•	–	–	•	–	–	–
Lotus corniculatus	•	–	–	–	–	–	–	–	–	–	–	–
Lotus pedunculatus	•	–	•	•	–	–	•	–	–	–	–	•
Lythrum	•	•	–	•	–	•	–	•	–	–	•	•
Mentha type	–	•	–	–	–	–	–	–	–	•	•	–
Polygonum aviculare	–	–	–	–	–	•	•	–	–	–	–	–
Pulmonaria type	–	•	–	–	–	–	–	–	–	–	–	–
Ranunculus	•	–	–	•	–	•	–	•	–	•	–	–
Ranunculaceae	–	–	–	•	–	–	–	–	–	–	–	–
Rumex acetosa type	•	–	-	•	–	–	–	–	–	–	–	–
Sanguisorba officinalis	–	–	–	–	–	•	–	–	–	–	–	–
Thalictrum	•	–	–	•	–	–	–	•	–	–	–	–
Vicia type	•	•	–	–	–	–	•	–	•	–	–	–
Polypodium	•	–	–	•	•	•	•	•	–	–	•	•
Pteridium	•	•	–	•	•	•	•	•	–	–	–	–
Sphagnum	•	–	•	•	•	•	•	•	–	•	–	–
Triletae psilatae	•	•	•	•	•	•	•	•	•	–	–	•
Acritarchs	–	•	•	•	•	•	–	•	–	•	•	•
Diatoms	–	–	–	•	–	•	–	–	•	–	–	•
Foraminiferae	•	•	•	•	•	•	•	•	•	–	–	•
Neurospora ascospore	–	–	–	–	•	–	–	–	–	–	–	–
Tetraploa aristata	–	–	–	–	–	–	–	–	–	•	•	–
Tilletia	•	–	•	•	–	–	–	–	•	–	–	–
Ustulina ascospore	–	–	–	–	–	–	–	•	–	–	-	–
Units only												
Veronica	•	–	–	•	–	•	•	•	.	.	.	.
Dinoflagellatae	–	–	–	–	–	•	–	–	.	.	.	.
wells only												
Calystegia	.	.	.	.	.	.	.	.	–	–	–	•
Filipendula	.	.	.	.	.	.	.	.	•	•	•	•
Humulus	.	.	.	.	.	.	.	.	–	–	•	–
Polygonum persicaria type	.	.	.	.	.	.	.	.	–	–	–	•
Pediastrum	.	.	.	.	.	.	.	.	–	–	–	•
Gelasinospora ascospore	.	.	.	.	.	.	.	.	–	–	–	•

Table 18.1 Pollen types not included in the diagrams.

18.3.2 Diagram Schipluiden 16 South

Schipluiden 16 South, which relates to Units 19 (clay) and 10 (peat), is quite similar to the above diagram. The stage in which the area was covered with sedges is not represented, presumably because the part of the peat concerned had already been removed by the time the samples were taken. The only element not encountered in the Schipluiden 40 diagram is Cerealia pollen. The characteristics of such pollen are a size of >36 μ, a large pore, an annulus with a thickness equal to the diameter of the pore and a distinct boundary between the annulus and the body of the grain. A few other Poaceae pollen grains had a similar size but lacked the other features. Some Cerealia are represented in the salt marsh deposit. A modest peak in the part of the diagram represent-ing the phase of peat growth must be associated with occupation phase 3. This implies that cereals were processed on the dune. Whether they were only threshed there or were actually grown there remains unclear. The kinds of cereals known at this time are poor pollen releasers. Most of the pollen of those cereals is released during rough handling of the crop.

