4 Botanical macroremains

4.1 Introduction

"Botanical macroremains" is a somewhat euphemistic expression covering all botanical remains that can be detected by means of a stereo-microscope with moderate magnifications (up to ca. 25 ×). Since wood has been included in the previous chapter, it is excluded here.

Botanical macroremains give information on a scale quite different from pollen diagrams and wood. Where pollen diagrams provide knowledge on a large area, without great detail, the analysis of botanical macroremains in general furnishes more detailed data about the vicinity of the sampling sites. Wood remains present information on a scale comparable to pollen diagrams, with the restriction that wood spectra are strongly influenced by human selection (see also *ch. 3*).

Since the sampling sites discussed here are all former human settlements, especially the ruderal vegetations present around the houses is encountered. Crops and refuse from crop-processing, the so-called by-products, also play an important role.

When dealt with in a general sense, botanical macroremains (seeds, fruits, stems, leaves, etc.) will hereafter be referred to as "seeds". An archaeological presentation of the sites discussed in the present study is included in paragraph 1.3.1. The location of the sites studied for botanical macroremains is indicated in figure 28.

4.1.1 Methods

Usually botanical macroremains are sampled during the archaeological excavation on a site. In the present study, some alternative sampling strategies were applied. As no Late Iron Age sites were excavated on Voorne-Putten until October 1990 and the excavation of the Late Iron Age site of Rockanje 08-52 could not be foreseen in the preceding period, it was decided to sample some Late Iron Age sites in a different way.

The sites concerned have become known through surveys only. Pottery remains and other indications of former habitation were discovered in the banks of ditches that cut through the sites. Samples were obtained from banks in the section near the water level. By sampling in the slopes of ditches, archaeologically dated samples for macroremains were obtained. Of course, these samples do not provide a detailed knowledge of the archaeological contexts, which would be available after excavation. Thus, the location of the samples in relation to the building is unknown.

A related way of sampling was applied to one Middle Iron Age site (Geervliet 17-55). Here, the samples from banks did not provide satisfactory results. Sampling by means of a corer for taking peat samples (Ø 6 cm) did yield material which was too deep beneath the water level for sampling along the ditch. However, only seven of these unconventionally obtained samples are presented here, against about one hundred samples from excavations.

On the excavated sites, the habitation layers were present below the water table, the so-called "*Feuchtboden-Siedlungen*" *sensu* Willerding (1971, 1991). As a consequence, the remains have been preserved in anaerobic, waterlogged conditions. This allows excellent conservation of organic material, such as seeds and wood. In contrast, on sites situated above the water table (upland-sites; "*Trockenboden-Siedlungen*"), only carbonized remains have stood up to the ravages of time.

After sampling, and sometimes after years of storage in plastic bags, the material was washed carefully with water over a series of sieves with decreasing meshes down to 0.25 mm. The smallest recovered macroremains, held by a sieve with a 0.25 mm mesh, are hardly visible to the naked eye. Even with this size of mesh, seeds of some plant species pass through the sieve. Using a still smaller size of mesh would, however, soon cause blocking of the sieve. This makes the use of these meshes extremely time-consuming. In practice, with the smallest meshes of 0.25 mm the point of diminishing returns seems to be reached. Because of the waterlogged preservation of the botanical remains, flotation techniques are less appropriate, as they mainly reveal carbonized remains. Furthermore, flotation produces severe bias, e.g. against grain chaff in comparison to kernels (G.E.M. Jones 1986).

After sieving, a short inventory was drawn up to facilitate subsequent selection of the samples to be further analysed. From each sieve fraction, one teaspoonful of material was examined under the microscope. The species present were registered, together with a general impression of the preservation condition of the material. The seeds on the coarsest sieve could often be detected with the naked eye, so the

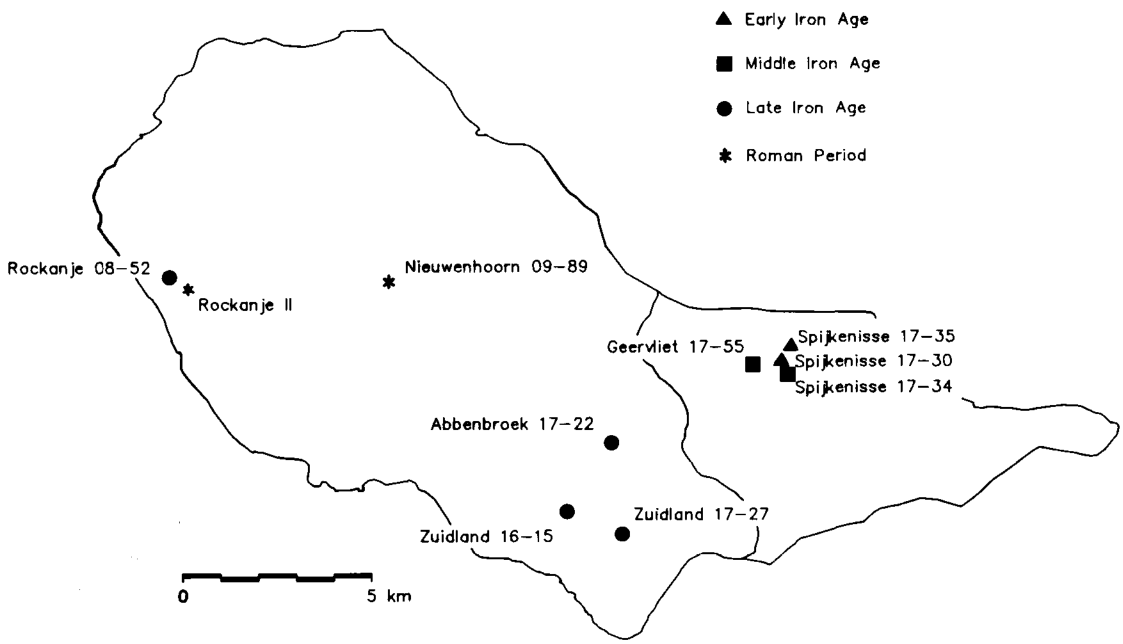


Fig. 28 Location of the sites studied for botanical macroremains on Voorne-Putten, scale 1:2000.

presence of grain kernels and other large seeds was often perceived. These observations enabled the final selection of samples to be analysed. Subsequently, the samples were stored in plastic bags, in water with some formaldehyde added. The samples were always kept wet to avoid damaging the fragile, waterlogged material.

In the final examination, the sample fractions were studied individually with a Wild M5 stereo microscope (magnification up to 50 ×). All remains which could potentially be identified were picked out and later identified, sorted and counted if possible. Large sample fractions were only partly examined. The numbers were then multiplied corresponding to the part analysed. Of the smallest fraction (0.25-0.5 mm), often only 1/16 or 1/64 was examined. Even a few teaspoonfuls sometimes contained hundreds of seeds, mainly of rushes (*Juncus* spec.).

The identification of macroremains was greatly facilitated by descriptions published earlier. These valuable sources of information are especially numerous in the German palaeoethnobotanical literature (see also the references in Appendix I). The reference collection of the botanical laboratory of the I.P.L. was also of great value. Grass- and rushseeds were mounted on microscope slides in gummisyrup to allow identification with a high-power light-transmitting microscope (Leitz Dialux, magnification 400-1600 ×).

After identification and counting, the mostly uncarbonized remains were stored in a mixture of water and glycerine (both 50 vol-%), with the addition of 5 mg phenol per litre. Lists of taxa and quantities were stored in a computer to facilitate sorting and calculations.

4.2 Previous studies of botanical macroremains from Voorne-Putten

Analyses of botanical macroremains of Iron Age and Roman sites on Voorne-Putten have hardly been done before the present study. Bakels (1986) mentioned one impression of a cereal grain, gnawed at by a wood mouse (*Apodemus sylvaticus*), from the Early Iron Age site of Rotterdam-Hartelkanaal 10-69 (see *fig. 29*). This site yielded several other impressions. Eight of these belonged to *Hordeum vulgare*, other taxa could not be demonstrated. Seven of the grains were still enclosed by their chaff. The grain gnawed at by the mouse was also barley (Bakels *pers. comm.*).

4.3 The present study of botanical macroremains

In the framework of the present study, organically tempered pottery from Spijkenisse 17-34 (33 sherds) and Abbenbroek 17-22 (13 sherds) did not reveal identifiable plant remains. Some sherds from Geervliet 17-55 were presented to me by archaeologists of the B.O.O.R. They appeared to be abundantly tempered with the silicles of *Camelina sativa* (gold of pleasure; see *fig. 30*).

These scanty data on pottery impressions are supplemented substantially by the analysis of waterlogged and carbonized plant remains. They did not only produce a

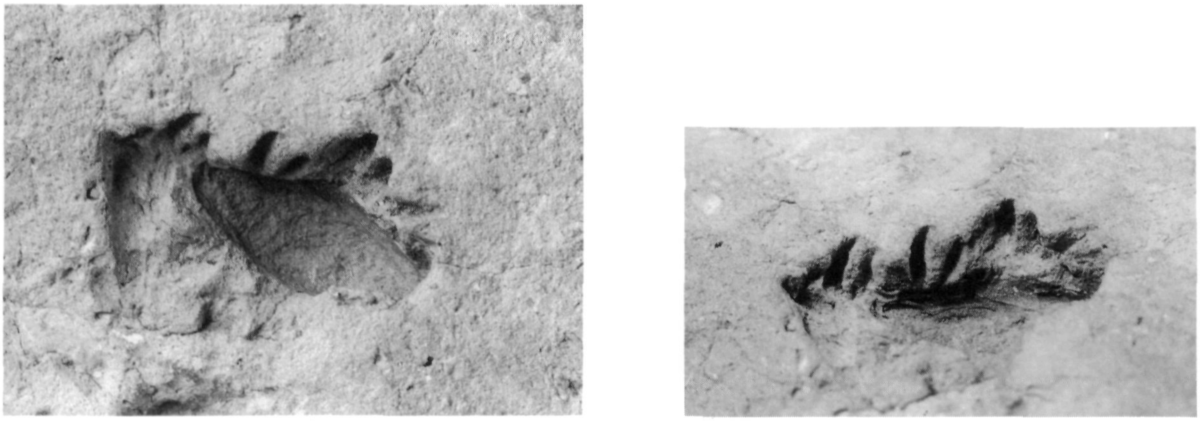


Fig. 29 Barley grain from Rotterdam-Hartelkanaal 10-69, gnawed at by a wood mouse.

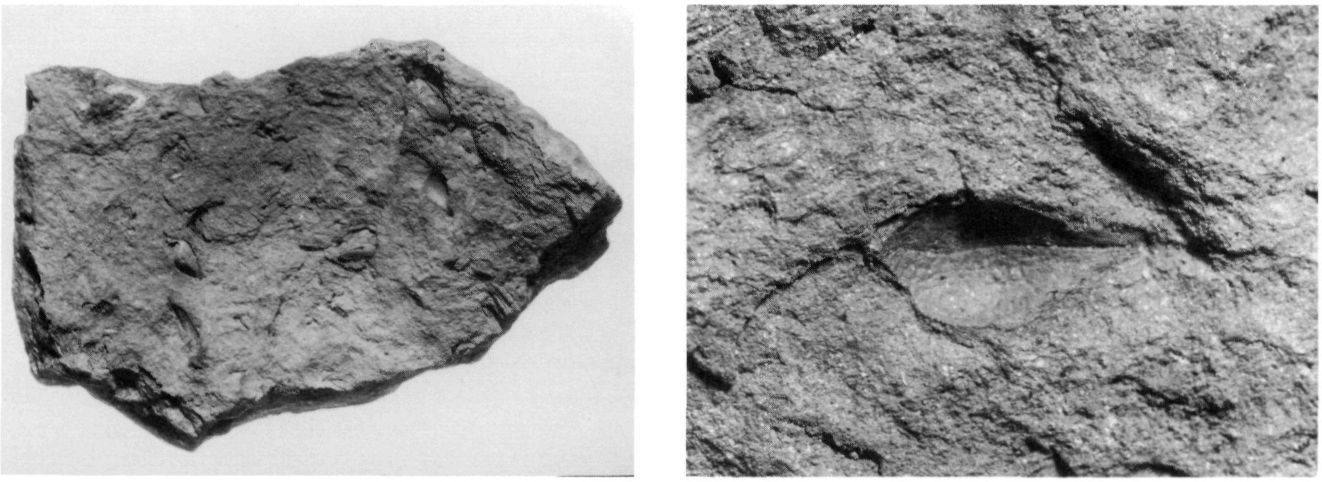


Fig. 30 Pottery from Geervliet 17-55 tempered with silicles of *Camelina sativa* (1.5 and 8x).

range of cultivated plants, but also attested to gathering of wild species for human consumption. Moreover, a range of other elements of the natural as well as the anthropogenically influenced vegetations surrounding the sites were found. The botanical macroremains of the following sites have been studied: Rotterdam-Hartelkanaal 10-69, Spijkenisse 17-30 and 17-35 (Early Iron Age); Spijkenisse 17-34, 17-35 and Geervliet 17-55 (Middle Iron Age); Abbenbroek 17-22, Zuidland 16-15 and 17-27 and Rockanje 08-52 (all Late Iron Age); and Nieuwenhoorn 09-89 and Rockanje II (Roman Period). The location of these sites is indicated in figure 28. It appears that all Early and Middle Iron Age sites studied are concentrated around the Bernisse on Putten, while the Roman sites are situated in the western part of Voorne. Only the Late Iron Age sites are both on Voorne and on Putten. It should be noted that one native Roman site along the Bernisse has also been excavated, viz. Simonshaven 17-24. Unfortunately, however, the conditions for preservation on this site were much worse than on all the other sites studied. Moreover, the site also produced medieval remains, which could not be separated stratigraphically with certainty from the Roman ones (Van Trierum *pers. comm.*). It was therefore decided not to analyse samples from this site.

Below, first the cultivated, then the gathered species will be discussed and finally the remaining plant remains. The raw data underlying the following paragraphs are presented in tables 17-24.

4.4 Cultivated plants

To facilitate comparisons, the material in this paragraph has been arranged per taxon and not per site. The corresponding tables have been arranged according to periods.

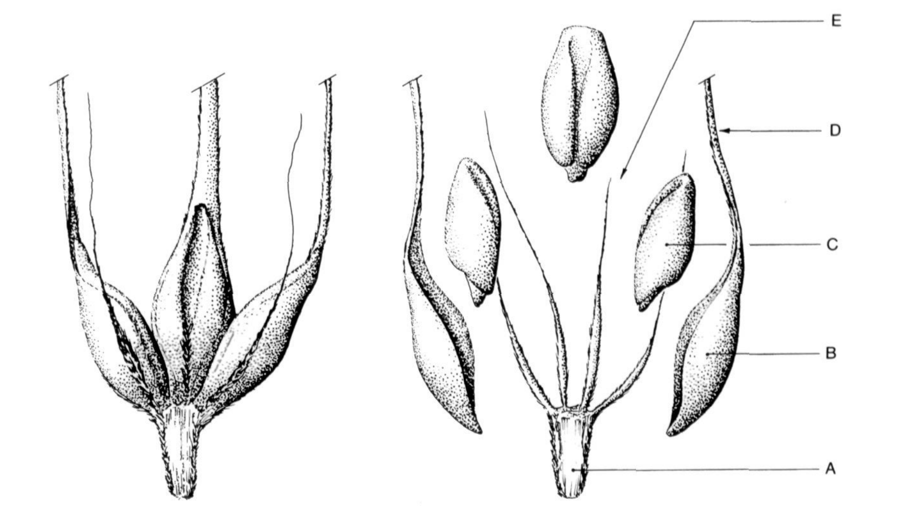


Fig. 31 Habitus of *Hordeum vulgare vulgare*. A = rachis internode; B = lemma; C = grain; D = awn; E = glume.

4.4.1 HORDEUM VULGARE VULGARE (HULLED BARLEY)

In barley, several species, varieties and forms occur. Since only some of them can be cultivated in coastal areas (see *ch. 6*), the differentiation of these taxa is highly relevant. The following introduction, mainly based on Van Zeist's (1970) publication, may help the non-botanist (see also *fig. 31*).

In cereals, the ears are composed of a central rachis, which bears one spikelet on every rachis internode. In barley, each rachis internode bears three florets per spikelet. In two-row barley (*Hordeum distichum*), only the central florets are fertile, giving rise to symmetric kernels. In four- and six-row barley (*Hordeum vulgare*), the lateral florets are also fertile. Kernels developing in these lateral florets are asymmetric (lopsided, "*Krummschnäbel*"). In both species occur naked as well as hulled varieties. In the hulled varieties (var. *vulgare*), the glumes tightly envelop the grains. Consequently, the grains are angular in cross section, which is also apparent when the glumes have disappeared. In naked barley (var. *nudum*), the grains are not tightly hulled by the glumes and the cross section is more rounded. Naked barley grains also have a shrivelled skin (cf. Van Zeist 1970: 49-50). The erect, dense-eared six-row barley and the nodding, lax-eared four-row barley can be distinguished by the length of the rachis internodes and (to a lesser extent) by their grains. In uncarbonized material, six-row barley internodes are shorter than 2.5 mm, in four-row barley they are longer. As a result of carbonization, the internodes shorten (cf. Behre 1983: 16-19). The first few internodes of four-row barley that do not bear grains, are also shorter than 2.5 mm. Some short internodes in a sample where long ones predominate is thus no proof of an admixture with six-row barley.

Since the spikes are more condensed in the dense-eared six-row variety, the lateral grains are forced sideways, whereas in four-row barley, they are more twisted towards the central axis. Consequently, lopsided specimens of four-row barley are more asymmetric than six-row ones. Furthermore, the length/width ratio of the grains is smaller than 1.8 in six-row and larger in four-row barley (Knörzer 1970: 26).

All the barley grains and internodes found in the samples studied here can be attributed to hulled, four-row barley (*Hordeum vulgare* var. *vulgare* fo. *tetrastichum*). Barley is the most common cereal on nearly all sites. The most prominent exception is the Early Iron Age site of Spijkenisse 17-30, where barley is completely absent (see *table 10*). This table further shows distinctly higher quantities of barley remains during the Roman Period, and to a lesser extent in the Late Iron Age.

In almost all the excavated sites (where contexts are known), carbonized barley grains occur mainly in the hearths. Uncarbonized internodes on the other hand predominate in dung (Rockanje 08-52) or in floors (Rockanje II and Spijkenisse 17-34).