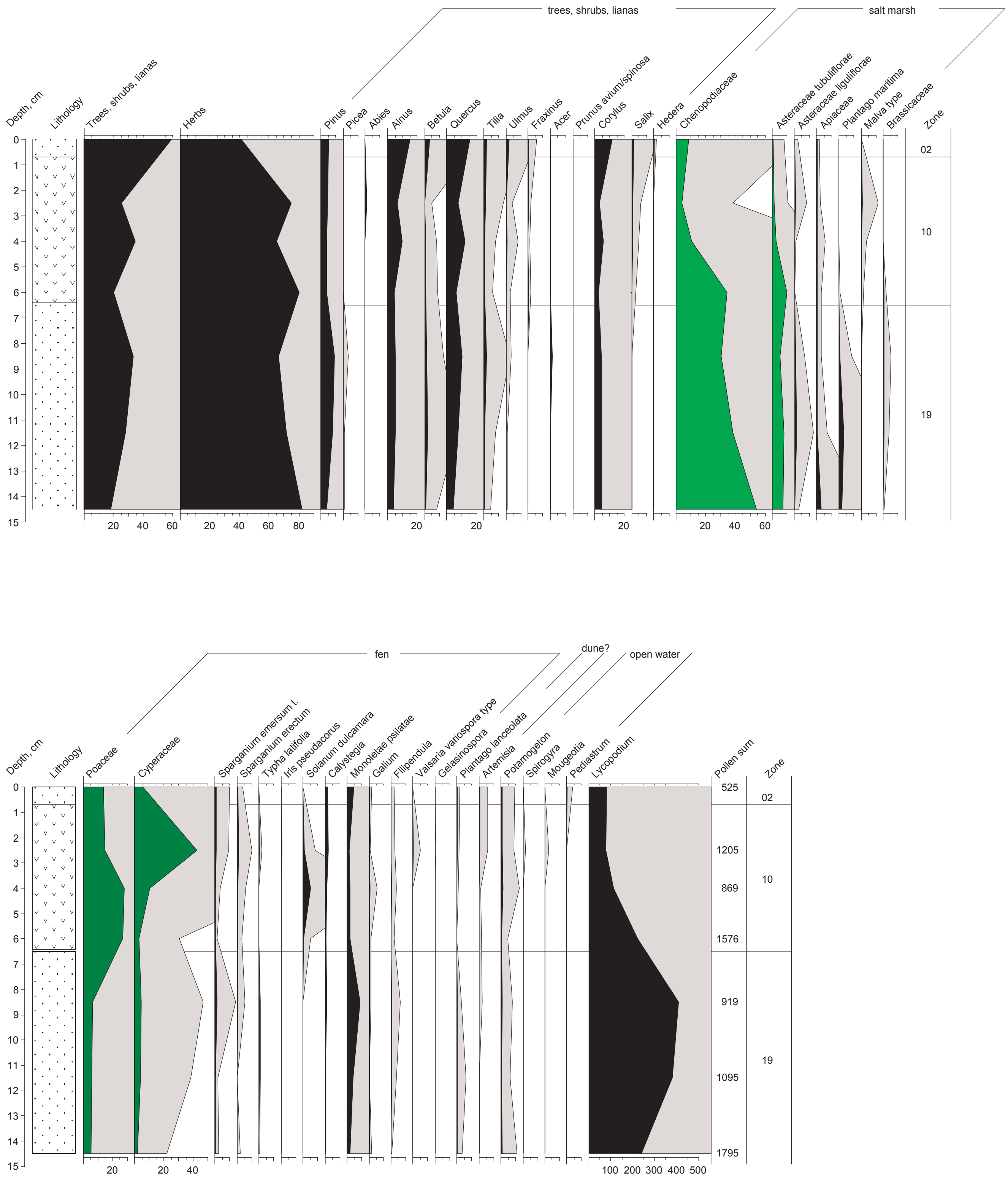

Figure 18.2 Pollen diagram Schipluiden 40. Percentages (black) and percentages 10× (grey). Dominant local pollen taxa indicated in colour.