4.4.2 *TRITICUM* DIV. SPEC. (WHEAT)

The genus of wheats (*Triticum*) comprises several species. They can be subdivided into glume wheats, in which glumes tightly hull the kernels, and species with naked grains, which easily fall out of the glumes when ripe. Naked wheats are also referred to as free-threshing. The three glume wheat species of einkorn (*Triticum monococcum*), emmer (*T. dicoccum*) and spelt (*T. spelta*) are respectively diploid, tetraploid and hexaploid in their number of chromosomes. The most important naked wheats in western Europe are bread- and

Table 10. The occurrence of *Hordeum vulgare*. Quantities and, in brackets, frequencies per context per site.

		Carbonized			Uncarbonized	
		grain	internode	awn-fragm.	grain	internode
Early Iron Age:						
Sp. 17-30:	total (9)	—	—	—	—	—
Sp. 17-35:	total (5)	2 (2)	2 (1)	—	—	—
hearth (1)	—	—	—	—	—	
	dung (3)	1 (1)	2 (1)	—	—	—
	refuse (1)	1 (1)	—	—	—	—
Middle Iron Age:						
Sp. 17-34:	total (19)	29 (6)	85 (8)	10 (4)	1 (1)	8 (3)
	hearth (3)	23 (2)	—	1 (1)	—	2 (1)
	floor (1)	1 (1)	—	4 (1)	1 (1)	5 (1)
	dung (6)	5 (3)	40 (4)	—	—	—
	ditch (9)	—	45 (4)	5 (2)	—	1 (1)
Sp. 17-35:	total (3)	4 (1)	18 (1)	—	—	3 (1)
	refuse (3)	4 (1)	18 (1)	—	—	3 (1)
Gv. 17-55:	total (3)	13 (3)	16 (3)	63 (3)	—	112 (3)
Late Iron Age:						
Ab. 17-22:	total (1)	—	—	—	—	—
Zl. 16-15:	total (1)	5 (1)	8 (1)	—	—	1 (1)
Zl. 17-27:	total (2)	59 (2)	203 (2)	50 (1)	62 (1)	124 (2)
Ro. 08-52:	total (11)	11 (4)	73 (3)	64 (1)	24 (3)	185 (3)
	hearth (4)	10 (3)	2 (1)	—	—	—
	dung (4)	—	—	—	7 (2)	113 (2)
	refuse (3)	1 (1)	71 (2)	64 (1)	17 (1)	72 (1)
Roman Period:						
Nh. 09-89:	total (26)	138 (8)	1477 (8)	302 (5)	23 (1)	6 (1)
	hearth (7)	136 (7)	1476 (7)	302 (5)	23 (1)	6 (1)
	dung (16)	2 (1)	1 (1)	—	—	—
Rock. II:	total (23)	126 (7)	237 (5)	12 (1)	1 (1)	184 (8)
	hearth (2)	18 (1)	3 (1)	—	—	—
	floor (19)	108 (6)	232 (3)	12 (1)	1 (1)	180 (7)
	pit (2)	—	2 (1)	—	4 (1)	—

club-wheat, which belong to the same, hexaploid species, *Triticum aestivum* s.l. The difference between glume and naked wheats also manifests itself in crop-processing (cf. Hillman 1981, 1984; G.E.M. Jones 1984). To dehusk glume wheats, parching is necessary to make the glumes brittle. This is usually done by roasting, the glumes can then easily be removed. In free-threshing or naked wheats, the grains can be separated from the glumes without roasting. This difference also has implications for the chances of carbonization of the different species (see *6.4*). The apparent advantage in threshing of naked wheats can turn into a disadvantage if harvesting is delayed too long. In that case, the naked wheat grains are easily spilled during harvesting. Besides, naked cereals in general are more susceptible to predation by birds and insects (Jacomet *et al.* 1989: 93).

In the present study, apart from a single grain of *Triticum* cf. *aestivum* s.l. in Rockanje II, all grains and chaff belonged to glume wheats. As in barley, the wheat chaff remains (spikelet forks and glume bases) outnumber the grains. The typical drop-shaped appearance of grains, which exclusively occurs in emmer (cf. Van Zeist 1970), can be observed in some specimens of the present material. Unmistakable grains of glume wheat species other than emmer have not been found. The carbonized chaff remains in most cases also show the characteristics of emmer-wheat. In contrast to einkorn, the spikelet forks are stouter and the two glumes of one spikelet fork are placed at an angle (more or less parallel in einkorn). The carbonized glumes of spelt have noticeable nerves on the dorsal side and have a larger width than those of emmer. The thickness of spelt glumes in contrast is smaller than in emmer (see also Jacomet *et al.* 1989: 325). Carbonized spelt glumes have not been found with certainty in the present material. Only Spijkenisse 17-34 and Zuidland 17-27 provided carbonized glumes of *Triticum* cf. *spelta*.

According to Körber-Grohne and Piening (1983: 65), uncarbonized glumes of spelt and emmer can, apart from their width, be identified by their epidermis cell patterns. Spelt has a zigzag epidermis cell pattern, while that of emmer is more wavy (see *fig. 32*). Material in our reference collection showed that emmer has much more irregular amplitudes in the meandering cell walls, while spelt is very

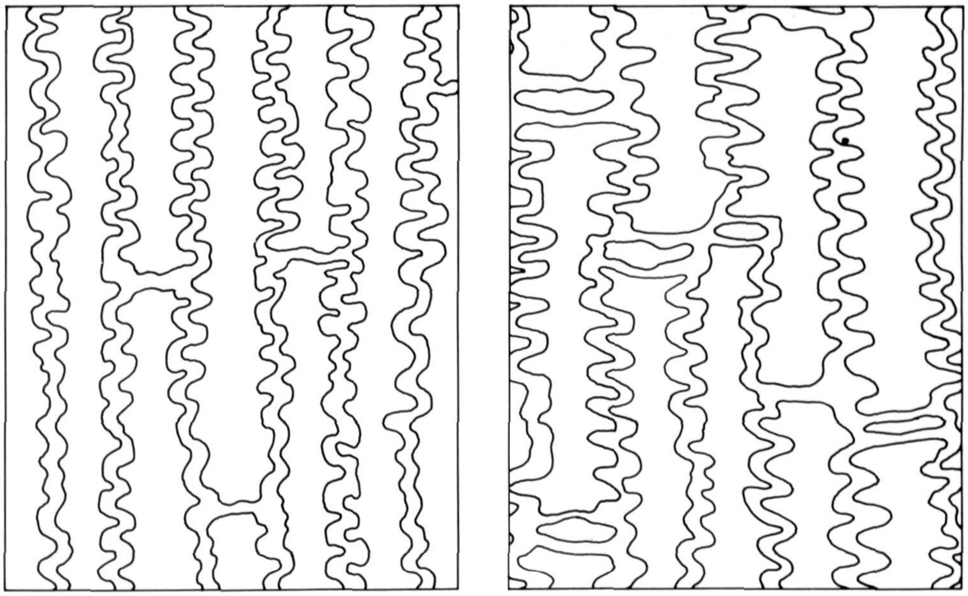


Fig. 32 Epidermis cell pattern of emmer (left) and spelt (right) according to Körber-Grohne/ Piening (1983: 65). Magnification ca. 600x.

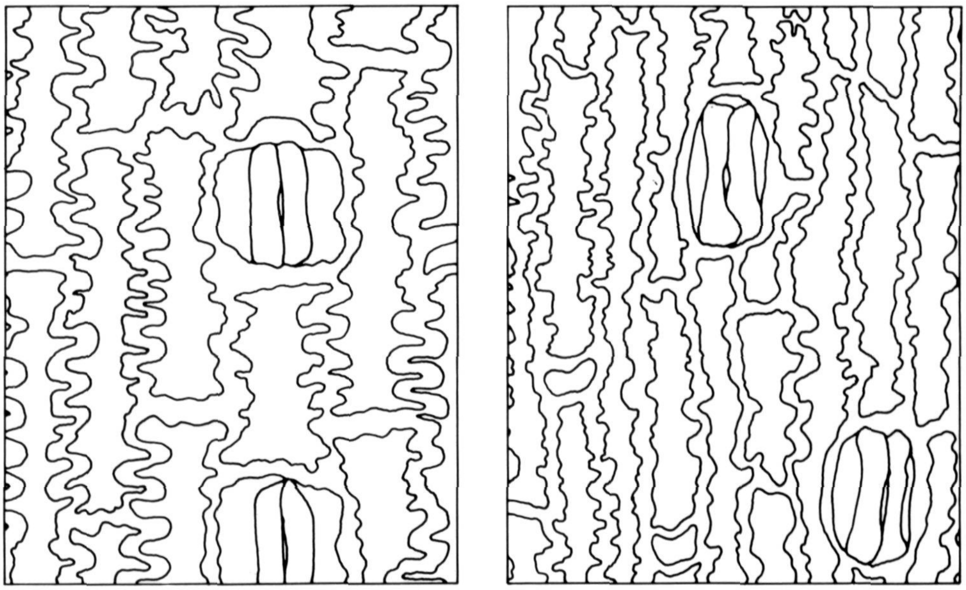


Fig. 33 Epidermis cell pattern of emmer (left) and spelt (right) according to the I.P.L. reference collection. Magnification ca. 600x.

regular (see *fig. 33*). The zigzag pattern observed by Körber-Grohne and Piening could not be found in our reference material, which included material from four different provenances.

The sites of Geervliet and Zuidland 17-27 yielded large numbers of waterlogged glumes. The widths of 380 glume bases from Geervliet have been measured. The distribution of the sizes is shown in figure 34a. Usually, the distinction between uncarbonized emmer and spelt is drawn at 1.3 mm (cf. Körber-Grohne/ Piening 1983). According to this criterion, about half of the glumes have the width of emmer. However, all the epidermes studied in emitted light showed the regularly wavy cell-wall pattern, according to our reference collection characteristic of spelt. The glume widths

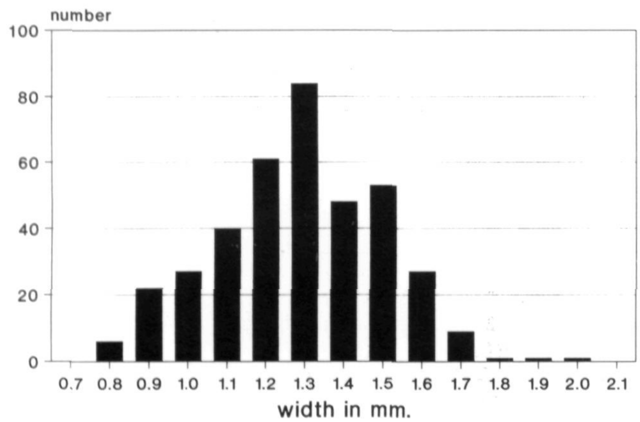


Fig. 34a Histogram showing the distribution of widths of glume bases of *Triticum* from Geervliet (n = 380)

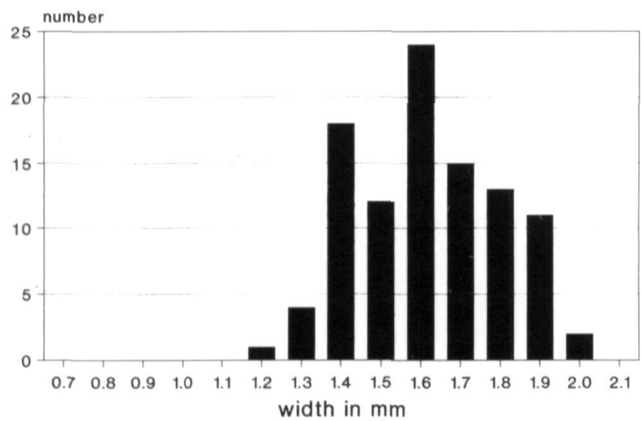


Fig. 34b Histogram showing the distribution of widths of glume bases of *Triticum* from Valkenburg (n = 100; material from Dr. J.P. Pals, I.P.P.).

yielded a unimodal curve. Both the unimodal width distribution and the uniform cell-wall pattern indicate that only one species is involved here. So far, spelt seems to be the most appealing candidate.

However, in the same samples from Geervliet, some carbonized glume bases are present. They are all relatively small, they lack the strong nervation which is characteristic of carbonized spelt glumes, and the margins do not show the right angles that characterize spelt either. They show all the characteristics of emmer glumes. The fact that all the grains found on Voorne-Putten were identified as emmer is also in contrast with the identification of the waterlogged glumes as spelt. Unfortunately, Geervliet did not yield carbonized *Triticum* grains that could be identified with certainty to give supplementary information.

In view of the confusion presented by all these data, further attention has been given to this subject.

For further exploration of the identification of these glumes, Dr. J.P. Pals kindly provided me with hundreds of waterlogged glumes from the Roman *castellum* near Valkenburg, which he had identified as spelt. The thickness of the glumes was remarkably small, corresponding to the criterion for spelt published by Jacomet *et al.* (1989: 325). This thickness was also much smaller than that found in the material from Geervliet. The width diagram of 100 of the glumes from Valkenburg is shown in figure 34b. The diagram shows high frequencies of values above 1.7 mm, in contrast to the diagram for Geervliet. The epidermis pattern of the glumes from Valkenburg could, owing to corrosion, be found in only one specimen. This epidermis was very much like those found on the glumes from Geervliet.

Thus, the epidermis cell pattern points to spelt, but the width of the material from Geervliet is clearly smaller than that of Valkenburg. It is possible that the wheat in Geervliet was grown under less appropriate conditions than that in Valkenburg, resulting in a smaller width. However, the fact that both the carbonized grains and the carbonized glumes from Geervliet are from emmer, strongly contradicts the identification as spelt.

Theoretically, a mixture of the two species is also possible. This would be supported by the presence of very small as well as very wide glumes. It would not be the first time that the presence of glumes of these two wheat species produce a unimodal width distribution (cf. Tomczyńska/ Wasylikowa 1988). This option is in contrast with the differences observed in thickness and size between the glumes of Geervliet and Valkenburg. If in Geervliet both species are represented, part of the material must resemble the glumes from Valkenburg.

In my opinion, two observations indicate that the glumes from Geervliet must be identified as emmer. Firstly, the larger width and smaller thickness of the spelt glumes from Valkenburg point to emmer for Geervliet. Secondly, spelt is completely absent among the carbonized material from Voorne-Putten.

This implies that the epidermis cell pattern cannot be used with confidence for the identification of subfossil material. The difference in present-day epidermis cells in emmer and spelt might be explained by a remark made by M. Jones (1981: 105). According to him, many crop species are inherently more likely than wild species to have undergone micro-evolutionary changes. The present difference in epidermis cells may not yet have existed during the Iron Age and the Roman Period. The epidermis cell pattern of the glumes deserve further attention, especially in the light of evolutionary changes.

Thus, all the glumes are considered to be emmer glumes.

Table 11. The occurrence of *Triticum dicoccum*. Quantities and, in brackets, frequencies per context per site.

			Carbonized			Uncarbonized	
		grain	spikelet fork	glume base	glume apex	spikelet fork	glume base
Early Iron Age:							
Sp. 17-30	total (9)	17 (1)	1? (1)	6? (3)	—	—	4? (1)
	hearth (5)	17 (1)	1? (1)	2? (2)	—	—	4? (1)
	dung (2)	—	—	4? (1)	—	—	—
Sp. 17-35	total (5)	—	—	—	—	—	—
Middle Iron Age:							
Sp. 17-34	total (19)	8? (3)	28 (4)	185 (12)	386 (3)	—	3 (1)
	hearth (3)	7? (2)	—	10 (2)	—	—	3 (1)
	floor (1)	1? (1)	2 (1)	5 (1)	1 (1)	—	—
	dung (6)	—	26 (3)	15 (5)	385 (2)	—	—
	ditch (9)	—	—	155 (4)	—	—	—
Sp. 17-35total (3)	—	11 (1)	21 (1)	—	6 (1)	15 (1)	
	refuse (3)	—	11 (1)	21 (1)	—	6 (1)	15 (1)
Gv. 17-55	total (3)	2? (1)	—	26 (2)	—	64 (3)	361 (3)
Late Iron Age:							
Ab. 17-22	total (1)	—	2 (1)	—	—	—	—
Zl. 16-15	total (1)	1? (1)	5 (1)	5 (1)	—	—	1 (1)
Zl. 17-27	total (2)	—	43 (2)	66 (2)	—	66 (2)	333 (2)
Ro. 08-52	total (11)	—	—	12 (1)	—	21 (3)	44 (4)
	hearth (4)	—	—	—	—	3 (1)	11 (2)
	dung (4)	—	—	—	—	9 (1)	15 (1)
	refuse (3)	—	—	12 (1)	—	9 (1)	18 (1)
Roman Period:							
Nh. 09-89	total (26)	—	—	—	—	—	—
Rock. II	total (23)	4? (1)	—	6 (1)	—	—	1 (1)
	hearth (2)	—	—	—	—	—	—
	floor (19)	4? (1)	—	6 (1)	—	—	1 (1)
	pit (2)	—	—	—	—	—	—

However, further research might prove this to be wrong. To meet this objection, all glumes wider than 1.3 mm are mentioned separately as *Triticum dicoccum/spelta* in the tables containing the raw data.

In conclusion, emmer is the most widespread wheat species, present on all Iron Age sites. The remarkable scarcity on the Roman sites will be discussed further in chapter 6.

Table 11 shows the occurrence of *Triticum dicoccum*. The total number of carbonized grains recovered amounts to 19 certain and 15 tentative identifications. Besides, 32 uncarbonized grains were found. In comparison to the number of carbonized barley grains, viz. 376, wheat is much scarcer. Chaff remains of wheats are much more common than grains. Carbonized *Triticum* grains mostly occur in hearth samples, whereas carbonized as well as uncarbonized chaff does not show such a restricted distribution.

4.4.3 *PANICUM MILIACEUM* (BROOMCORN MILLET)

Millet grains have been found in only one hearth sample in the Early Iron Age site of Spijkenisse 17-30. All were carbonized, remains of chaff did not occur. The grains measure 1.80 (1.28-2.30) × 1.55 (1.15-1.98) × 1.24 (0.54-1.70) mm. These sizes are similar to other measurements on carbonized prehistoric material. Kroll (1987: 100) observed that the weeds that characterize millet crops when regular cultivation occurs, are absent on coastal sites as well as in samples from sites on Pleistocene sand. He concludes that millet has never been of considerable importance as a crop plant in northern Germany. This also seems to hold true for the present sites.

4.4.4 *LINUM USITATISSIMUM* (LINSEED OR FLAX)

Linum is a crop plant with two possible functions; as linseed where the seeds can be used for consumption or as flax where the stems are used for their fibres. Concentrations of seeds, as has been found in numerous palaeobotanical studies, have been seen as evidence for consumption. Behre (1977) mentioned that the *Linum* seeds in Jemgumkloster were mostly broken open lengthways, because oil had apparently been pressed out of them, which indicates consumption.

Direct evidence for the consumption of linseed has been

Table 12. The occurrence of *Linum usitatissimum*. Quantities and, in brackets, frequencies per context per site.

		Uncarbonized		Carbonized	
		seed	capsule segment	seed	capsule segment
Early Iron Age:					
Sp. 17-30	total (9)	—	—	—	—
Sp. 17-35	total (5)	15 (1)	1 (1)	—	—
	hearth (1)	—	—	—	—
	dung (3)	—	—	—	—
	refuse (1)	15 (1)	1 (1)	—	—
Middle Iron Age:					
Sp. 17-34	total (19)	29 (8)	2 (2)	21 (2)	5 (1)
	hearth (3)	8 (1)	—	21 (2)	5 (1)
	floor (1)	14 (1)	—	—	—
	dung (6)	2 (1)	1 (1)	—	—
	ditch (9)	5 (5)	1 (1)	—	—
Sp. 17-35	total (3)	232 (1)	71 (1)	—	—
	refuse (3)	232 (1)	71 (1)	—	—
Gv. 17-55	total (3)	96 (3)	180 (2)	—	—
Late Iron Age:					
Ab. 17-22	total (1)	1 (1)	3 (1)	—	—
Zl. 16-15	total (1)	1 (1)	8 (1)	1 (1)	—
Zl. 17-27	total (2)	158 (2)	547 (2)	—	4 (1)
Ro. 08-52	total (11)	73 (5)	75 (3)	1 (1)	—
	hearth (4)	3 (1)	—	1 (1)	—
	dung (4)	59 (3)	65 (1)	—	—
	refuse (3)	11 (1)	10 (2)	—	—
Roman Period:					
Nh. 09-89	total (26)	13 (2)	1 (1)	12 (2)	—
	hearth (7)	1 (1)	1 (1)	12 (2)	—
	dung (16)	12 (1)	—	—	—
Rock. II	total (23)	—	—	—	—

provided by Helbæk (1958), who demonstrated the occurrence of linseed in the intestines of the two men found at Tollund and Grauballe in Denmark.

Flax fibres are very difficult to demonstrate in subfossil material, because of their high susceptibility to corrosion (Behre 1972). Sometimes, however, flax fibres have been demonstrated in subfossil material (e.g. Körber-Grohne 1967, 1985). The use of flax was indirectly demonstrated by Körber-Grohne (1967), Van Zeist (1970: 129) and Behre (1976c). They found small heaps of the outer layers of the stems, which form the waste material from making *Linum* stems into fibres. Classical writers also report on the use of linen tissues in *Germania* (Plinius and Tacitus, cited in Körber-Grohne 1967). It can be concluded that in pre- and early historic times, *Linum* was used both for consumption and for its fibres. The seeds of present-day linseed grown for consumption and of flax for the production of fibers differ in size (cf. Zohary/ Hopf 1988: 114). Linseed cultivated for seeds have larger seeds than flax cultivated for its fibres. Large seeded specimens have not been demonstrated in palaeobotanical studies.

In the present material, linseed is far more common in an uncarbonized than in a carbonized state (see *table 12*). The seeds of *Linum* are enveloped in a capsule of ten segments. These capsules contain ten seeds at most. The seeds can be threshed out of the capsules mechanically. In contrast to glume wheats and hulled barley, roasting is not necessary. This explains the predominance of uncarbonized remains. Table 12 also reveals that *Linum* remains occur regularly distributed in all kinds of contexts. On some sites they occur far more frequently than on others. Especially on the Roman sites, *Linum* is much scarcer than on the Iron Age ones, while it is also lacking in Spijkenisse 17-30. On sites where the contexts are known, carbonized *Linum* remains appear to be restricted to hearths.

Table 13. Sizes of *Linum usitatissimum* seeds.

			length (mm)			width (mm)		
Site	sample	n	average	min.	max.	average	min.	max.
Sp. 17-34	279	2		3.55	3.94		2.27	2.43
Sp. 17-35	612	25	3.92	3.55	4.19	2.22	1.92	2.40
Gv. 17-55	2	11	3.64	3.35	3.94	1.91	1.60	2.11
Gv. 17-55	3	23	3.59	3.04	3.94	2.06	1.83	2.34
Zl. 17-27	8	10	3.74	3.49	4.09	2.09	1.92	2.37
Zl. 17-27	9	23	3.70	3.23	4.02	2.09	1.80	2.34

The sizes (see *table 13*) correspond to other prehistoric, uncarbonized linseed. As Behre (1983: 24) showed, medieval linseed is considerably larger. Its length measures on average 4.16 mm (in Elisenhof) and 4.20 mm (in Haithabu). Hellwig (1990) reported an average length of 4.18 mm for medieval material.

4.4.5 *CAMELINA SATIVA* (GOLD OF PLEASURE, FALSE FLAX)

Gold of pleasure is cultivated for its oil-rich seeds. These seeds are enclosed by two silicles, which have a very characteristic shape. In the Netherlands, it first appeared during the Iron Age, although Schultze-Motel (1979) mentioned some dubious Bronze Age finds in the Netherlands. Nowadays, it is cultivated in remote parts of Europe only. As in *Linum*, threshing is done mechanically. The fact that no roasting is needed, explains the predominance of uncarbonized remains. This is also the reason why *Camelina* and *Linum* are much more commonly found in *Feuchtboden-Siedlungen* (see Willerding 1971). *Camelina* is a secondary crop; during the Bronze Age it was probably a weed in *Linum* crops. However, it was a crop on its own right during the Early Iron Age, as Kučan (1986) demonstrated for northern Germany.

Seeds of *Camelina*, as well as silicles, which contain the seeds, have been found. They are very unevenly distributed over the sites investigated (compare *table 14*). Especially Geervliet 17-55 produced large numbers of silicles. This site has been sampled by means of a corer for taking peat samples after the discovery of *Camelina* silicles as tempering material in pottery on this site (see *fig. 30*). This use of gold of pleasure indicates that it was processed on the site of pottery production. In this way the large amounts of waste needed for tempering can be obtained (cf. Schultze-Motel 1979). If the pottery was produced locally, we could expect Geervliet to produce substantial quantities of gold of pleasure remains in samples for macroremains. The analyses showed this to be the case. One level of the cored sample showed almost nothing but *Camelina* capsules (see *fig. 35*). The presence of such large amounts of threshing waste of *Camelina* can only be expected on sites where this crop was grown by the inhabitants. The presence of threshing waste excludes importation, because that would be effected in the form of threshed seeds (see further *6.6.4*). These observations also strongly suggest that the pottery was indeed produced locally, in a domestic mode.

The fact that hundreds of *Camelina* remains occur in combination with only four *Linum* seeds in sample 1 from Geervliet indicates that *Camelina* was not a weed, but a crop on its own right on this site.

Table 14 clearly illustrates that *Camelina* predominates in the Middle Iron Age samples from Geervliet, and to a lesser extent in those from Spijkenisse 17-35 and in the Late Iron Age samples from Zuidland 17-27. All the other sites yielded just a few isolated seeds at best. The quantities on the excavated sites were too small to allow conclusions to be drawn about differences between contexts.

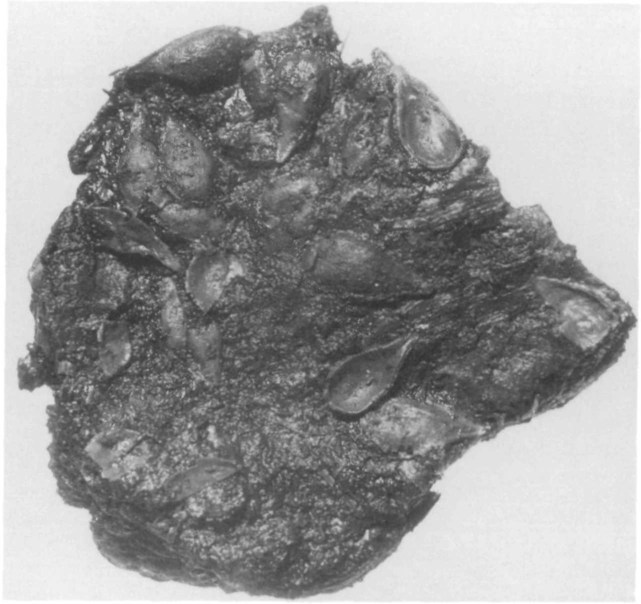


Fig. 35 Silicles of *Camelina sativa* in cored sample from Geervliet 17-55 (2x)

Table 14. The occurrence of *Camelina sativa*. Quantities and, in brackets, frequencies per context per site.

		Uncarbonized		Carbonized	
		seed	silicle	seed	silicle
Early Iron Age:					
Sp. 17-30	total (9)	—	—	—	—
Sp. 17-35	total (5)	1 (1)	—	—	—
	hearth (1)	—	—	—	—
	dung (3)	—	—	—	—
	refuse (1)	1 (1)	—	—	—
Middle Iron Age:					
Sp. 17-34	total (19)	1 (1)	—	—	—
	hearth (3)	1 (1)	—	—	—
Sp. 17-35	total (3)	20 (1)	18 (1)	—	—
	refuse (3)	20 (1)	18 (1)	—	—
Gv. 17-55	total (3)	85 (3)	366 (3)	8 (1)	20 (3)
Late Iron Age:					
Ab. 17-22	total (1)	—	—	—	—
Zl. 16-15	total (1)	—	—	1 (1)	—
Zl. 17-27	total (2)	3 (1)	31 (2)	—	—
Roman Period:					
Nh. 09-89	total (26)	5 (2)	—	1 (1)	—
	hearth (7)	4 (1)	—	1 (1)	—
	dung (16)	1 (1)	—	—	—
Rock. II	total (23)	—	—	—	—

4.4.6 *BRASSICA RAPA* (= *B. CAMPESTRIS*, TURNIP)

The identification of the different *Brassica* species is incorporated in the description of seeds (Appendix I). In our area it has been assumed that the recent *Brassica rapa* (= *B. campestris*) is not an indigenous species, but probably a remnant of earlier cultivation (cf. Van Zeist 1974; Schultze-Motel 1986; Jacomet *et al.* 1989). In palaeo-botanical literature, a debate is going on about the role of this species in prehistoric times. Some consider it a cultivated crop (cf. Van Zeist 1974; Schlichterle 1981), while others see it as an arable weed (cf. Behre 1983; Körber-Grohne 1987). Jacomet *et al.* (1989: 206) assume that *Brassica* seeds have been collected, in view of their high frequency but relatively low average concentrations. Murphy (1977 cited in Green 1981: 142) reported the find of a pot filled with *Brassica* seeds on the Iron Age site of Old Down Farm, which suggests a crop being stored for further cultivation or culinary use. Knörzer (1970: 67-68) found *Brassica* seeds together with pronounced garden plants (*Amaranthus*, *Lens*, *Vicia*, *Pisum*), a combination which he saw as storage of seeds of plants for consumption.

In the present study, turnip seeds occur in almost every sample of Spijkenisse 17-30 (see *table 15*). The greatest numbers have been found in hearth samples, in which several cereals were recorded. The other sites only revealed an incidental seed of this species. If *Brassica* occurred as a weed, a more even distribution among the sites would be expected. Furthermore, the greatest numbers occur in samples with other crop plants. This may also indicate that we are dealing with a cultivated species, or one gathered deliberately. Another indication that these seeds may have been used for consumption can be found in the scarcity of other oil-yielding plants in Spijkenisse 17-30. On all Iron Age sites, remains of oil-rich plants occur in substantial quantities, in the case of Spijkenisse 17-30 seemingly as turnips. Similar observations were made by Van Zeist (1974), who found *Brassica campestris* in Tzummarum with high frequency, while *Linum* and *Camelina* were both absent.

Brassica rapa is almost exclusively found uncarbonized. Silicles of this species have not been found, despite the extra attention given to finding them during the recovery of the larger numbers of seeds in Spijkenisse 17-30. Probably, these remains become unrecognizable when fragmented, in contrast to *Camelina* silicles and *Linum* capsule segments.

Table 15. The occurrence of *Brassica rapa*. Quantities and, in brackets, frequencies per context per site.

		Uncarbonized seed	**Carbonized** seed
Early Iron Age:			
Sp. 17-30	total (9)	98 (8)	—
	hearth (5)	79 (4)	—
	floor (2)	5 (2)	—
	dung (2)	14 (2)	—
Sp. 17-35	total (5)	—	—
Middle Iron Age:			
Sp. 17-34	total (19)	5 (4)	—
	floor (1)	1 (1)	—
	ditch (9)	4 (3)	—
Sp. 17-35	total (3)	4 (2)	—
	refuse (3)	4 (2)	—
Gv. 17-55	total (3)	—	1? (1)
Late Iron Age:			
Ab. 17-22	total (1)	2 (1)	—
Zl. 16-15	total (1)	—	1 (1)
Zl. 17-27	total (2)	2 (1)	—
Ro. 08-52	total (11)	—	—
Roman Period:			
Nh. 09-89	total (26)	—	—
Rock. II	total (23)	—	—

4.4.7 *VICIA FABA* (CELTIC BEAN)

In the range of edible Papilionaceae seeds, only Celtic bean has been found in the present study (see *fig. 36*). Lentil and pea, not unimportant in other material from the Iron Age and/or Roman Period, are conspicuous by their absence.

From a dietary point of view, legumes such as *Vicia faba* are important sources of vegetable proteins. Especially the amino acids isoleucine and lysine are important, since they complement the low levels of these amino acids in cereals. Besides, legumes are also important because of their role in crop rotation. In nodules on the roots, symbiosis occurs with bacteria that can fix nitrogen by oxidizing it into nitrate. This process fertilizes the soil for the following crop when the roots decay in the soil.

The potential recovery of Papilionaceae seeds is hampered by two facts. Firstly, uncarbonized seeds of this family decay very easily. Secondly, roasting is not necessary in crop-processing, so the chances of carbonization are small. Only uncarbonized bean straw can be preserved in quantities under favourable conditions, as is shown in Feddersen Wierde and Elisenhof. Even there only a few carbonized seeds have been found. In Neuß, where Knörzer (1970) analyzed the contents of burnt-down buildings, more than 50,000 Celtic beans were recovered, nearly as many as all *Triticum* grains together! This indicates that the consumption of these beans might very well have been considerably more important than the few seeds mostly found suggest.

The carbonized seeds found in Nieuwenhoorn all occur in four hearth samples. They are probably the result of accidents during food preparation.

4.5 Gathered wild plants.

In most cases, it is impossible to conclude deliberate gathering on the basis of archaeological plant remains. Many species, some of which occur abundantly on almost every west European site investigated, are potential food

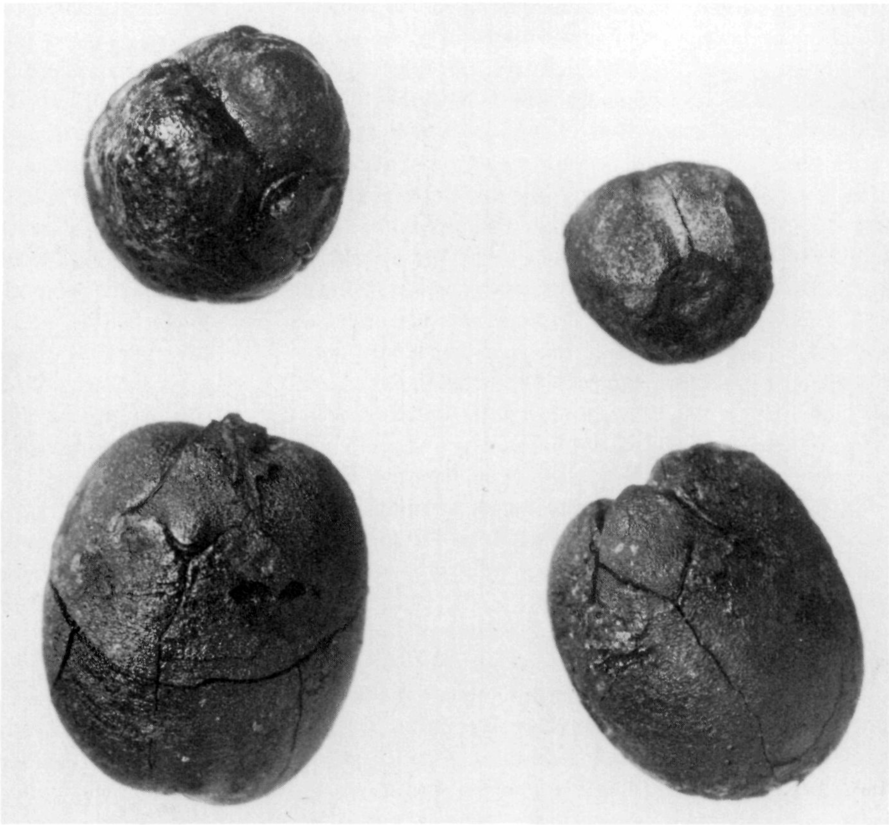


Fig. 36 Seeds of *Vicia faba* from Nieuwenhoorn (Roman Period)(6x).

plants. Very common are *Atriplex*, *Polygonum*, *Rumex* and *Chenopodium* species. Consumption of the leaves of these plants is highly probable, but virtually impossible to prove (see also Hinz 1954; Knörzer 1971c). The seeds of these species may also haven been eaten. Dembinska (1976) mentioned that seeds of Chenopodiaceae and Polygonaceae can be ground into meal. Helbæk (1951) described an Iron Age pot from Denmark which was filled with a mixture of barley and considerable quantities of seeds of *Chenopodium album*, *Polygonum convolvulus* and other weed seeds. In view of the large quantities (ca. 30%), he concluded that these weed seeds were gathered for their own sake.

Seeds of many of the above-mentioned species have also been found in bog corpses. However, their presence may be the result of crop impurities, apart from being remains of vegetables. Besides, bog corpses may in some cases represent sacrificial victims, whose last meal might also have had a ritual, and thus not representative, character. The species dealt with here give us (a little) more certainty about their role in prehistoric food consumption on Voorne-Putten.