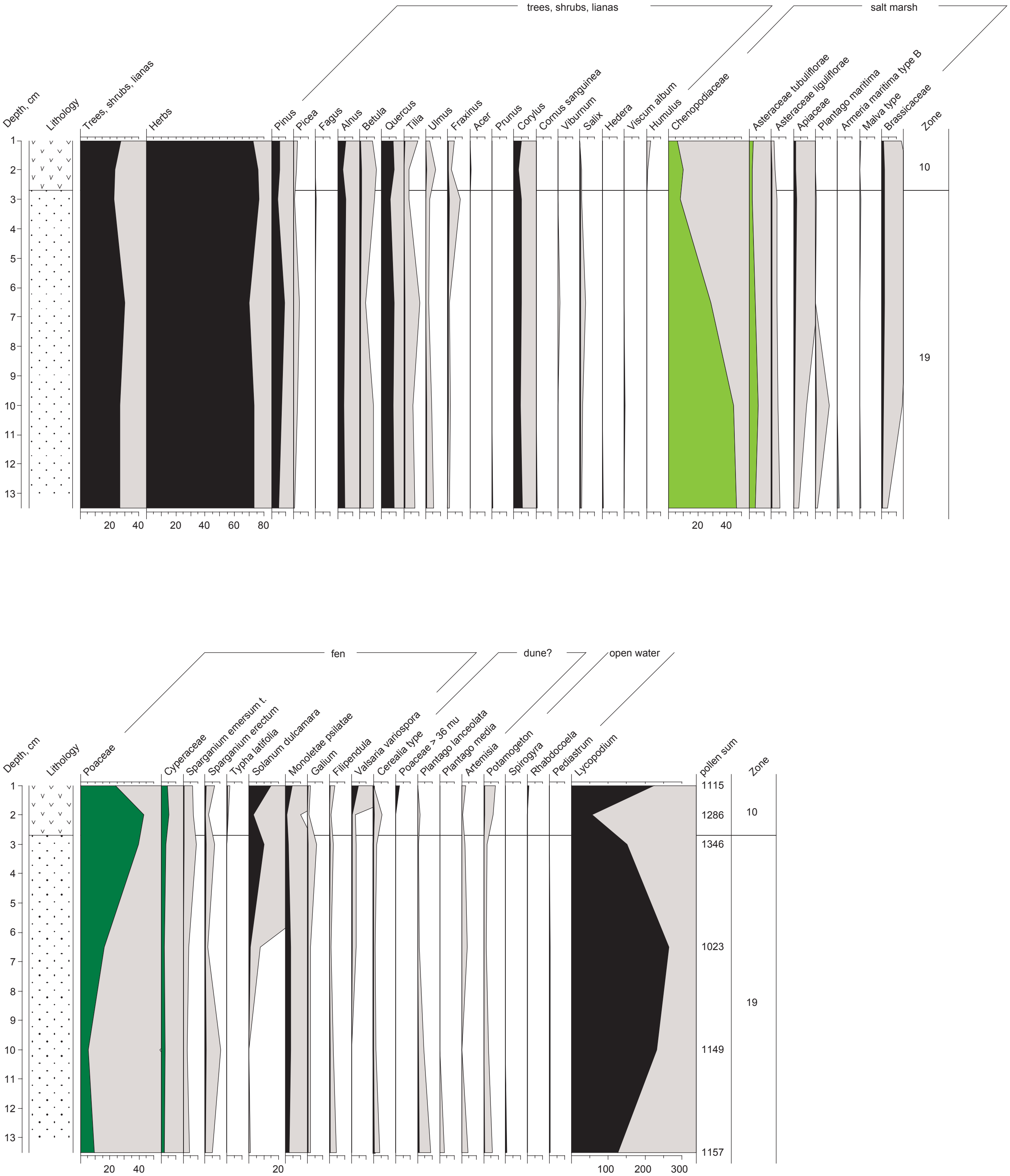

Figure 18.3 Pollen diagram Schipluiden 16 South. Percentages (black) and percentages 10× (grey). Dominant local pollen taxa indicated in colour.