4.5.1 *RUBUS CAESIUS* AND *R. FRUTICOSUS* (BLACKBERRIES)

In Spijkenisse 17-35, blackberry seeds occur in one sample, which dates from the Early Iron Age. It is highly improbable that these species grew in the vicinity of the site. *R. caesius* occurs on calcareous soils, especially in dune areas and in forests on levees (Fraxino-Ulmetum). Both blackberry species do not occur on peaty soils (Weeda *et al.* 1987: 64). The native Roman site of Nieuwenhoorn also yielded one seed of *Rubus fruticosus*. Collection of the fruits will have taken place on a small scale only, in view of the narrow distribution of the conspicuous seeds over the sites investigated.

4.5.2 *PRUNUS SPINOSA* (SLOE)

Sloe stones are relatively large, and therefore conspicuous. None the less, they occur only very occasionally in the Iron Age samples, and on two sites only, viz. in three samples from Spijkenisse 17-34 and in one sample from Spijkenisse 17-35. All these samples date from the Middle Iron Age. According to Weeda *et al.* (1987: 104), sloe occurs on mineral soils that are not too clayey nor too acid. It grows in shrubs along forest fringes and in hedges, in Fraxino-Ulmetum (levee) forests also in the forests themselves. The absence on peaty soils renders the occurrence of sloe in the close vicinity of the sites improbable. They must have been collected from the levees or the dunes.

Fig. 37 Grains of *Glyceria fluitans* from Spijkenisse 17-34 (Middle Iron Age)(6x).

4.5.3 *ROSA* SPEC. (ROSE)

Wild roses especially occur along forest fringes and in hedges (Jacomet *et al.* 1989: 202). The present study demonstrated rose hips in Spijkenisse 17-34 (two samples), while the native Roman site near Rockanje yielded one tentative specimen. The very rare occurrence of rose hips indicates that the fruits were only seldom collected, as was also the case with blackberries and sloe.

4.5.4 *SAMBUCUS* CF. *NIGRA* (ELDERBERRY)

Elderberries are also edible. Elder occurs in forest clearings and fringes and in hedges but also in ruderal places. The single fruit found in Spijkenisse 17-35 may thus have come from an elder shrub near the site. Alternatively, it may have been gathered together with the blackberries, which occur in the same sample. As with the previous fruits, large scale collection was not practised on Voorne-Putten in the Iron Age or the Roman Period. This is all the more remarkable, because gathered fruits normally survive uncarbonized (cf. Jacomet *et al.* 1989: 193) and are thus mainly to be expected in waterlogged deposits, such as we find in the sites studied here.

4.5.5 *GLYCERIA FLUITANS* (FLOATING SWEETGRASS, MANNA-GRASS)

In a hearth at Spijkenisse 17-34 (samples 580 and 580a), as many as 416 carbonized grains of *Glyceria fluitans* were found (see *fig. 37*). In these samples, carbonized remains of several cultivated crops were also present (i.c. *Hordeum vulgare*, *Triticum* spec., *Linum usitatissimum* and *Camelina sativa*). A considerable portion of the *Glyceria* grains was unripe when carbonization took place.

A concentration of a species like this may have different causes. In the first place, if *Glyceria fluitans* was used for thatching, this might have resulted in a large number of grains on the site. However, because of its small leaves, this species is not particularly suited for this purpose, while *Glyceria maxima* is (cf. Aichele/ Schwegler 1983). A second alternative is collection of the fruits for human consumption. This consumption of manna-grass is well documented in historical data (e.g. Dembinska 1976).

Hegi (1906) described how the *Glyceria* grains were harvested by hitting the stems with a sieve. In this way the grains fell out of the ears into the sieve. The grains were dried at home. Kohl (1864) described harvesting *Glyceria* by boat. The blades were bent over the side into the boat and with combs, resembling those for rippling flax, the seeds were threshed into a cloth. *Glyceria* is eaten when there is a shortage of cereals, for instance in times of war and crop failures. According to Hegi, the groats of manna-grass were also sold.

Körber-Grohne (1990) composed tables with all uncarbonized and carbonized grass seeds of sites in the Netherlands, Germany, Belgium, France and Switzerland. All the sites published until 1987 with more than one identified taxon of Gramineae were included. It appears that carbonized *Glyceria fluitans* has not been found in this area before. Uncarbonized specimens occur more frequently, sometimes even in large numbers. In Xanten (Knörzer 1981), it is the predominating grass species, in Bentumersiel (Behre 1977) only *Poa* and *Agrostis* are more abundant.

What is most remarkable is that A.G. Lange (1988: 66), in his numerical approach of the seeds of Roman Wijk bij Duurstede, observed an irregular distribution among his samples of *Glyceria fluitans*, and also of *Linum usitatissimum*, *Trifolium dubium* and *Sisymbrium officinale*. He assumed cultural causes for the extraordinarily high scores of *Linum* in some samples, but natural causes for the other species. Deliberate collecting of *Glyceria*, however, may also be a reasonable explanation for large numbers in some samples. Behre (1991a) found great numbers of waterlogged *Glyceria fluitans* grains in medieval cesspits in Bremen, a very direct evidence of consumption of this grass. According to Körber-Grohne (1987: 22), to get one gram of grains of *Glyceria fluitans*, 500 grains are required, while in cultivated barley 26 grains weigh one gram. The ease of threshing of *Glyceria*, however, is an advantage compared to hulled barley and emmer wheat.

As for Spijkenisse 17-34, *Glyceria fluitans* seems to have been consumed as early as the Iron Age. The unripe grains may be a result of the harvesting method, comparable to the method in which combs are used.

4.5.6 Conspicuously absent gathered plants

Another very remarkable aspect regarding gathered wild plants should be discussed here. It is the complete absence of fruits and nutshells of *Quercus* (acorns) and *Corylus avellana* (hazelnuts). These two are often the predominating gathered taxa on pre- and early historic sites in western Europe. Despite the reconstructed presence of tidal forests along the Meuse, in which hazel was little affected by the inhabitants during the Early and Middle Iron Age habitation, its nutshells did not reach the settlements at some kilometres' distance in recoverable quantities.

4.6 Macroremains of other wild plants.

In the following section, the results of the analyses with respect to the wild taxa are discussed. After a general introduction, the results will first be discussed per site, followed by a comparison between the sites. In the tables 10-20, the taxa have been arranged according to their present occurrence in plant communities. The syntaxonomical grouping *sensu* Westhoff and Den Held (1969) has here been used.

A drawback of this method is that the former ecological conditions sometimes were thus deviating from the present, that particular plants occurred in plant communities in which they are absent today. It is for this reason that A.G. Lange (1988) tried to group the taxa he had found in a Roman settlement by means of numerical methods. He concluded that the grouping corresponded closely to the present ecological grouping. This provides a basis for an *a priori* classification in ecological groups, although the method he used probably did not reveal all the details (see *4.7*).

In the publication of Westhoff and Den Held (1969), the taxa have been arranged according to syntaxonomical approach of Braun-Blanquet. It was pointed out by Behre (1972), Willerding (1979), M. Jones (1988) and Behre and Jacomet (1991) that a detailed grouping of palaeobotanical data, in lower syntaxonomical units (orders, associations) is hampered by the possibility of taxa occurring in other plant communities than at present. It is less likely that considerable changes have taken place at class level. This class level has been used in the following.

Another problem arises from plant ecology itself. Most plant species are not restricted to only one single plant community. This is expressed in the fact that many species are not only character species (German: *Kennarten*) for a particular plant community, but also (or sometimes only) differential species (German: *Trennarten*) in others. For a more elaborate discussion of the concepts of the Braun-Blanquet method in the classification of vegetation, the reader is referred to the publication by Westhoff and Van der Maarel (1973).

In the present study, the primary subdivisions are founded on character species only. A very subjective grouping may otherwise be the result, as Behre (1977) pointed out. However, important alternative classes, of which particular species are differential species, have been listed in the tables concerned.

Some classes occur very regularly on the sites studied, and their ecology is of great use in the interpretation of the data. Some basal knowledge of these classes is relevant in the following description per site, so a short introduction is presented first.

4.6.1 Ecological notes on some actual plant communities

4.6.1.1 Arable weeds.

The arable weeds are subdivided into two different syntaxonomical classes. Class 12 (Chenopodietea) comprises species that occur in summer cereal and root crops (esp. order 12A) and annual species from ruderal places like rubbish dumps, dung hills and the like (esp. order 12B). On the other hand, class 13 (Secalietea) consists of species occurring in winter cereal crops. The differences between species of summer- versus wintercrops become clear, when the associated methods for cultivation are inspected.

Ploughing is normally undertaken before sowing, thus in autumn for wintercrops, which are sown in September-November, and in early spring for summercrops (sown around April). Ideally, wintercrop weeds germinate in the autumn. In a wintercrop plot, they can develop together with the cereals, after ploughing. In that case they can produce ripe seeds in late summer when the cereals are also ripening.

Alternatively, the wintercrop weeds that have germinated in a plot that will carry a summercrop, will be ploughed under in early spring. The remaining time between sowing and harvesting is now too short for a wintercrop weed to produce ripe seeds.

Summercrop weeds have a much shorter growing cycle and can produce ripe seeds in summercrops. In wintercrops, any germinating summercrop weeds have to develop in an already dense growth of plants. Only in wintercrop fields with a lot of open space (owing to a badly growing crop) or along the edges, a considerably larger number of summercrop weeds may well develop. Although this picture is somewhat idealized and actual data often show evidence of combined occurrences of summer- and wintercrop weeds, we usually find that in summercrops no wintercrop weeds can develop (see also Willerding 1980). The reverse occurs much more often. Thus, the presence of summercrop weeds is not too characteristic, but the presence or absence of wintercrop weeds is much more so (see also Bannink *et al.* 1974).

4.6.1.2 Plant communities of pastures and meadows. Several classes contain elements of grasslands. Sandy, dry grasslands belong to class 20 (Koelerio-Corynephoretea), dry grasslands on calcareous soils to class 21 (Festuco-Brometea) and damp grasslands to class 25 (Molinio-Arrhenatheretea). Furthermore, in grazed heathlands on acid, poor soils another class occurs; class 30 (Nardo-Callunetea), while in salt environments class 24 (Asteretea tripolii) provides good grazing territory. Very heavily grazed pastures are allocated to class 16 (Plantaginetea majoris), where resistance to treading is the key factor.

In the present study, class 20 and 21 are absent. Class 25 on the other hand is of considerable importance. This class is subdivided into two orders, in which the Arrhenatheretalia include the mown meadows, which (at present) are heavily fertilized and the Molinietalia, which are essentially pastures, with less fertilization.

Körber-Grohne (1990: 25) has put forward that the species at present characterizing damp grasslands, and especially mown ones, are dominated by *Arrhenatherum elatius*, which gave its name to the class and order. Subfossil seeds of this species, however, have been found only once, despite the potential capacity for good preservation in this species. Apparently, *Arrhenatherum* was very rare in prehistoric conditions, and thus it is improper to name former meadows after it. Körber-Grohne (1990: 98) proposed not to use

Table 16. Class numbers, syntaxonomical names and ecological descriptions after Westhoff & Den Held (1969) and class numbers after Ellenberg (1979).

Class number (Westhoff & Den Held)	Present class names	Ecological description	Class number (Ellenberg)
5	Potametea	Waterplants	1.3
8	Thero-Salicornietea	Therophytic saltmarsh pioneers	2.4
9	Cakiletea maritimae	Tide-mark plants	2.8
10	Isoeto-Nanojuncetea	Ephemeral plants	3.1
11	Bidentetea tripartiti	Therophytic nitrophilous pioneers	3.2
12	Chenopodietea	Summercrop weeds and annual ruderals	3.3
13	Secalietea	Wintercrop weeds	3.4
16	Plantaginetea majoris	Tread resistant plants	3.7
17	Artemisietea vulgaris	Perennial ruderals	3.5
19	Phragmitetea	Reedswamp plants	1.5
24	Asteretea tripolii	Saltmarsh plants	2.6
25	Molinio-Arrhenatheretea	Plants of damp grasslands	5.4
27-30	Parvocaricetea, Scheuchzerietea, Oxycocco-Sphagnetea, Nardo-Callunetea	Heathland and bog plants	1.7, 1.8, 5.1
32-34	Franguletea, Salicetea purpureae Rhamno-Pruneteae	Shrubs	8.1, 8.2 (p.p.) 8.4 (p.p)
35	Alnetea glutinosae	Alder carr plants	8.2
38	Querco-Fagetea	Forest plants of rich soils	8.4

present syntaxonomical names for prehistoric times, because of the absence of important character species. She prefers to use a name which indicates ecological factors, e.g. wet to damp grasslands instead of Molinietalia. This proposal will be followed here. Class numbers (*sensu* Westhoff/ Den Held 1969) will be used to avoid repeated use of these long descriptions. A drawback is that this numbering is not standardized, and deviates for instance from Ellenberg's (1979) numbering. In table 16, the class numbers, present syntaxonomical names, ecological descriptions and Ellenberg's class numbers are given for those classes which are of relevance here.

The occurrence of mown meadows during the Iron Age is especially relevant in the light of the common occurrence of byres with stalls in this period (see e.g. Waterbolk 1975; Haarnagel 1984). The housing of livestock will have necessitated some kind of winter feeding (see also Behre/ Jacomet 1991).

4.6.1.3 Plant communities of salt environments.

In salt marsh situations, the transition of sea to land passes through a characteristic series of plant communities. In the littoral zone, up to slightly below mean high water level (M.H.W.), the two *Zostera* species (eel grass) occur, which belong to class 2 (Zosteretea). In the tidal zone, in the range from slightly below M.H.W. to springtide level, the vegetation is dominated by *Salicornia europaea* s.l., arranged in class 8 (the present Thero-Salicornietea). *Suaeda maritima*, *Aster tripolium* and *Spartina X townsendii* may occur as accompanying species. This vegetation of annual pioneers is followed by perennial plants allocated to class 14 (Spartinetea), a still open type of vegetation in which at present the neophyte *Spartina* X *townsendii* strongly predominates. In the supralittoral zone of a salt marsh, perennial plants form a closed plant cover, arranged in class 24 (Asteretea tripolii). This type of vegetation provides excellent pastures. On the tide-marks that are deposited at high tide levels in salt marshes, a characteristic vegetation is present, often with *Atriplex littoralis* or *Suaeda maritima*, they are included in class 9 (Cakiletea maritimae).

According to Westhoff *et al.* (1971), plant species that are characteristic of the contact zone between salt and fresh water are a.o. *Odontites verna*, *Carex cuprina*, *Trifolium fragiferum*, *Triglochin palustris*, *Ranunculus sardous*, *Oenanthe lachenalii* and *Aster tripolium*.

4.6.1.4 Waterside vegetation types.

The vegetation of reed and other large grasses and sedges which grow "with their feet submerged" for the greater part of the year, is included in class 19 (Phragmitetea). According to Westhoff *et al.* (1971), three possible succession series can be observed in reed communities, viz. the tendency to form an alder carr vegetation, to acidification with oligotrophic bog formation, and to ruderalisation. Several tall herbs characterize ruderal situations in reed vegetations, e.g. *Lysimachia vulgaris*, *Stachys palustris*, *Lythrum salicaria*, *Eupatorium cannabinum*, *Valeriana officinalis*, *Thalictrum flavum* and *Epilobium hirsutum.* According to these authors, the fringes of reed along shores in more brackish situations are replaced by vegetations with *Scirpus maritimus* and *S. lacustris* ssp. *tabernaemontani*, locally with *Althaea officinalis* and *Oenanthe lachenalii.*

In places which periodically fall dry, a vegetation of annual plants develops, belonging to class 11 (Bidentetea tripartiti).

4.6.1.5 Vegetation types of environments disturbed by man.

The first plant community to be mentioned here is class 16 (Plantaginetea majoris), consisting of tread resistant plants on all kinds of soils. In more neglected places around human settlements, the tall perennial weeds of class 17 (Artemisietea vulgaris) dominate the vegetation.

4.6.2 THE MACROREMAINS OF ROTTERDAM-HARTELKANAAL 10-69

This Early Iron Age site yielded only two samples for botanical macroremains, which have been studied by W.J. Kuijper (see *table 17*). These samples apparently did not contain any carbonized plant remains. Crop plants are not represented, neither are crop weeds or plants that are indicative of anthropogenic influence. Unfortunately, the samples may

Table 17. Botanical macroremains of Rotterdam-Hartelkanaal 10-69. Counted numbers. (Contexts unknown).

Sample number Volume (l)	28 0.25	54 0.5	Alternative classes
Therophytic nitrophilous pioneers (cl.11)			
Polygonum hydropiper	1	—	12,13,19,33
Tread resistant plants (cl.16)			
Potentilla anserina	—	2	10,24
Ranunculus repens-type	—	4	10,12,13,25
Reedswamp plants (cl.19)			
Eleocharis palustris	2	—	10,16,24
Lycopus europaeus	—	1	35
Plants of damp grasslands (cl.25)			
Hypericum quadrangulum	—	3	
Stachys palustris	—	2	12,13,33
Heathland and bog plants (cl.27-30)			
Hydrocotyle vulgaris	—	1	10,16,19,33
Alder carr plants (cl.35)			
Carex cf. elongata	5	6	
Various:			
Euphorbia palustris	—	1	25
Mentha aquatica/arvensis	2	—	12,13,16,19

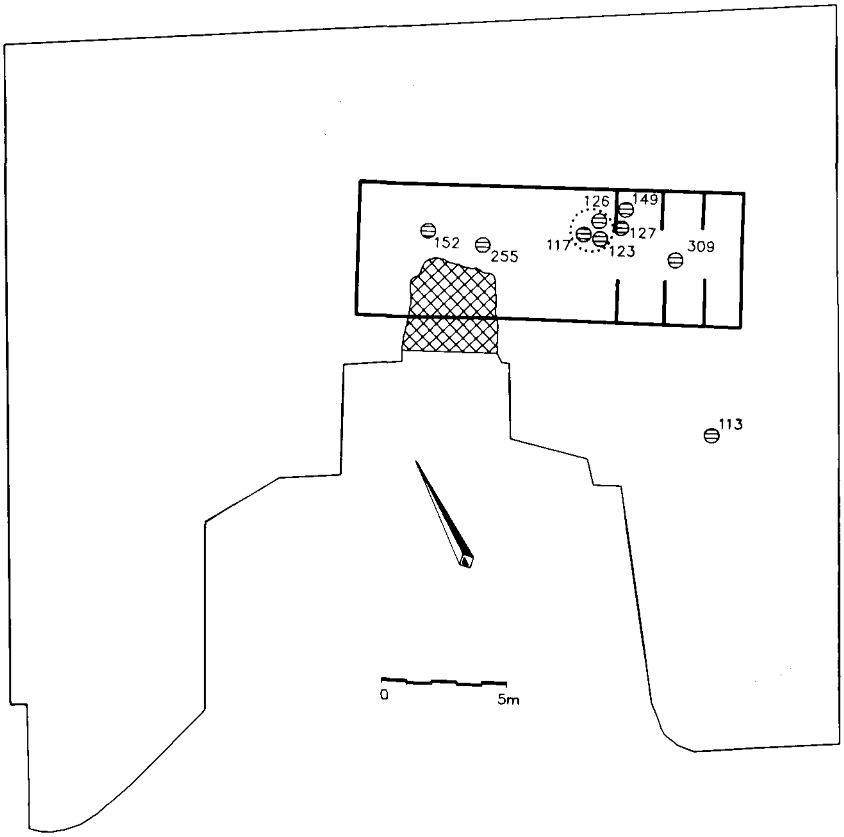


Fig. 38 Location of samples for botanical macroremains in and around the houseplan of Spijkenisse 17-30, scale 1:300. Dotted line = hearth.

have been composed of the peaty subsoil of the site (see Van Trierum *in press*). If so, crop plants or other anthropogenic indicators could not be expected. All species, albeit character species of various syntaxonomical classes, may have derived from natural vegetation types.

4.6.3 THE MACROREMAINS OF SPIJKENISSE 17-30

On this Early Iron Age site, several hearths (samples 113, 117, 126, 127 and 309), floor layers (sample 149 and 152) and dung layers (sample 123 and 255) were sampled (see *fig. 38*).

One hearth, represented by sample 113, was situated outside the building. It was considered possible that this hearth served a special purpose (roasting of grain or the like), but botanical evidence for such a function could not be found (compare *table 18*). The only carbonized remains belonged to *Alnus glutinosa* and clearly came from the firewood. Apart from this very poor sample (with respect to number of taxa and absolute number of macroremains), the samples are dominated by seeds of waterside plants (class 19 and class 11).

Taxa occurring in damp meadows and pastures (class 25) are considerably more important than arable weeds. These arable weeds are without exception characteristic of class 12. As explained before, this class comprises both summercrop weeds (the present order of Polygono-Chenopodietalia) and annual ruderal vegetations of dung hills, refuse heaps and the like (the present Sisymbrietalia). Of the four species occurring here, two (*Capsella bursa-pastoris* and *Polygonum aviculare*) are character species of the annual ruderals, the other two (*Solanum nigrum* and *Stellaria media*) typify both orders. Consequently, they were not necessarily derived from cultivated fields either. The absence of ecologically more restricted, stenoecious crop weed species and the remarkably small amount of cereal chaff found on this site will be discussed further in chapter 6.

In the samples, indicators of salt habitats are present in very small numbers of seeds, the only species concerned is *Salicornia europaea*.

4.6.4 THE MACROREMAINS OF SPIJKENISSE 17-35

The two Iron Age phases occurring on this site (see *1.3.1.1*) both yielded samples for macroremains. Unfortunately, only a few samples proved worth analysing.

Sample 614 concerns a hearth in the Early Iron Age building, no. 506 represents dung from the byre area and sample 604 is from the central aisle in the byre. The samples 598 and 600 can also be dated to the Early Iron Age, but

Table 18. Botanical macroremains of Spijkenisse 17-30. Counted numbers, * = carbonized.

Sample number	113	117	123	126	127	149	152	255	309	
Context	hearth	hearth	dung	hearth	hearth	floor	floor	dung	hearth	Alternative
Volume (l)	0.3	2	2	3	1.5	0.25	0.1	0.5	0.5	classes
Crop plants:										
Brassica rapa	—	1	13	74	3	1	4	1	1	
Cerealia indet.	—	—	1*	1*	—	—	—	—	—	
cf. Triticum dicoccum fr.	—	—	—	28*	—	—	—	—	—	
Panicum miliaceum	—	—	—	38*	—	—	—	—	—	
Triticum cf. dicoccum gl.b.	—	1*	4,4*	1*	—	—	—	—	—	
Triticum cf. dicoccum sp.f.	—	—	—	1*	—	—	—	—	—	
Triticum dicoccum	—	—	—	17*	—	—	—	—	—	
Triticum spec. awn fr.	—	—	—	1*	—	—	—	—	—	
Therophytic saltmarsh pioneers (cl.8):										
Salicornia europaea	—	—	—	—	—	—	—	1	35	24
Ephemeral plants (cl.10):										
Juncus bufonius	—	368	128	96	32	2	1	16	—	12,13,16,24
Therophytic nitrophilous pioneers (cl.11):										
Chenopodium rubrum	—	48	—	—	9	—	—	3	2?	12
Ranunculus sceleratus	1	30	415	1211	12,3*	5	19	6	21	
Rorippa palustris	—	8	—	—	—	—	3	—	—	
Rumex maritimus	1	1,1*	—	—	3	2	4	—	—	
Stellaria aquatica	—	—	2	—	—	—	—	—	—	
Summercrop weeds (cl.12):										
Capsella bursa-pastoris	—	—	—	—	—	—	—	1	—	11,16
Polygonum aviculare	—	—	2	1?	—	—	2	—	—	
Solanum nigrum	—	1	—	—	—	—	—	—	—	11
Stellaria media	—	—	2	2	—	—	2	—	—	
Tread resistant plants (cl.16):										
Carex cuprina-type	—	7,4*	37	127	3,1*	1	1	4	—	25
Carex hirta	—	—	—	—	—	—	—	—	1	25
Juncus effusus-type	—	—	64	—	32	—	—	—	—	25
Plantago major	—	—	—	—	3	1	—	—	—	10,12,13,24
Poa trivialis-type	—	—	—	48	32	1	13	89	16	17,33
Potentilla anserina	—	1	—	—	3*	—	—	—	—	10,24
Ranunculus repens-type	—	1	—	2	—	—	—	—	—	10,12,13,25
Triglochin palustris	—	—	—	—	—	—	—	2	—	24,27
Perennial ruderals (cl.17):										
Galium aparine	—	—	—	2*	—	—	—	—	—	12,33,38
Urtica dioica	—	4	63	375	3	—	—	1	—	33,38
Reedswamp plants (cl.19):										
Berula erecta	—	3	1	2	2	3	4	3	89	25,33,35
Carex paniculata-type	—	2	—	—	—	—	—	—	3	35
cf. Oenanthe aquatica	—	2	—	—	—	—	—	—	—	
Cladium mariscus	—	32,1*	23	15,3*	7	4	12	6	201,1*	
Eleocharis palustris	—	26,238*	80	6,54*	49,83*	1*	—	116	6,1*	10,16,24
Galium palustre	—	61	—	—	43	—	1	1	—	10,16
Iris pseudacorus	—	—	—	—	3	—	—	—	—	33,35
Lycopus europaeus	2	48	10	—	22	9	17	15	143	35
Phragmites australis	—	—	—	48	148	—	13	79	38	17,24,27
Phragmites australis stem	—	10-s*	—	7*	10,10*	—	—	—	—	17,24,27
Rumex hydrolapathum	—	—	—	—	1?	—	—	—	3	33
Scirpus lacustris tabernaemontani	2	17,71*	52	109,7*	26,8*	8	5	5	12	
Scutellaria galericulata	—	—	4	—	1	—	—	—	2	35
Typha spec.	—	—	—	—	3	—	—	1	—	25
Saltmarsh plants (cl.24):										
Juncus gerardi	—	128	480	144	96	27	2	512	40	10,16,25

Sample number Context Volume (l)	113 hearth 0.3	117 hearth 2	123 dung 2	126 hearth 3	127 hearth 1.5	149 floor 0.25	152 floor 0.1	255 dung 0.5	309 hearth 0.5	Alternative classes
Plants of damp grasslands (cl.25):										
Carex cf. panicea	—	—	—	—	—	—	—	—	1	29
cf. Cirsium palustre	—	—	—	—	—	—	—	—	1	35
Hypericum quadrangulum	—	20	—	—	—	32	—	—	190	
Lychnis flos-cuculi	—	36	—	—	1	1	—	5	268	
Lythrum salicaria	—	16	—	1	35,16*	96	2	25	157	19,35
Stachys palustris	8	11	—	2	3	1	—	1	54	12,13,33
Thalictrum flavum	—	1	—	1	—	1	—	—	2	33
Heathland and bog plants (cl.27-30):										
Hydrocotyle vulgaris	—	3	—	—	4	1	6	—	168	10,16,19,33
Juncus squarrosus	—	—	32	—	—	—	—	1	—	
Juncus subnodulosus	—	16	32	—	—	27	6	112	448	19,25
Sagina nodosa-type	—	—	—	—	—	16	—	—	22	
Stellaria palustris	—	—	—	—	—	—	—	6	14	
Alder carr plants (cl.35):										
Alnus glutinosa	1*	—	—	—	—	—	—	—	—	
Alnus glutinosa catkin axis	—	—	—	—	2*	—	—	—	—	
Alnus glutinosa bud	4*	19,1*	—	—	2,18*	—	—	—	—	
Forest plants of rich soils (cl.38):										
Moehringia trinervia	—	—	—	2	—	—	—	—	—	33
Various:										
Agrostis spec.	—	32	32*	101*	54	2	24	488	48,8*	16,24,25
Atriplex patula/prostrata	—	2,88*	17	12,2*	70	10	24	16	91	11,12,16,17,24
Bromus mollis/secalinus	—	—	—	7*	—	—	—	—	—	
Carex spec. bicarpellate	—	—	—	—	—	—	3	—	—	
Eupatorium cannabinum	—	1	—	1	—	3	—	35	19	17,25
Euphrasia/Odontites spec.	—	—	—	—	—	—	—	2	1	
Euphorbia palustris	—	—	—	—	2	—	—	—	—	25
Gramineae indet.	—	8*	2*	—	6*	—	27	—	—	
Gramineae/Sclerotium	—	1*	—	—	—	—	—	—	—	
Juncus articulatus-type	—	96	128	—	80	—	1	144	24	10,16,25
Juncus spec.	—	16	320	—	—	—	—	112	32	
Juncus spec. non bufonius	—	32*	—	—	32*	—	13*	—	—	
Mentha aquatica/arvensis	1	50	8	51	8	3	4	7	165	12,13,16,19
Molinia-type stem	—	—	—	—	1	—	—	—	—	
Papilionaceae indet.	—	4*	—	—	—	—	—	—	—	
Phalaris arundinacea	—	—	—	—	—	—	—	1	—	16,19,25,33
Rumex spec.	—	1,1*	6	2	—	—	—	—	3	
Salix spec. bud scale	—	—	—	—	9,1*	—	—	—	—	
Anagallis minima/Samolus valerandi	—	—	—	—	—	—	—	—	8	6,10
Trifolium repens/fragiferum	—	7*	—	—	7*	—	—	—	—	
Umbelliferae non Oenanthe	—	—	—	—	1	1	—	—	—	

they were probably redeposited and not *in situ* (Van Trierum *in press*). Samples 612, 615 and 616 are (*in situ*) from Middle Iron Age contexts (see *table 19*). Figure 39 illustrates the location of the samples on this site.

As in Spijkenisse 17-30, the samples, both from Early and Middle Iron Age contexts, are dominated by waterside plants (classes 19 and 11). The Middle Iron Age sample 612 shows extraordinarily large numbers of *Galium aparine* and *Urtica dioica*, both perennials belonging to class 17, characteristic of neglected ruderal places, fallow land, etc. *Galium aparine* can also be a serious pest in wintercrops in traditional agricultural conditions (cf. Reynolds 1981b). In view of the absence of other wintercrop weeds, it seems, however, unlikely that the present cleaver seeds derive from arable fields. Taxa of class 12 (summercrops or dung hills etc.) are more common. In contrast to Spijkenisse 17-30, the site of 17-35 also produced some ecologically restricted (stenoecious) summercrop weeds. They are more or less limited in their occurrence to summer cereal- and root crops. Here we are dealing with *Echinochloa crus-galli*, *Erysimum cheiranthoides* and *Polygonum persicaria*. Plants from meadows (cl. 25) also occur regularly, species from salt environments are very rare again.

A remarkable occurrence is the characteristic fruit of *Xan-*

Table 19. Botanical macroremains of Spijkenisse 17-35. Counted numbers, * = carbonized.

Sample number	506	598	600	604	614	612	615	616	
Volume (l)	1	3.5	2.5	2.5	0.5	3	0.5	1.5	
Context	dung	refuse	dung	dung	hearth	refuse	refuse	refuse	Alternative
Period	EIA	EIA	EIA	EIA	EIA	MIA	MIA	MIA	classes
Crop plants:									
Brassica cf. rapa	—	—	—	—	—	3	1	—	
Camelina sativa	—	1	—	—	—	20	—	—	
Camelina sativa silicle fr.	—	—	—	—	—	18	—	—	
cf. Hordeum vulgare	—	—	—	—	—	2*	—	—	
Hordeum vulgare internode	—	—	2*	—	—	3,18*	—	—	
Hordeum vulgare	—	1*	1*	—	—	4*	—	—	
Hordeum cf. vulgare	—	—	—	—	—	6	—	—	
Hordeum/Triticum internode	—	—	—	—	—	15*	—	—	
Linum usitatissimum	—	15	—	—	—	232	—	—	
Linum usitatissimum capsule fr.	—	1	—	—	—	71	—	—	
Triticum dicoccum glume base	—	—	—	—	—	15,21*	—	—	
Triticum dicoccum spikelet fork	—	—	—	—	—	6,11*	—	—	
Waterplants (cl.3-5):									
Potamogeton spec.	—	4	—	—	—	—	—	—	
Zannichellia palustris	—	3	—	—	—	—	—	—	
Therophytic saltmarsh pioneers (cl.8):									
Salicornia europaea	—	—	—	—	—	—	1	1	24
Tide-mark plants (cl.9):									
Atriplex littoralis-type	—	—	—	—	—	5	—	—	
Ephemeral plants (cl.10):									
Juncus bufonius	32	176	4800	—	—	1120	1920	896	12,13,16,24
Therophytic nitrophilous pioneers (cl.11):									
Bidens cernua	—	1	4	—	—	6	1	—	19
Bidens tripartita	—	15	6	—	—	35	—	5	12,19
Chenopodium rubrum	—	4	20	—	—	1150	2	2	12
Polygonum hydropiper	—	17	13	—	—	14	—	—	12,13,19,33
Polygonum minus	—	88	101	—	—	—	—	6	19
Ranunculus sceleratus	—	241	178	450	—	245	1000-s	420	
Rorippa palustris	—	2	—	—	—	15	110-s	127	
Rumex maritimus	—	22	111	—	—	67,3*	100	25	
Stellaria aquatica	2	22	6	—	—	1997	—	—	
Summercrop weeds (cl.12):									
Capsella bursa-pastoris	—	—	—	—	—	15	—	—	11,16
Chenopodium ficifolium	—	74	19	—	—	1442	—	—	
Echinochloa crus-galli	—	3	—	—	—	73	—	—	
Erysimum cheiranthoides	—	—	2	—	—	—	—	—	
Polygonum aviculare	—	3	—	—	—	4	—	—	24
Polygonum lapathifolium	—	50	—	—	—	389	—	62	11
Polygonum persicaria	—	—	—	—	—	98,1*	173	—	19
Sisymbrium officinale	—	—	—	—	—	184	—	—	
Solanum nigrum	—	3	—	—	—	38	—	—	11
Sonchus arvensis	—	2	—	—	—	—	—	—	
Sonchus asper	—	3	—	—	—	33	—	—	
Sonchus oleraceus	—	—	—	—	—	18	—	—	
Stellaria media	—	5	2	—	—	1670	—	—	
Urtica urens	—	—	—	—	—	34	—	—	
Tread resistant plants (cl.16):									
Carex cf. hirta	—	—	—	—	—	2	—	—	25
Carex cuprina-type	—	6	2	—	—	3	—	—	25
Juncus effusus-type	—	—	480	—	—	362	—	—	25
Plantago major	1	53	5	—	—	283	—	—	10,12,13,25
Poa annua	—	—	—	—	—	18	—	—	10,11,12

Sample number	506	598	600	604	614	612	615	616	
Volume (l)	1	3.5	2.5	2.5	0.5	3	0.5	1.5	
Context	dung	refuse	dung	dung	hearth	refuse	refuse	refuse	Alternative
Period	EIA	EIA	EIA	EIA	EIA	MIA	MIA	MIA	classes
Poa trivialis-type	34	332	502	96	—	2451	228	187	17,33
Potentilla anserina	—	15,3*	5	—	—	2	—	—	10,24
Ranunculus repens-type	—	67	36	—	—	11	—	—	10,12,13,25
Ranunculus sardous	—	1	—	—	—	—	—	—	10,25
Perennial ruderals (cl.17):									
Galium aparine	—	—	—	—	—	107,3*	—	—	12,33,38
Solanum dulcamara	—	—	3	—	1	—	1	—	19,33,35
Urtica dioica	—	164	106	8	—	9974	—	—	33,38
Reedswamp plants (cl.19):									
Alisma plantago-aquatica	—	17	6	—	—	142	—	—	33
Alisma spec. embryo	—	23	6	—	—	196	—	—	33
Berula erecta	2	66	20	29	13	26	4	14	25,33,35
Carex acuta-type	—	172	59	—	—	3	—	—	
Carex acutiformis	—	10	7?	—	—	—	—	—	
Carex paniculata-type	—	23*	4	—	—	11	—	—	35
Carex pseudocyperus	2	2	—	—	—	2	—	—	
Carex riparia	—	13	1	—	1	—	—	—	35
Cladium mariscus	3	35	4	6	63	—	—	3	
Eleocharis palustris	2	783	365	—	—	921	2	—	24
Galium palustre	—	16,5*	10,2*	15	4	66,1*	2	10	10,16,24
Glyceria fluitans	—	21	2	—	—	53	—	—	
Glyceria maxima	1	4	2	—	—	45	—	—	33
Iris pseudacorus	—	15,2*	15	—	1	—	—	1	33,35
Lycopus europaeus	15	46	148	679	166	361	10	119	35
Oenanthe aquatica	—	1	—	—	—	1?	—	—	
Oenanthe fistulosa	—	74,6*	46	—	—	66	—	—	
Phragmites australis	99	4	—	—	—	11	—	—	17,24,27
Phragmites australis stem	10	—	—	—	—	10-s	10-s,3*	—	17,24,27
Rumex hydrolapathum	—	58	6	—	—	81	—	—	33
Sagittaria sagittifolia	—	1	—	—	—	—	—	—	
Scirpus lacustris tabernaemontani	28	2686,3*	1787	1510	200	62	19	516	
Scutellaria galericulata	—	—	—	20	13	10	—	13	35
Sparganium erectum	—	145,5*	9	—	—	1	—	—	33
Typha spec.	216	112	160	—	4	48	—	1	25
Veronica beccabunga-type	16	—	—	—	—	—	—	—	
Saltmarsh plants (cl.24):									
Aster tripolium	—	—	—	—	—	—	—	1	17
Juncus gerardi	—	32	—	—	—	—	16	—	10,16,25
Scirpus maritimus	—	—	—	—	—	—	1	—	
Plants of damp grasslands (cl.25):									
Angelica sylvestris	—	—	—	—	—	4	—	—	33
Caltha palustris	—	1	—	—	—	—	—	—	19,27,33
Carex disticha	—	999,9*	286	—	—	208	1	—	16
Cirsium palustre	—	14?	—	3	—	—	—	—	35
Filipendula ulmaria	—	1	—	—	—	216	—	—	
Hypericum quadrangulum	—	808	960	1048	59	192	17	266	
Lychnis flos-cuculi	—	163	124	—	—	194	2	25	
Lythrum salicaria	716	140	94	3248	66	390	2	182	19,35
Molinia caerulea	—	—	—	—	—	5	—	—	29,30,32,35
Prunella vulgaris	—	—	—	—	—	3	—	—	10,33
Senecio aquatica	—	19	—	—	—	50	—	—	
Stachys palustris	3	2	5	59	11	4	—	6	12,13,33
Thalictrum flavum	—	3	2	—	—	1	—	—	33
Valeriana officinalis	—	—	—	—	—	10	—	—	19,33
Heathland and bog plants (cl.27-30):									
Calluna vulgaris	—	—	—	—	—	48	—	—	