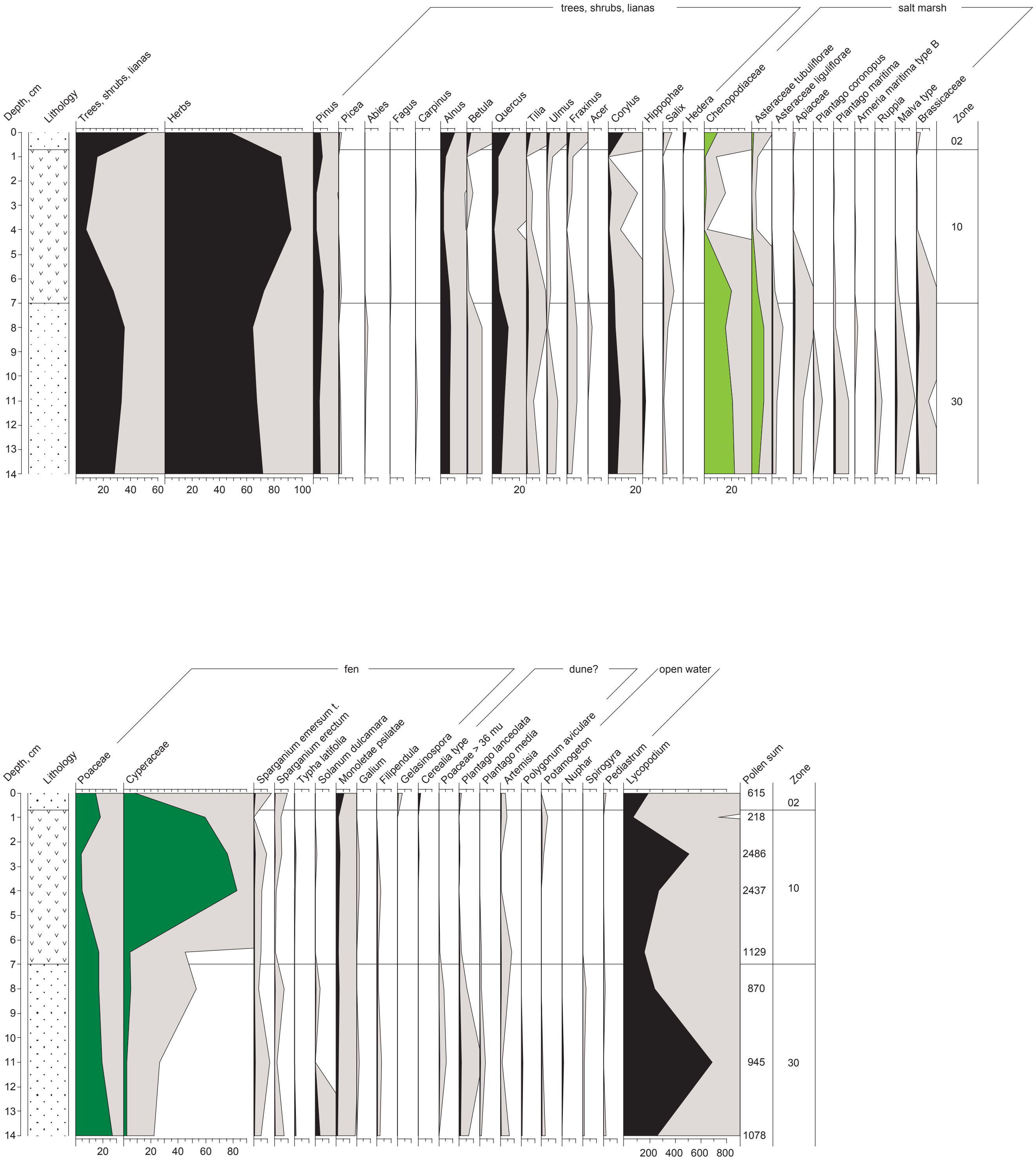

Figure 18.4 Pollen diagram Schipluiden 16 North. Percentages (black) and percentages 10× (grey). Dominant local pollen taxa indicated in colour.

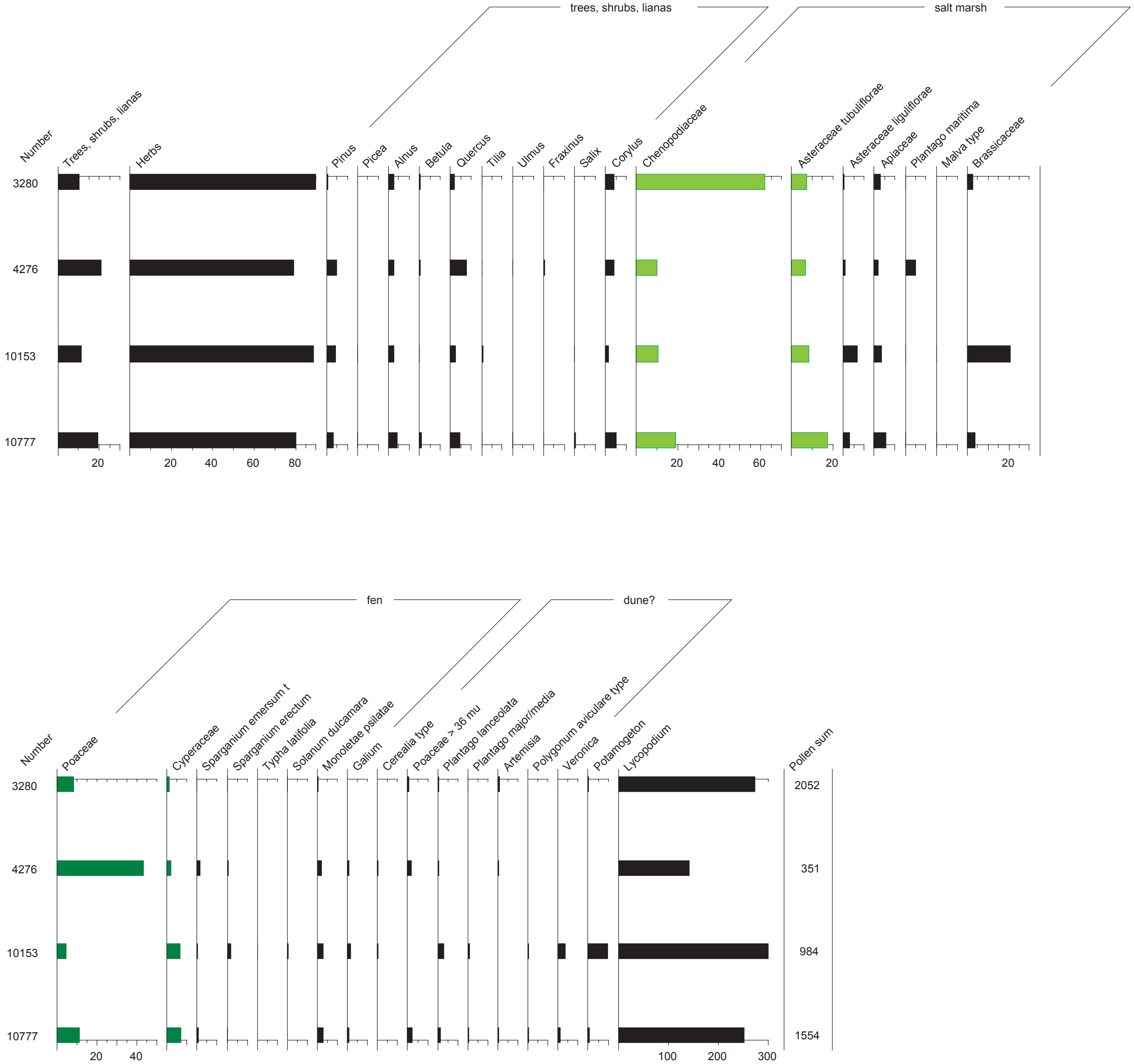

Figure 18.5 Pollen spectra obtained for the fills of the wells. Dominant local pollen taxa indicated in colour.

18.3.3 Diagram Schipluiden 16 North

The other side of the dune is represented by diagram Schipluiden 16 North, relating to Units 30 (clay) from occupation phases 1-2a, 10 (peat) from phase 3, and 2 (clay). The diagram shows the same kind of vegetation as revealed by the diagrams obtained for the southern side. *Ruppia* points to salt or brackish open water in depressions on the salt marsh or in nearby environments, from which it may have been transported by occasional floods. The *Malva*-type pollen in this diagram is at least partly released by *Althaea officinalis*. This tall herb and the shrub *Hippophae* are characteristic of the lower parts of dunes which are only flooded by salt water during extremely high tides. In the other diagrams *Malva*-type pollen is not associated with the salt marsh, but – in

Schipluiden 40 at least – with the peat, and the pollen grains were not clearly *Althaea*-like. The vegetation may be characteristic of the foot of the northern slope. There seems to have been no brackish peat-forming vegetation comprising *Phragmites*. This impression may however be attributable to the counting of an insufficient number of spectra. The peat was very compressed; the pollen zone containing Poaceae may have been overlooked.

18.3.4 Unlined wells

It was hoped that the missing information concerning the vegetation on the dune itself would be provided by the samples from the bases of the fills of the (unlined) wells. Four of those samples were analysed, all from the northwestern group and all dating from phases 1-2a. The results are shown in figure 18.5 and table 18.1. It should be borne in mind that the pollen retrieved from such features will not all have been released by the surrounding vegetation. Many pollen grains will have made their way into the wells along with plant matter thrown into the wells by the occupants or with the dung of their cattle. The samples nevertheless show an almost complete absence of trees and shrubs. There is no evidence suggesting that any insect-pollinated trees or shrubs, or trees or shrubs producing little pollen grew close to the wells. If such trees and shrubs were present, some of their pollen would have been found. One well sample (no. 3280) was dominated by Chenopodiaceae. This well was also sampled for the presence of macro-remains. It was found to contain many remains of a rich brackish, ruderal flora comprising Chenopodiaceae (see also chapter 19, sample 12). These remains are in accordance with the pollen. Poaceae pollen dominated a sample from another well (no. 4276). The same sample contained pollen of *Plantago maritima*, but also that of *Sparganium erectum*. These plants do not grow together. A third well sample (no. 10,153) contained mainly Brassicaceae pollen (see chapter 19, sample 21, for the fairly undifferentiated macro-remains recovered from this well), while a fourth (no. 10,777) yielded pollen of Poaceae, Asteraceae tubuliflorae and Chenopodiaceae. When the latter sample was being prepared for pollen analysis it was found to contain macro-remains of *Salicornia*. Except for the alga *Spirogyra* in the second sample and *Potamogeton* and some diatoms in the third one, plants that may have grown in the water in the well are absent, indicating that the wells were indeed short-lived, as suggested in chapter 3, section 3.4.2.