Sample number	506	598	600	604	614	612	615	616	
Volume (l)	1	3.5	2.5	2.5	0.5	3	0.5	1.5	
Context	dung	refuse	dung	dung	hearth	refuse	refuse	refuse	Alternative
Period	EIA	EIA	EIA	EIA	EIA	MIA	MIA	MIA	classes
Calluna vulgaris flower	—	—	—	—	—	4	—	—	
Calluna vulgaris twig	—	—	1	—	—	—	—	—	
Epilobium palustre	—	15	—	—	2	133	—	2	19
Erica tetralix leaf	—	—	2	—	—	10	—	—	25,32
Galium cf. saxatile	—	—	—	—	—	86	—	—	
Hydrocotyle vulgaris	—	15	10	8	—	12	1	4	10,16,19,33
Juncus subnodulosus	—	336	560	—	—	398	48	—	19,25
Pedicularis palustris	—	12	1	—	—	6	—	—	
Potentilla erecta-type	—	15	21	—	—	88	—	—	
Stellaria palustris	—	7	—	—	—	—	—	—	
Shrubs (cl.32-34):									
Myrica gale leaf fr.	—	—	—	—	—	2	—	—	
Myrica gale bud scale	—	—	—	—	—	10-s	—	—	
Prunus spinosa	—	—	—	—	—	5	—	—	
Sambucus cf. nigra	—	1	—	—	—	—	—	—	38
Alder carr plants (cl.35):									
Alnus glutinosa	—	9	5	—	—	23	—	—	
Thelypteris palustris leaf fr.	—	—	—	—	—	6	—	—	19
Forest plants of rich soils (cl.36-38):									
Moehringia trinervia	—	231	150	—	—	—	—	—	
Various:									
Agrostis spec.	756	20	2	80	—	1269	88	103	16,24,25
Alopecurus spec.	—	—	—	—	—	6	—	—	
Atriplex patula/prostrata	6	82	60	33	134	2489	100	15	11,12,16,17,24
Betula cf. pubescens	—	—	—	—	—	11	—	—	
Betula cf. pubescens scale	—	—	—	—	—	1	—	—	
Bromus spec.	—	—	—	—	—	19	—	—	
Carex cf. remota	—	1	—	—	—	—	—	—	
Carex oederi s.l.	—	—	—	—	—	5	—	—	
Cerastium spec.	—	44	42	—	—	261	—	—	
cf. Claviceps sclerotium	—	1	—	—	—	—	—	—	
Epilobium hirsutum-type	—	203	16	—	2	238	—	—	25
Eupatorium cannabinum	3	—	1	42	6	1	—	64	17,25
Euphrasia/Odontites spec.	—	—	4	—	—	12	—	—	
Galeopsis bifida-type	—	—	—	—	—	11	—	—	
Gramineae indet.	32	—	—	—	—	6	—	1	
Juncus articulatus-type	64	752	15680	—	—	1663	32	48	10,16,25
Juncus spec.	—	16	480	—	—	72	48	16	
Mentha aquatica/arvensis	—	1008,12*	283	448	115	211	—	94	12,13,16,19
Myosotis spec.	—	69	4	—	—	134	—	—	
Peucedanum palustre	—	1	—	—	—	—	—	—	19,27,35
Phalaris arundinacea	—	1	—	—	—	19	—	—	16,19,25,33
Rhinanthus spec.	—	7	—	—	—	3	—	—	
Rubiaceae non Galium palustre	—	3	—	—	—	—	—	—	
Rubus caesius	—	9	—	—	—	—	—	—	17,33
Rubus fruticosus s.l.	—	4	—	—	—	—	—	—	
Rumex conglomeratus	—	176,3*	—	—	—	—	—	—	16
Rumex spec.	—	18,5*	43	—	5	320	1	15	
Sagina apetala/procumbens	—	907	1648	—	4	336	32	16	10,16
Trifolium repens flower	—	—	1?	—	—	4	—	—	10,16
Trifolium spec. pod fr.	—	—	—	—	—	1	—	—	
Veronica spec.	—	—	—	—	—	108	—	—	
Viola palustris-type	—	1	—	—	—	7	—	—	
Xanthium strumarium	—	—	—	—	—	1	—	—	

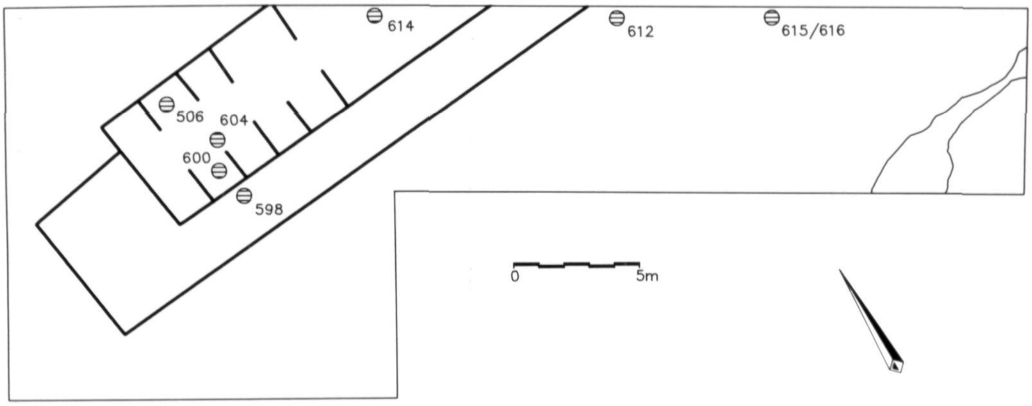


Fig. 39 Location of samples for botanical macroremains in and around the houseplan of Spijkenisse 17-35, scale 1:300.

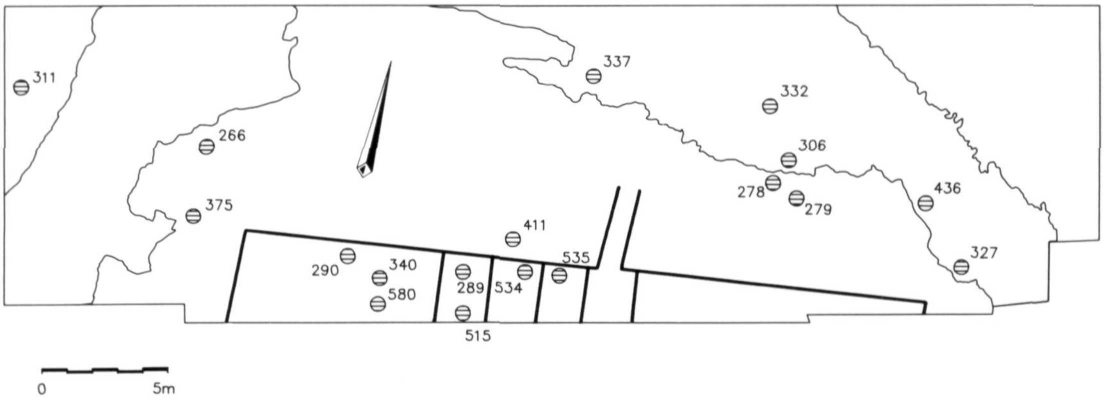


Fig. 40 Location of samples for botanical macroremains in and around the houseplan of Spijkenisse 17-34, scale 1:300.

thium strumarium, which is also found on several other Iron Age sites on Voorne-Putten. This occurrence in Iron Age contexts, and the fact that all west European sites that yielded fruits of this species are situated near rivers, have led Brinkkemper and Kuijper (*in press*) to conclude that the cocklebur was spread by natural agents, and not by man, as was previously assumed (cf. Opravil 1983).

As in Spijkenisse 17-30, salt plants are rather rare, *Salicornia europaea* and *Juncus gerardi* occur in two samples, *Aster tripolium* and *Atriplex littoralis*-type in one. Both Early and Middle Iron Age contexts contain some salt plants.

The eight samples contained on average ca. 50 taxa, but some poor and some very rich samples occurred. The richest sample (expressed in number of taxa), sample 612, revealed 104 taxa (belonging to at least 102 different species), the largest number of all samples analysed in the present study.

4.6.5 The macroremains of Spijkenisse 17-34

Of this Middle Iron Age settlement, 19 samples for botanical macroremains have been analysed. They came from hearths (samples 340, 580 and 580a), from dung layers (samples 289, 290, 411, 515, 534 and 535), from a ditch, contemporary with habitation (samples 266, 278, 306, 311, 327, 332, 337, 375 and 436) and from a floor layer (sample 279). The location of the samples is indicated in figure 40. The results of the analyses are given in table 20.

The presence of the ditch is clearly demonstrated in the large numbers of waterplants (class 5), especially *Callitriche* spec. and *Chara* spec. Furthermore, this is the only site that yielded *Najas marina* fruits. *Najas marina* is typical of fresh or slightly brackish water (Van der Meijden 1990: 471). In this respect, it is interesting to note that as in Spijkenisse 17-30 and 17-34, salt marsh plants (cl. 8, 9 and 24) are present in only very small quantities and few species. The ditch concerned cannot have dried out yearly, since *Chara* and *Najas* indicate the presence of permanently open water.

Waterside plants (cl. 19 and 11) are very markedly present, as may be expected along a ditch. Species of pastures (cl. 25) are much more common than arable weeds (cl. 12), both in terms of numbers of taxa and of seeds.

One weed has been listed as a wintercrop weed (cl. 13:

Table 20. Botanical macroremains of Spijkenisse 17-34. Counted numbers. * = carbonized.

Sample number	266	278	279	289	290	306	311	327	332	337	340	375	411	436	515	534	535	580	580a	
Context	ditch	ditch	floor	dung	dung	ditch	ditch	ditch	ditch	ditch	hearth	ditch	dung	ditch	dung	dung	dung	hearth	hearth	Alternative
Volume (l)	1	1	2	1.5	0.6	2	1.5	1	1	1	0.5	1	1.5	2	0.5	3	3	3	3	classes
Crop plants:																				
Brassica rapa	—	—	1	—	—	—	—	1	1	—	—	—	—	2	—	—	—	—	—	
Camelina sativa	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	
Cerealia indet. fr.	—	—	1*	1*	1*	1*	—	1*	1*	—	—	—	2*	1*	—	4*	35*	—	12	
Hordeum awn fr.	1*	—	4*	—	—	—	—	—	—	—	—	4*	—	—	—	—	—	1*	—	
Hordeum vulgare internode	3*	—	5*	—	2*	4*	—	2*	—	—	—	1	1*	36*	—	9*	28*	2	—	
Hordeum vulgare	—	—	1*	1*	—	—	—	—	—	—	—	—	1*	—	—	—	3*	1,19*	4*	
Linum usitatissimum capsule fr.	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	5*	—	
Linum usitatissimum	1	—	14	—	—	—	1	1	—	1	—	—	—	1	2	—	—	8,14*	7*	
Triticum cf. dicoccum	—	—	1*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3*	4*	
Triticum cf. spelta glume base	—	—	—	—	2*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Triticum dicoccum glume base	—	—	5*	1*	—	—	—	1*	2*	1*	—	—	7*	9*	—	64*	83*	3,1*	9*	
Triticum dicoccum spikelet fork	—	—	2*	—	—	—	—	—	—	—	—	—	3*	—	—	13*	10*	—	—	
Triticum dicoccum glume apex	—	—	1*	—	—	—	—	—	—	—	—	—	—	—	—	96*	289*	—	—	
Triticum spec. awn fr.	—	—	—	—	—	—	—	—	—	—	—	—	—	24*	—	1000*	400*	—	—	
Triticum spec. internode	—	—	8*	—	—	4*	—	—	—	—	—	—	—	—	—	8*	—	1*	—	
Waterplants (cl.3-5):																				
Callitriche spec.	1671	35	4	—	—	155	19	45	74	106	—	376	—	—	—	—	—	61,16*	—	
Ceratophyllum demersum	3	—	—	—	—	—	—	1?	1	2	—	—	—	—	—	—	—	—	—	
Ceratophyllum spec.	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	
Ceratophyllum submersum	2	—	2	—	—	2	—	—	1	—	—	—	—	—	—	—	—	—	—	
Chara spec. oospores	14	850	—	—	—	2152	216	448	512	3041	—	104	—	72	—	48	—	—	—	
Najas marina	4	6	17	—	—	31	—	4	10	53	—	11	—	—	—	—	—	—	—	
Potamogeton spec.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	
Ranunculus sg. Batrachium	—	—	—	—	—	—	10	—	—	—	—	—	—	—	—	—	—	3	—	
Zannichellia palustris	30	134	5	—	—	62	2	5	32	96	—	86	—	—	—	—	—	4	—	
Therophytic saltmarsh pioneers (cl.8):																				
Salicornia europaea	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	24
Tide-mark plants (cl.9):																				
Atriplex littoralis-type	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	
Matricaria maritima	—	—	1	—	—	—	9	—	—	—	—	—	—	—	—	—	—	—	—	
Ephemeral plants (cl.10):																				
Juncus bufonius	464	624	14400	5424	—	3456	1400	672	1536	480	16	288	1488	1680	64	720	2500	16	—	12,13,16,24
Therophytic nitrophilous pioneers (cl.11):																				
Bidens cernua	—	—	16	—	—	2	—	1	1	2	—	1	—	22	—	—	—	2	—	19
Bidens spec	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Bidens tripartita	—	—	9	—	—	2	18	5	—	—	—	—	—	20	9	—	—	1,3*	—	12,19
Chenopodium rubrum	—	38	5	4	1	65	1	42	110	8	1	4	—	60	—	—	—	4	1	12
Polygonum hydropiper	—	—	—	—	—	—	—	11	6	1	—	6	—	6	—	—	—	—	—	12,13,19,33
Polygonum minus	37	1	13	2	—	17	—	16	2	5	—	4	—	17	—	—	—	—	—	19
Ranunculus sceleratus	184	50	22	83	2	114	84	108	7	42	—	130	2	24	—	4	13	101, 22*	12,3*	

Sample number	266	278	279	289	290	306	311	327	332	337	340	375	411	436	515	534	535	580	580a	
Context	ditch	ditch	floor	dung	dung	ditch	ditch	ditch	ditch	ditch	hearth	ditch	dung	ditch	dung	dung	dung	hearth	hearth	Alternative
Volume (l)	1	1	2	1.5	0.6	2	1.5	1	1	1	0.5	1	1.5	2	0.5	3	3	3	3	classes
Rorippa palustris	1	—	—	—	—	—	32	1	—	—	—	—	—	4	—	—	—	3	—	
Rumex maritimus	3	3	—	1	—	1	24	2	—	—	—	8	—	—	—	—	—	2	—	
Stellaria aquatica	44	2	48	162	—	73	69	41	26	6,1*	—	10	—	336	—	—	—	4,3*	3	
Summercrop weeds (cl.12):																				
Chenopodium ficifolium	5	—	63	8	—	64	22	11	4	9	—	—	—	106	—	12,9*	12	4,2	1	
Chenopodium polyspermum	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Echinochloa crus-galli	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1*	1*	—	—	
Hyoscyamus niger	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	
Polygonum aviculare	1	—	4	—	—	—	—	1	4	—	—	1	—	1	—	—	—	—	—	24
Polygonum lapathifolium	13	10	48,1*	87	—	49	53	15	20	1	—	5	2	119	3	—	2	6,5*	1	11
Polygonum persicaria	—	—	62	—	—	—	45	10	—	7	—	—	—	—	—	—	—	—	—	19
P.lapathifolium/persicaria	—	—	—	—	—	—	—	19	—	—	—	—	—	—	—	—	—	—	—	
Solanum nigrum	—	1	—	—	—	1	—	—	2	—	—	—	—	4	—	—	—	—	—	11
Sonchus arvensis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	
Sonchus asper	1	1	3	—	—	4	22	—	—	—	—	—	—	5	—	—	—	3	—	
Stellaria media	9	2	132,1*	2	—	8,8*	—	14	2	—	1	2	—	196	—	—	3?	1,1*	—	
Urtica urens	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	
Wintercrop weeds (cl.13):																				
Cuscuta epilinum	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	
Tread resistant plants (cl.16):																				
Alopecurus geniculatus	—	3	—	—	—	—	175	—	—	—	—	—	—	—	—	—	—	—	—	
Carex hirta	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	1?	—	—	25
Juncus effusus-type	32	128	—	96	—	192	900	32	368	224	16	512	432	48	—	—	1750	—	—	25
Juncus cf. effusus capsule	—	—	—	—	—	—	—	—	—	—	—	—	—	1*	—	—	—	—	—	25
Leontodon autumnalis	—	—	—	—	—	—	8	—	—	—	—	—	—	—	—	—	—	—	—	10,24,25
Plantago major	4	8	14	—	21	32	315	3	4	—	1	16	4	8	—	2	32	27,1*	—	10,12,13,24
Poa trivialis-type	54	22	141	56	464	113	5	12	101	33	—	36	54	78	3	1	112	2	—	17,33
Potentilla anserina	—	—	1	—	—	2	73	1	3	2,2*	—	2	—	4	—	—	—	1	—	10,24
Ranunculus repens-type	11	10	5	—	—	32	74	9	9	21	—	35	—	3	—	—	2	1	—	10,12,13,25
Ranunculus sardous	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	1	—	10,25
Perennial ruderals (cl.17):																				
Artemisia cf. vulgaris	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	12
Galium aparine	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	12,33,38
Solanum dulcamara	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	19,33,35
Urtica dioica	20	17	19	24	16	110	8	28	29	8	5	30	25	190	1	14	64	9	—	33,38
Reedswamp plants (cl.19):																				
Alisma plantago-aquatica	13	10	—	—	—	100	—	112	44	114	—	108,4*	—	—	—	—	30	16,2*	7,3*	33
Alisma spec. embryo	8	13	4	—	13	32	6	15	4	36	—	4	4	—	—	2	—	6,3*	—	33
Berula erecta	1	13	7	4	—	166	1	47	16	44,1*	1	10	—	8	—	—	2	1	7,1*	25,33,35
Carex acuta-type	8	1	—	—	—	20	—	5	12	4	—	36	—	—	—	—	—	—	—	
Carex cf. acutiformis	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	
Carex cuprina-type	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	25
Carex elata	—	—	1	—	—	—	—	—	—	8?	—	—	—	—	—	—	—	—	—	
Carex paniculata-type	—	—	2	—	—	—	—	—	—	4,2*	—	—	—	4	—	1	—	3	1	35
Carex pseudocyperus	—	—	4	—	—	—	—	1	—	1	—	—	8	4	—	—	—	—	—	

Sample number	266	278	279	289	290	306	311	327	332	337	340	375	411	436	515	534	535	580	580a	
Context	ditch	ditch	floor	dung	dung	ditch	ditch	ditch	ditch	ditch	hearth	ditch	dung	ditch	dung	dung	dung	hearth	hearth	Alternative
Volume (l)	1	1	2	1.5	0.6	2	1.5	1	1	1	0.5	1	1.5	2	0.5	3	3	3	3	classes
Carex riparia	—	—	1	—	—	—	2	—	—	—	—	—	—	4?	—	—	—	—	—	35
Cicuta virosa	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	
Cladium mariscus	37	1	52,1*	7	—	110,8*	5	97,3*	104	32	—	25	1	—	—	—	3,1*	6	7	
Eleocharis palustris	54	55	137,1*	28	369,2*	323	67	74	48,2*	60	2	59	37,1*	164,4*	9	87,6*	752,4*	94,43*	4	10,16,24
Galium palustre	—	2*	—	—	—	24	—	2	—	5	—	13	—	4	—	—	—	2	—	10,16
Glyceria fluitans	15	7	9	—	—	9	170	1	2	1	—	8	5	18	—	1	1	50, 113*	8, 309*	
Glyceria cf. fluitans	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	216, 22*	35*	87*	
Glyceria maxima	2	20	1	—	—	20	4	—	10	4	—	8	8	—	—	8	118	3,47*	1,61*	33
Hippuris vulgaris	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1*	—	
Iris pseudacorus	—	—	—	—	—	2	—	—	—	4	—	2*	—	—	—	—	—	—	—	33,35
Lycopus europaeus	—	5	19	30	3,1*	40	1	7	6	42,1*	1	14	60	44	3	—	72,1*	4	—	35
Lysimachia thyrsiflora	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	
Oenanthe aquatica	—	—	—	—	—	—	1	5?	—	—	—	—	—	—	—	—	—	—	—	
Oenanthe fistulosa	—	8	20	5	—	18	—	13	12	15	—	26	—	5	—	—	—	—	—	
Phragmites australis	—	—	3	—	—	—	—	35	18	104	—	—	—	—	3	—	24	—	—	17,24,27
Phragmites australis stem[1]	—	—	—	—	—	—	—	—	—	10-s	—	—	—	—	1	—	—	—	—	17,24,27
Rumex hydrolapathum	10	18	—	—	—	53	—	14	32	79	—	110	—	7	—	—	—	—	—	33
Scirpus lacustris tabernaemontani	86	737	48,45*	19	27	469	15	319	272	265	1	87	8	291	—	33	105	9,12*	16	
Scutellaria galericulata	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	2	—	—	35
Sium latifolium	—	1	—	—	—	—	—	1	—	4	—	23	—	—	—	—	—	—	—	33
Sparganium erectum	—	1	—	—	—	1	2	1	2	5	—	—	—	—	—	1	—	2,4*	1	33
Typha spec.	50	128	6	240	16	456	24	32	—	64	16	32	300	120	—	96	48	34	—	25
Veronica beccabunga-type	592	304	320	48	—	192	—	65	—	64	—	32	—	—	—	—	—	17	—	
Perennial saltmarsh plants (cl.24):																				
Glaux maritima	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	10,27
Juncus gerardi	32	—	136	48	—	128	900	32	32	—	—	—	—	—	—	—	—	16	—	10,16,25
Scirpus maritimus	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	17,19,24
Spergularia maritima/salina	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16
Triglochin maritima	—	—	—	—	—	—	6	—	—	—	—	—	—	—	—	—	—	—	—	
Plants of damp grasslands (cl.25):																				
Alopecurus pratensis	—	—	—	—	—	—	120	—	—	—	—	—	—	—	—	—	—	—	—	
Angelica sylvestris	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	33
Caltha palustris	—	1	—	—	—	13	—	3	2	15	—	4	—	—	—	—	—	—	—	19,27,33
Carex disticha	3	10	39	19	33	54	20	28	30,2*	210, 40*	—	58	6	45	1	—	74	2	3	16
Carex cf. panicea	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	29
Cirsium palustre	—	—	1?	2	—	—	—	1?	—	—	—	—	—	—	—	—	—	—	—	35
Daucus carota	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Filipendula ulmaria	—	1	2	—	—	—	—	2	2	2	—	—	—	1	1	—	—	2	—	
Hypericum quadrangulum	50	8	5	16	18	8	—	—	—	—	—	—	96	24	—	—	6	—	—	
Lychnis flos-cuculi	2	1	39	—	1	48	7	25	16	32	—	4	—	40	—	1	18	5	—	
Lythrum salicaria	404	713	208	—	—	788	24	151	116	41	—	509	192	44	—	96	50	10	3	19,35
Molinia caerulea	2	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	29,30,32,35
Prunella vulgaris	—	—	1	—	—	—	—	—	1	—	—	—	—	1	—	—	—	3	—	10,33
cf. Scirpus sylvaticus	35	—	—	—	—	—	2	32	—	2	—	—	—	—	—	—	—	—	—	

Sample number	266	278	279	289	290	306	311	327	332	337	340	375	411	436	515	534	535	580	580a	
Context	ditch	ditch	floor	dung	dung	ditch	ditch	ditch	ditch	ditch	hearth	ditch	dung	ditch	dung	dung	dung	hearth	hearth	Alternative
Volume (l)	1	1	2	1.5	0.6	2	1.5	1	1	1	0.5	1	1.5	2	0.5	3	3	3	3	classes
Senecio aquaticus	8	2	—	—	—	—	27	4	4	2	—	12	—	—	—	—	—	—	—	
Stachys palustris	1	—	3	1	—	4	—	2	—	3	—	1	2	—	—	—	—	—	—	12,13,33
Thalictrum flavum	—	—	2	—	—	4	—	—	—	—	—	—	—	4	—	—	—	—	—	33
Trifolium dubium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	
Valeriana officinalis	—	—	2	—	1	—	—	—	—	1	—	4	3	—	—	—	5	—	—	19,33
Heathland and bog plants (cl.27-30):																				
Calluna vulgaris	—	—	—	—	—	—	—	—	—	—	—	—	—	24	—	—	—	—	—	
Epilobium palustre	—	1	25	—	—	—	—	1	2	—	—	—	—	8	—	—	—	—	—	19
Erica tetralix	—	—	—	—	—	—	—	—	—	—	16	—	—	—	—	—	—	—	—	25,32
Erica tetralix leaf	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	25,32
Hydrocotyle vulgaris	17	11	36	17	—	59	6	16	24	6	—	16	2	57	—	—	2	2	2	10,16,19,33
Juncus subnodulosus	64	176	543	912	—	1920	—	256	384	96	112	96	768	96	16	—	—	32	—	19,25
Pedicularis palustris	—	—	—	—	—	—	—	—	—	4,1*	—	—	—	—	—	—	—	—	—	
Potentilla erecta-type	—	—	—	—	—	—	—	1	—	—	—	—	—	8	—	—	—	2	—	
Schoenus nigricans	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	
Stellaria palustris	—	—	1	—	—	8	—	3	4	2	—	—	—	1	—	—	—	—	—	
Shrubs (cl.32-34):																				
Myrica gale	—	—	—	4	—	—	—	5	—	—	—	—	—	—	1	—	—	—	—	
Myrica gale bud	—	—	—	2	—	—	—	—	—	—	—	—	—	—	50	—	—	—	—	
Myrica gale bud scale	—	—	—	—	—	—	—	—	—	—	—	—	2	—	100	—	—	—	—	
Prunus spinosa	—	—	3	—	—	3	—	—	1	—	—	—	—	2	—	—	—	—	—	
Alder carr plants (cl.35):																				
Alnus glutinosa	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	15,6*	8,1*	
Alnus spec. catkin axis	—	—	—	—	—	—	—	—	—	—	1*	—	—	—	—	—	—	3	1	
Alnus spec. bud scale	—	—	—	—	2*	—	—	—	—	—	26*	—	—	—	—	—	—	1	—	
Thelypteris palustris leaf fr.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—	—	—	19
Plants of forests on rich soils (cl.36-38):																				
Crataegus laevigata	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	
Various:																				
Agrostis spec.	64	3	—	—	64	320	1	3	55	65	—	—	—	24	—	1	—	—	—	16,24,25
Atriplex patula/prostrata	12	5	106	18	56	115	204	80,1*	124	18	2,1*	20	51	417	1	27	18	12,3*	2	11,12,16,17,24
Avena spec.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Avena-type awn fr.	—	—	2*	—	1*	—	—	—	—	—	—	—	—	24*	—	98*	9*	—	—	
cf. Avena lemma-base	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2*	—	1*	—	
cf. Campanulaceae	—	—	—	—	—	—	24	—	—	—	—	—	—	—	—	—	—	—	—	
Carex oederi s.l.	—	—	—	1	—	8	—	—	—	—	—	—	—	5	—	—	—	—	—	
Carex spec. bicarpellate	—	—	—	—	—	—	3	—	—	1	—	—	—	—	—	1	—	1	—	
Carex spec. tricarpellate	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	
Cerastium spec.	—	2	20	—	—	—	1	6	4	2	—	4	—	32	—	—	—	—	—	
Cirsium arvense	—	—	1	—	—	—	—	—	—	1?	—	—	—	—	—	—	—	—	—	13,17,25
cf. Crepis spec.	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Elymus spec.	—	—	—	—	—	2	—	—	—	1	—	—	—	—	—	—	—	—	—	
Epilobium hirsutum-type	—	—	—	—	—	1	—	1	—	1	—	—	—	—	—	—	—	—	—	25
Eupatorium cannabinum	—	2	1	1	—	—	2	3	4	2	2	—	7	6	—	6	78	—	—	17,25
Euphrasia/Odontites spec.	—	—	1	—	—	—	69	—	2	1	—	—	—	—	—	—	—	—	—	

Sample number	266	278	279	289	290	306	311	327	332	337	340	375	411	436	515	534	535	580	580a	
Context	ditch	ditch	floor	dung	dung	ditch	ditch	ditch	ditch	ditch	hearth	ditch	dung	ditch	dung	dung	dung	hearth	hearth	Alternative
Volume (l)	1	1	2	1.5	0.6	2	1.5	1	1	1	0.5	1	1.5	2	0.5	3	3	3	3	classes
Galeopsis bifida-type	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Galium cf. spurium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	
Gramineae indet.	18	3	1*	—	96	1?	1	—	4	33	—	—	—	—	1	—	72	16	—	
Juncus articulatus-type	448	448	3800	240	—	4224	900	960	1296	992	—	480	2784	840	16	3744	7000	112	—	10,16,25
Juncus spec.	144	112	—	48	—	192	100	128	48	64	—	64	48	—	—	5332	400	—	—	
Luzula cf. multiflora	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	
Mentha aquatica/arvensis	80	102	108	11	25	321	63	154	118	84,1*	—	190	38	64	—	31	90	15,3*	2,2*	12,13,16,19
Myosotis spec.	2	4	4,1*	—	—	60	—	15	8	21	—	4	—	—	—	—	—	—	—	
Phalaris arundinacea	—	—	—	—	—	—	—	3	—	4	—	12	—	8	—	—	—	—	—	16,19,25,33
Potentilla spec.	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Rhinanthus spec.	—	—	—	—	—	—	—	—	—	—	—	—	2	—	3	3	2	—	—	
Rosa spec.	—	—	1	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	
cf. Rosaceae indet.	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	
Rubus fruticosus s.l.	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	
Rubus spec.	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Rumex acetosella	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1*	12,13
Rumex conglomeratus	—	2	—	—	—	—	—	6	—	—	—	—	—	—	—	—	—	—	—	16
Rumex spec.	17	33	16	—	—	56	—	33	18	14,2*	—	95	—	—	1	—	—	9,4*	7	
Sagina apetala/procumbens	16	16	705	—	—	1024	—	96	64	160	—	—	—	384	—	—	—	—	—	10,16
Sagina nodosa-type	—	—	—	—	—	64	—	—	—	—	—	—	—	—	17	—	—	—	—	
Salix spec. bud scale	—	—	—	—	—	—	—	—	—	—	1	12	—	—	—	—	—	—	—	
cf. Samolus valerandi	—	—	—	—	—	—	—	32	2	64	—	—	—	—	—	—	—	—	—	6,10
cf. Scirpus stem fr.	—	—	—	—	2*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Silene dioica/vulgaris	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Solanum spec.	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Umbelliferae cf. Oenanthe	—	—	9	—	—	—	—	—	—	15	—	—	—	—	—	5	55	1	—	
Umbelliferae indet.	4	8	—	—	—	24	—	—	6	—	—	26	1	—	—	—	2	—	—	
Xanthium strumarium spine	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	

[1] The presence of Phragmites stems has not been registrated consistently.

Table 21. Botanical macroremains of Geervliet 17-55. Counted numbers, * = carbonized. (Contexts unknown).

Sample number	1	2	3	Alternative
Volume (l)	0.5	0.5	0.5	classes
Cultivated plants:				
Brassica cf. rapa	—	1*	—	
Camelina sativa	49,8*	5	31	
Camelina sativa silicle fr.	250,12*	78,7*	38,1*	
Camelina sativa silicle fork	3	1	—	
Hordeum vulgare awn fr.	18*	43*	2*	
Hordeum vulgare internode	46,8*	25,2*	41,6*	
Hordeum vulgare	3,1*	1*	4,11*	
Hordeum/Triticum internode	1*	—	—	
Hordeum/Triticum spec.	—	1*	—	
Linum usitatissimum	4	21	71	
Linum usitatissimum caps. fr.	—	42	138	
Triticum dicoccum gl. b.	64,1*	99	95,24*	
Triticum dicoccum intern. + sp.f.	1	—	—	
Triticum dicoccum sp. f.	5	14	36	
Triticum dicoccum/spelta gl. b.	17	84	2	
Triticum dicoccum/spelta sp. f.	—	9	—	
Triticum spec.	—	—	2*	
Triticum spec. internode	12	—	5,9*	
Triticum spec. awn fr.	32*	—	240*	
Waterplants (cl.3-5):				
Callitriche spec.	—	—	1	
Ephemeral plants (cl.10):				
Juncus bufonius	144	416	800	12,13,16,24
Therophytic nitrophilous plants (cl.11):				
Bidens cernua	8	4	—	19
Bidens tripartita	3	4	2	12,19
Chenopodium rubrum	1,1*	—	—	12
Polygonum hydropiper	1*	3	2	12,13,19,33
Polygonum minus	1	4	—	19
Ranunculus sceleratus	1	4	—	
Rorippa palustris	—	—	16	
Stellaria aquatica	—	4	14	
Summercrop weeds (cl.12):				
Anagallis arvensis	—	—	2	
Chenopodium ficifolium	7,7*	19	15	
Echinochloa crus-galli	15	11	6,2*	
Erysimum cheiranthoides	1	—	—	
Polygonum aviculare	1	2	—	24
Polygonum lapathifolium	1	12	6	11
Solanum nigrum	—	—	1	11
Sonchus asper	—	2	8	
Sonchus oleraceus	—	—	1	
Stellaria media	1	3	1	
Tread resistant plants (cl.16):				
Carex hirta	—	—	1	25
Juncus effusus-type	—	304	80	25
Plantago major	—	10	25	10,12,13,24
Poa annua	—	—	1	10,11,12
Poa trivialis-type	40	20	236	17,33
Potentilla anserina	—	1	—	10,24
Ranunculus repens-type	1	4	3	10,12,13,25
Rumex crispus	—	2	3	
Perennial ruderals (cl.17):				
Urtica dioica	—	—	3	33,38
Reedswamp plants (cl.19):				
Carex paniculata-type	—	2	—	35
Cicuta virosa	—	1	—	
Eleocharis palustris	15	67,1*	41,6*	10,16,24
Galium palustre	—	1*	1,1*	10,16
Glyceria fluitans	1	—	—	
Glyceria maxima	—	—	2	33
Lycopus europaeus	3	4	20	35
Oenanthe fistulosa	2	10	5	
Phragmites australis	19	32	—	17,24,27
Phragmites australis stem	4	11,1*	6	17,24,27
Scirpus lacustris tabernae-montani	3	12	2	
Typha spec.	—	1	—	25
Saltmarsh plants (cl.24):				
Juncus gerardi	—	—	64	10,16,25
Spergularia maritima/salina	—	—	16,16*	16
Plants of damp grasslands (cl.25):				
Carex disticha	6	12	18,2*	16
Filipendula ulmaria	1	2	2	
Hypericum cf. quadrangulum	—	2	—	
Lychnis flos-cuculi	5	15	13	
Lythrum salicaria	16	—	34	19,35
Prunella vulgaris	—	9	11	10,33
Trifolium pratense flower	3	—	—	
Trifolium pratense calyx	2	—	—	
Trifolium pratense pod	1	2	—	
Valeriana officinalis	—	1	1	19,33
Vicia cf. cracca	—	2	—	
Heathland and bog plants (cl.27-30):				
Calluna vulgaris leaf	—	4	—	
Epilobium palustre	3	4	3	19
Erica tetralix leaf	—	—	2*	25,32
Hydrocotyle vulgaris	—	3	—	10,16,19,33
Juncus subnodulosus	—	64	80	19,25
Potentilla erecta-type	—	1	—	
Sagina nodosa-type	—	16	—	
Stellaria palustris	—	1	1	
Shrubs (cl.32-34):	—	—	—	
Myrica gale bud scale	—	100-s	8	
Alder carr plants (cl.35):				
Thelypteris palustris leaf fr.	17	6	+	19
Various:				
Agrostis spec.	70	80	410	16,24,25
Atriplex patula/prostrata	2	12	6,2*	11,12,16,17,24
Avena spec.	—	—	1*	
Avena spec. glume	1*	—	1?*	
Avena spec. awn fr.	2*	—	3*	
Bromus spec.	—	11	14	
Carex spec. tricarpellate	—	—	1	
Cerastium spec.	10	10	2	
Epilobium hirsutum-type	—	—	1	
Eupatorium cannabinum	1	—	—	17,25