18.3.5 Conclusion based on the pollen from waterlogged sediments

The conclusion that can be drawn from the pollen contained in the waterlogged sediments is that the dune was in the first occupation phase on both sides surrounded by a low-lying salt marsh. After a period without deposition the salt marsh vegetation gave way to actively growing peat – first of all (in occupation phase 3) reed peat, at least on the south side, and later sedge peat. As far as can be concluded from the pollen diagrams, there were no significant bodies of open fresh water on or nearby the dune. The dune itself was treeless. The wells that were dug on the dune were not sufficiently long-lived to allow the development of an established vegetation of water plants. The resolution of the diagrams is too low to allow any statements to be made about human influence on the local vegetation.

18.4 THE COPROLITES

Pollen in coprolites to some extent reflects the environment in which the producer spent its day, or the days before (Vermeeren/Kuijper 1993). Ingested with food, drunk with water or inhaled, pollen passes the intestines fairly undamaged. Cattle dung contains pollen from feed, from drinking water and from the air. It is possible for pollen to stay in the gut for several days or more, and individual coprolites are not assumed to represent a single meal or a single day. As cattle roamed freely in the near and far surroundings of the dune, their dung may contain more extra-local pollen than the sediment formed on the sides of the dune. The same is true of the droppings of omnivores such as dogs and humans. The analysis of coprolites may therefore yield additional information on the environment.

The Schipluiden coprolites were grouped into three categories – a flat type a, a smaller flat type b and a cylindrical type c – with subdivisions, which were attributed to cattle, possibly cattle and dog/human, respectively (fig. 17.1). Within category c, a subtype, c-large, was distinguished: a cylindrically shaped coprolite with a large diameter possibly deriving from a human (see chapter 17). Two coprolites of type a, two of type b, two of the smaller type c and two c-large coprolites were selected for pollen analysis. Three date from phases 1-2a, three from phase 2b and two from phase 3. Their findspots are shown in fig. 18.1. Table 18.2 presents the results of the analysis. The counting was time-consuming due to the presence of tiny charcoal particles. This explains why fairly little pollen was counted. Nevertheless, the results are assumed to represent the contents well, although some rarer pollen types may have been missed. Special attention was paid to the detection of remains of coprophilous fungi such as *Cercophora*, *Sordaria*, *Podospora*, *Bombardioidea* and *Sporormiella*, but none were observed.

To be noted is the low concentration of pollen encountered in numbers 8809 and 2728. The first is a coprolite of type b and the second is one of type c/c3. These low concentrations are clearly not associated with the kind of producer. What distinguishes these two coprolites

Unit	17	17	10	16	15	15	10	23
phase	2a	2a	3	2b	2b	2b	3	1?
find number	8809	2728	5856	2755	8239	8230	7965	9408
type	b	c/c3	a	c-large	b	a	c-large	c2
no. in graphs	1	2	3	4	5	6	7	8
Pinus	7.4	2.3	`9.1	2.9	–	3.0	–	0.7
cf Juniperus	2.1	2.3	1.1	0.7	–	–	–	1.1
Quercus	5.3	7.0	6.9	2.2	1.9	–	–	3.6
Tilia	1.0	–	–	–	–	–	–	–
Ulmus	–	–	–	0.7	–	–	–	0.7
Fraxinus	–	–	0.6	–	–	–	0.8	–
Prunus	4.2	–	0.6	2.9	–	–	–	0.4
Betula	–	–	–	1.4	–	1.5	0.8	0.7
Hippophae	–	–	–	0.7	–	–	4.2	–
Sambucus	–	–	–	–	–	–	1.7	–
Rhamnus	–	–	–	0.7	–	–	–	–
Populus	–	–	–	–	–	1.5	0.8	–
Corylus	2.1		8.6	6.5	11.1	3.0	7.6	14.3
Alnus	7.4	41.9	6.9	15.8	3.7	11.9	16.1	25.1
Salix	1.0	–	–	–	–	–	–	0.7
Humulus	–	–	–	–	–	–	–	0.4
Poaceae	20.0	16.3	31.4	32.4	13.0	10.4	13.6	36.2
Poaceae >36μ	–	–	–	2.9	–	–	–	–
Hordeum t.	–	2.3	–	–	–	–	–	–
Cerealia	–	–	–	–	–	10.4	–	1.4
Cyperaceae	13.7	2.3	9.1	2.2	7.4	1.5	2.5	0.7
Apiaceae	1.0	–	–	1.4	1.9	–	–	–
Artemisia	–	–	1.7	3.6	–	3.0	–	–
Asteraceae tubuliflorae	5.3	7.0	1.1	10.1	3.7	1.5	0.8	1.1
Asteraceae liguliflorae	–	–	1.1	0.7	–	1.5	0.8	–
Brassicaceae	–	2.3	3.4	1.4	16.7	28.4	5.1	–
Caryophyllaceae	–	–	–	–	–	1.5	–	–
Chenopodiaceae	6.3	2.3	8.0	2.9	9.3	10.4	2.5	9.7
Euphorbia	–	–	–	0.7	–	–	–	1.4
Euphrasia	5.3	–	–	–	–	–	–	–
Filipendula	–	2.3	–	0.7	–	–	34.7	–
Galium t.	1.0	–	–	–	1.9	–	–	–
Plantago coronopus	–	–	–	–	1.9	–	–	0.4
Plantago lanceolata	–	–	–	–	13.0	3.0	–	–
Plantago maritima	1.0	–	0.6	–	–	1.5	–	–
Polygonum aviculare	1.0	–	–	–	–	–	–	–
Potamogeton	–	2.3	1.1	–	9.3	1.5	1.7	0.7
Ranunculus aquatilis t.	3.2	2.3	–	–	–	3.0	–	–
Rumex acetosella	2.1	–	–	–	–	–	–	–
Rumex aquaticus t.	–	–	–	1.4	–	–	–	–
Solanum dulcamara	–	–	–	0.7	–	–	3.4	–
Sparganium emersum t.	–	2.3	–	–	3.7	–	0.8	–
Spergularia	1.0	–	1.1	0.7	–	–	–	–
Trifolium	–	–	0.6	–	–	–	0.8	0.7
Typha latifolia	2.1	–	–	–	–	–	–	–
Urtica	–	–	–	–	–	–	0.8	–
Monoletae psilatae	6.3	4.7	4.6	3.6	1.9	–	–	–
Polypodium	–	–	0.6	–	–	–	–	1.1
Triletae reticulatae	–	–	–	–	–	1.5	–	–
Equisetum	–	–	–	–	–	–	–	0.4
Sphagnum	–	–	1.7	–	–	–	–	–
Pollen sum	95	43	175	139	54	67	118	279
Concentration/cc	2804	1257	11764	6728	17195	11922	3449	20095
Diatoms	1	–	1	–	2	19	–	4
Spirogyra	1	–	–	–	–	1	–	–
Hystricosphaeridae	2	–	–	–	–	–	–	2
Assulina	–	–	–	–	–	–	–	1

Table 18.2 Coprolites: pollen spectra based on a Total Pollen sum. Diatoms, *Spirogyra*, Hystricosphaeridae and *Assulina* are not included in the sum and are presented by the actual numbers counted.

from the others is the sediment in which they were found: the top of the salt marsh deposits. Five of the other coprolites came from the peat deposits and one from the fill of a well. This observation raised the question whether the pollen in the coprolites corresponds to that contained in the original droppings. When droppings are still soft, beetles often dig holes in them. Vegetation can penetrate the matter and leave pollen and, after the plants' decay, holes, too. Such holes were indeed observed in the coprolites, especially in those of types a and b. They were avoided during the sampling. But although the samples were taken from the most compact parts of the coprolites and were thoroughly cleaned, there was still a possibility of the pollen contained in them being secondary and not primary. To test this, the pollen contents of the coprolites were compared with the pollen spectra obtained for the sediments in which they were found. This was done by means of Principal Components Analysis (PCA) and Correspondence Analysis (CA) using CANOCO 4 (Ter Braak/Smilauer 1998). The latter analysis was executed because the data displayed a barely normal distribution, which is a drawback for PCA. In both cases the pollen in the coprolites was found to differ from that in the matrices in which the coprolites were embedded.

The second question was whether the distinguished types of coprolite also differed from one another in their pollen contents – whether, say, type a, assumed to derive from cattle, differed from type c-large, assumed to derive from a large dog or even a human being, to give the two extremes. No such differences are immediately observable in the table. Differences between the types are observable only along the second PCA axis (fig. 18.6a). Differences are even less clearly observable in the CA results (fig. 18.6b).

The position of one type c-large in the plot differed from the other positions. The separation is based on *Filipendula*, *Hippophae*, *Solanum dulcamara* and *Sambucus*. The last three all have edible berries (the *Solanum dulcamara* berries are not poisonous when ripe). The berries of the different species ripen in the same season. Although Vermeeren and Kuijper (1993) showed that the season of consumption cannot usually be inferred from pollen in coprolites, this case may be one of the exceptions. Did the producer eat berries in the late summer?

The two a and b types on the lower right in the PCA plot and in the upper right in the CA plot are characterised by pollen of *Plantago lanceolata,* Cerealia, Chenopodiaceae and *Potamogeton*. The animals may have fed on the stubble of a cereal field and drank fresh pond water. *Plantago lanceolata* and Chenopodiaceae are in this case assumed to have formed part of the weed flora. The other coprolites yielded no such information.

18.4.1 *Conclusion*

The first axis in the PCA plot is tentatively assumed to represent the former environment. What is clear from this axis is that the tree and shrub species characteristic of dune vegetations were actually scarce in the surroundings of the

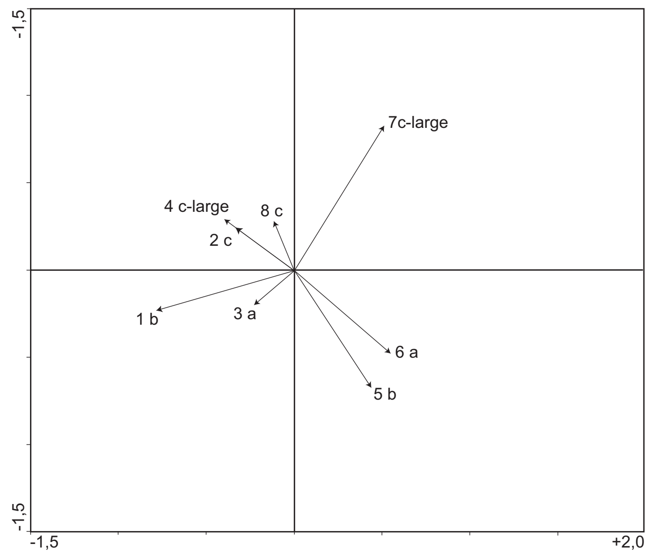

Figure 18.6a PCA analysis of coprolites, log transform.

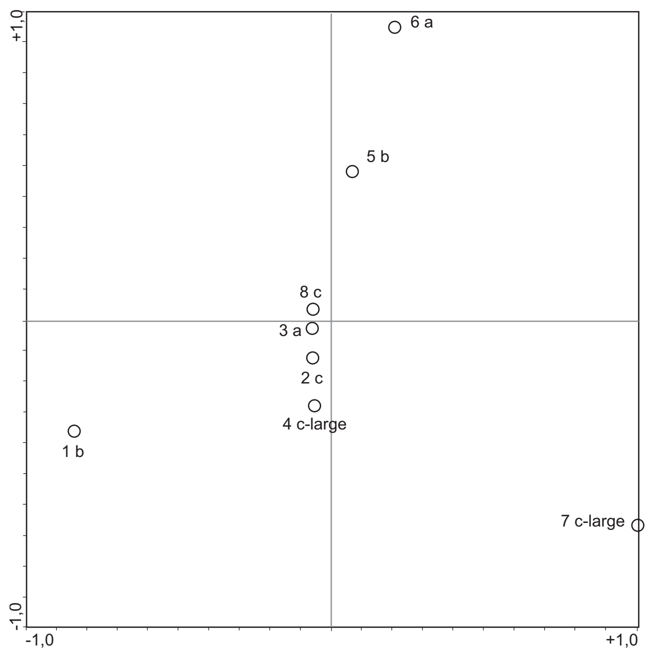

Figure 18.6b CA analysis of coprolites, log transform.

Schipluiden site. Even if we assume that tree pollen is underrepresented in dung because dung producers will not have eaten any parts of flowering trees, if there were any trees in the area visited by the dung producers, a small quantity of tree pollen would nevertheless have made its way into the dung via tree pollen adhering to consumed herbs and suspended in drinking water (see for instance Carrion *et al*. 2000). The coprolites therefore confirm the conclusion based on the pollen diagrams and spectra obtained for the well fills, which is that there were no trees at the site, and that trees were possibly also scarce in its immediate surroundings. Some of the coprolite producers seem to have visited areas where *Alnus* grew. There may have been stands of alder trees at some distance from the site. If the information based on two coprolites is to be trusted, it suggests that crops were grown somewhere near the site.

A sample of only eight coprolites is fairly small, so our interpretations may be somewhat premature. More coprolites need to be investigated. The first axis may moreover represent the matrices containing the coprolites rather than the original dung. The low pollen contents of the two coprolites from the salt marsh still need to be explained. The investigations are being continued.

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