Sample number Volume (l)	1 0.5	2 0.5	3 0.5	Alternative classes
cf. Eupatorium cannabinum pappus	2	4	—	17,25
Euphrasia/Odontites spec.	1	—	7	
Gramineae indet.	19	26	132	
Hordeum spec.	—	2	4	
Juncus articulatus-type	160	464	1008	10,16,25
Juncus spec.	16	—	16	
Juncus spec. capsule	—	—	1*	
Mentha aquatica/arvensis	7,2*	8	2	12,13,16,19
Myosotis spec.	1*	2	2	
Rhinanthus spec.	—	3	4	
Rumex conglomeratus	1*	12	4	16
Rumex spec.	5	46	13,1*	
Sagina apetala/procumbens	2	66	80	10,16
cf. Senecio spec.	—	1	—	
Sphagnum spec. leaf	—	—	1	
Stellaria neglecta	1	—	—	
Trifolium spec. flower	1	6	1	
Trifolium spec. calyx	1	—	—	
Umbelliferae indet.	—	—	2	

Secalinetea). This is *Cuscuta epilinum* (flax bindweed), which is a parasitic weed in flax fields and does not have wild host plants. It is, however, not at all an indication of autumn-sowing of flax, since it occurs in spring-sown flax as well. Behre (1983) observed that in the flax fields in medieval Haithabu there were also some Secalietea species. He pointed out that this was still the case in recent times, and the reason why the weeds of summercrop flax are looked upon as wintercrop weeds. The total absence of other wintercrop weeds strongly points to spring sowing of flax in Iron Age Spijkenisse.

The summercrop weeds found are dominated by euryoecious species, which are not very informative. On the other hand, some species with more restricted ecological demands have also been found. They are mainly characteristic of cultivated fields (*Echinochloa*, *Sonchus* and *Polygonum*). It is remarkable that the more specific weeds all belong to relatively tall species. This information will be further elaborated on in chapter 6.

The 19 samples yielded on average 51 taxa, with a maximum of at least 78 different species.

4.6.6 The macroremains of Geervliet 17-55

This Middle Iron Age site has not been excavated. During a survey carried out by employees of the B.O.O.R., some pottery fragments with coarse organic tempering material were discovered. Archaeologists assumed that it was grain and I was in the position to confirm this identification. It appeared that the silicles of *Camelina sativa* (gold of pleasure) were used for tempering (see also *4.4.5*). If the pottery was manufactured locally, we may expect *Camelina* remains to be common in the botanical macroremains of the site. This was clearly confirmed in the samples that were obtained by sampling with a corer (see *table 21*). Some levels consisted of virtually nothing but *Camelina* silicles. Remarkably enough, crop weeds are rather scarce in the same samples. As usual, all are summercrop weeds. This is the only site on which a low-growing, stenoecious summercrop weed (i.c. *Anagallis arvensis*) has been found. It is probably connected with the crop concerned. *Camelina* is mostly harvested by uprooting, as was convincingly demonstrated by Körber-Grohne (1967; see also *6.4.3*). With such a harvesting method, low growing weeds will also reach the site.

The waterside vegetations are of considerable importance, as on all other Iron Age sites studied. Tread resistant plants are also well represented. Meadow species are not abundant, but they outnumber the crop weeds. Remarkable is the occurrence of numerous bud remains of *Myrica gale*.

This site has a large number of taxa per sample, on average 67. This is especially large in view of the small volumes of the samples analysed. The taxa found in sample 2 belong to at least 62 different species.

4.6.7 The macroremains of the Late Iron Age sites near Abbenbroek and Zuidland

At the start of the present research, no Late Iron Age sites on Voorne-Putten had been excavated. For this reason it was decided to obtain samples from this period in an alternative way. At the time (1987), six Late Iron Age sites were known from surveys. Three of these were situated so low in relation to the water table that they seemed the most promising with respect to the preservation of waterlogged organic remains. These three were sampled in the banks of ditches, as explained in paragraph 4.1.1.

Table 22 shows that the sample from the site of Abbenbroek 17-22 yielded a few linseed remains as well as two spikelet forks of emmer wheat and two turnip seeds (see *4.4*), which is very meagre for three litres of processed soil. Since the context of the sample is unknown, no conclusions can be drawn from the scarcity of crop plant remains. The great majority of seeds of this site come from waterside vegetations. As in all Iron Age sites around the Bernisse, plants of salt marsh vegetations are very rare. In Abbenbroek, only *Aster tripolium* belongs to this category.

The site of Zuidland 16-15 also yielded one sample. Here, some barley, wheat, linseed and gold of pleasure have been found. The wild plants are dominated by the nitrophilous species *Ranunculus sceleratus* and *Urtica dioica*. Crop weeds, pasture plants and tread resistant species are all rare.

From Zuidland 17-27, two samples have been analysed. Sample number 8 consists of dung and number 9 concerns a dark, hearth-like layer. Both samples contain much grain, both barley and emmer wheat. Linseed is also abundantly present, and there are some gold of pleasure and turnip

Table 22. Botanical macroremains of Abbenbroek 17-22, Zuidland 16-15 and Zuidland 17-27. Counted numbers. * = carbonized. (Contexts unknown).

	Ab. 17-22	Zl.16-15	Zl.17-27	Zl.17-27	
sample nr.	1	1	8	9	Alternative
volume (l)	3	3	5	4.5	classes
Crop plants:					
Brassica rapa	2	—	5	2	
Camelina sativa silicle fr.	—	—	33	12	
Camelina sativa	1*	—	2?	3	
Cerealia indet.	—	2*	—	16*	
Hordeum vulgare	—	5*	12*	62,47*	
Hordeum vulgare awn fr.	—	—	20*	50*	
Hordeum vulgare internodes	—	1,8*	9,44*	123,175*	
Hordeum vulgare lemma	—	—	—	21*	
Linum usitatissimum	1	1,1*	51	117	
Linum usitatissimum capsule fr.	3	8	462,2*	141,4*	
Triticum dicoccum glume base	—	1,5*	—	—	
Triticum dicoccum spikelet fork	2*	5*	—	—	
Triticum dicoccum/spelta glume base	—	—	185,42*	148,24*	
Triticum dicoccum/spelta spikelet fork	—	—	27,27*	39,16*	
Triticum spec.	8	1*?	—	26	
Waterplants (cl.3-5):					
Callitriche spec.	4	—	—	—	
Chara spec. oospores	192	—	—	—	
Therophytic saltmarsh pioneers (cl.8):					
Salicornia europaea	—	—	16	—	24
Tide-mark plants (cl.9):					
Atriplex littoralis-type	—	—	—	1	
Ephemeral plants (cl.10):					
Centaurium spec.	—	—	—	16	16,24
Juncus bufonius	5184	—	8150,64*	4100,288*	12,13,16,24
Therophytic, nitrophilous pioneers (cl.11):					
Bidens cernua	14	—	1	10	19
Bidens tripartita	—	1	258	138	12,19
Chenopodium glaucum/rubrum	—	3	—	—	12
Chenopodium rubrum	61	25	—	10	12
Polygonum hydropiper	4	—	—	—	12,13,19,33
Polygonum minus	—	—	8	—	
Ranunculus sceleratus	132	100-s	133	62	
Rorippa palustris	4	—	—	—	
Rumex maritimus	23	—	516	5	
Stellaria aquatica	10	39,1*	81	15	
Summercrop weeds (cl.12):					
Capsella bursa-pastoris	—	1	4	4	11,16
Chenopodium ficifolium	16	30,2*	—	68	
Echinochloa crus-galli	—	—	225,17*	83,1*	
Polygonum aviculare	—	—	8	2	24
Polygonum lapathifolium	6	8	250	115,6*	11
Solanum nigrum	5	—	26	—	11
Sonchus asper	3	2	216	59	
Sonchus oleraceus	—	—	25	4	
Stellaria media	14	1	4	—	
Sisymbrium officinale	—	—	—	2	
Urtica urens	5	—	—	—	
Tread resistant plants (cl.16):					
Alopecurus geniculatus	—	—	4	—	
Carex cuprina-type	—	—	8	2	25
Juncus effusus-type	—	—	215	144	25
Plantago major	5	26	628	113	10,12,13,24
Poa trivialis-type	—	13	461	48	17,33
Potentilla anserina	2	4	8	3	10,24

	Ab. 17-22	Zl.16-15	Zl.17-27	Zl.17-27	
sample nr.	1	1	8	9	Alternative
volume (l)	3	3	5	4.5	classes
Ranunculus repens-type	—	—	—	9	10,12,13,25
Ranunculus sardous	1	—	8	4	10,25
Triglochin palustris	—	—	162	44	24,27
Perennial ruderals (cl.17):					
Artemisia cf. vulgaris	—	—	—	6	12
Conium maculatum	—	11	—	3	
Solanum dulcamara	2	—	—	—	19,33,35
Urtica dioica	17	100-s	8	—	33,38
Reedswamp plants (cl.19):					
Alisma plantago-aquatica	11	—	40	4	33
Alisma spec. embryo	8	7	16	—	33
Berula erecta	2	—	4	4	25,33,35
Carex acuta-type	—	—	1	2	
Carex paniculata-type	4	—	9	5	35
Carex pseudocyperus	2	—	—	—	
Cicuta virosa	—	—	20	2	
Cladium mariscus	1	1*	8	6,2*	
Cladium mariscus leaf fr.	—	—	—	2,25*	
Eleocharis palustris	27,2*	73,3*	941,4*	245,14*	10,16,24
Galium palustre	—	—	8	15,4*	10,16
Glyceria fluitans	—	—	9	20	
Glyceria maxima	45	1	12	3	33
Iris pseudacorus	—	—	2	—	33,35
Lycopus europaeus	28	7,2*	590	137	35
Oenanthe fistulosa	2	—	29	6	
Phragmites australis	—	—	81	24	17,24,27
Phragmites australis stem	—	—	—	10-s	17,24,27
Rumex hydrolapathum	2	—	—	8	33
Sagittaria sagittifolia	2	—	—	—	
Scirpus lacustris tabernaemontani	72	100-s,4*	735,72*	1030,39*	
Sium latifolium	—	—	62	8	33
Typha spec.	196	1	12	—	25
Veronica beccabunga-type	4	—	—	—	
Saltmarsh plants (cl.24):					
Aster tripolium	11	—	38	34	17
Scirpus maritimus	25	—	1260,18*	—	17,19
Spergularia cf. marginata	—	—	32	4	16
Plants of damp grasslands (cl.25):					
Carex cf. panicea	—	—	—	2	29
Carex disticha	14	16	58	26	16
Hypericum quadrangulum	—	2	4	—	
Lychnis flos-cuculi	5	1	8	8	
Lythrum salicaria	—	8	81	12	19,35
Molinia caerulea	—	1	16	17	29,30,32,35
Prunella vulgaris	—	—	45	21	10,33
Stachys palustris	—	1	—	2	12,13,33
Thalictrum flavum	—	—	8	—	
Heather and bog plants (cl.27-30):					
Andromeda polifolia	6	—	—	—	
Calluna vulgaris	—	—	—	216	
Calluna vulgaris flower	6	—	—	2	
Calluna vulgaris leaf	588*	—	—	44	
Carex cf. flava	—	—	1	—	
Carex cf. nigra	6	—	—	—	
Erica tetralix	384	—	—	—	25,32
Erica tetralix leaf	29,23*	—	9,4*	36,8*	25,32
Hydrocotyle vulgaris	13	18	—	7	10,16,19,33

	Ab. 17-22	Zl.16-15	Zl.17-27	Zl.17-27	
sample nr.	1	1	8	9	Alternative
volume (l)	3	3	5	4.5	classes
Juncus subnodulosus	—	—	215	—	19,25
Sphagnum spec. leaf	1000-s	—	—	100-s	
Shrubs (cl.32-34):					
Myrica gale	6	—	4	—	
Alder carr plants (cl.35):					
Thelypteris palustris leaf fr.	—	—	—	17	19
Forest plants of rich soils (cl.36-38):					
Moehringia trinervia	—	—	—	4	33
Various:					
Agrostis spec.	4	—	1105,8*	594,32*	16,24,25
Atriplex patula/prostrata	38	46,2*	1090	258	11,12,16,17,24
Avena spec.	—	—	1?*	1*	
Avena spec. awn fr.	—	2*	16*	14*	
Carex oederi s.l.	1	1	—	—	
Carex riparia/hirta	—	—	—	2	
Cerastium spec.	—	—	—	8	
cf. Galium spec.	—	1*	—	—	
cf. Lolium perenne	—	—	—	2	
Cruciferae indet.	—	—	—	4	
Eupatorium cannabinum	—	1.5	—	2	17,25
Euphrasia/Odontites spec.	1	16	225	99,12*	
Galium cf. saxatile	—	—	4	—	
Gramineae indet	195	1	16,16*	6	
Hordeum spec.	—	—	1	4	
Juncus articulatus-type	768	—	2466	1152	10,16,25
Juncus spec.	—	—	430	—	
Mentha aquatica/arvensis	14	128	—	20	12,13,16,19
Myosotis spec.	4	—	—	—	
Peucedanum palustre	—	—	18?	4	19,27,35
Phalaris arundinacea	—	—	—	2	16,19,25,33
Poa spec.	—	4*	—	4*	
Rhinanthus spec.	—	1	—	—	
Rumex acetosella	—	—	8	—	
Rumex conglomeratus	—	—	—	2	16
Rumex spec.	9	1*	9	6,4*	
Sagina apetala/procumbens	192	—	—	144	10,16
cf. Sinapis arvensis	—	1	—	—	
Umbelliferae indet.	4	2	46	—	
Vaccinium spec.	—	—	—	2	
Xanthium strumarium	—	—	21	2	

seeds as well. The share of cultivated plants is among the highest of all the sites investigated on Voorne-Putten (see also *4.8.1*).

Sonchus asper and *Echinochloa crus-galli*, both stenoecious summercrop weeds, are present in considerable numbers. Remarkably enough, *Sonchus* is indicative of rich soils, whereas *Echinochloa* occurs on poor, sandy soils (Westhoff/Den Held 1969). This may be attributed to the two different crop types present in the samples, cereals and linseed, which were probably cultivated on different soils. However, more detailed information requires more detailed sampling, which is only possible in excavations.

Regarding the wild plants, apart from the always numerous waterside vegetations, plants from pastures are also of considerable importance, especially if the representatives of class 16 are also seen as indicators of grazing.

The numerous seeds of *Triglochin palustris* are highly remarkable, since they hardly ever occurred in the other sites studied. This site also yielded fruits of *Xanthium strumarium*, a species already discussed in paragraph 4.6.4.

4.6.8 THE MACROREMAINS OF ROCKANJE 08-52

This site was excavated in October 1990, during the final part of the present investigations. Since it was the first Late

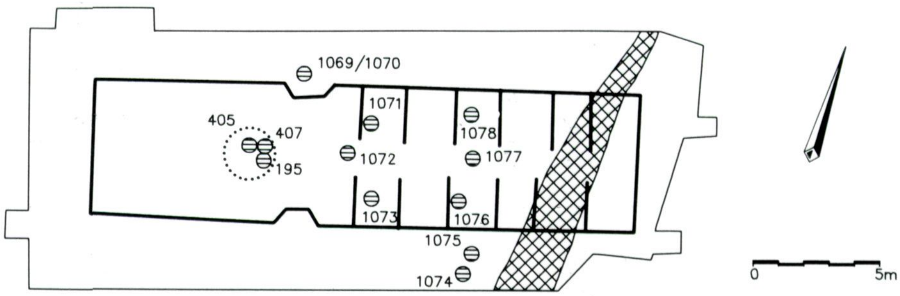


Fig. 41 Location of samples for botanical macroremains in and around the houseplan of Rockanje 08-52, scale 1:300. ..... = hearth.

Iron Age site excavated on Voorne-Putten, and since it was the link between the other Iron Age sites excavated around the Bernisse on the one hand and the Roman sites on Voorne on the other, it has been included in the analyses. This was above all possible thanks to W.J. Kuijper, who undertook the time consuming sortings and identifications of the samples. Twelve samples have been analyzed, the location of these samples is indicated in figure 41. Samples 1073, 1076, 1077 and 1078 are derived from dung in the byre area, samples 230, 282, 405 and 407 contain mainly carbonized remains from hearths. Sample 1070 represents the natural subsoil and samples 1069, 1074 and 1075 are from refuse layers, situated outside the house.

The sample of the natural subsoil is dominated by *Sphagnum*, *Myrica gale* and *Juncus bufonius* (compare *table 23*). *Sphagnum* and *Myrica* belong to raised bog vegetations, where *Myrica* points to strong decomposition, owing to desiccation. Such a terrain apparently served as the basis for settlement.

Of the cultivated plants, *Hordeum*, *Triticum*, *Linum* and *Camelina* have all been found regularly. The crop weeds are represented by several stenoecious summercrop weeds, which reach large numbers in some samples.

The remains from the dung layers in the part of the house with stalls for livestock are strongly dominated by salt marsh plants. Most likely, this biotope has been exploited for livestock grazing territory and/or for hay-making.

Remarkable is the very rare occurrence of reed swamp species, despite the fact that reed stems are abundantly present. In view of this, Westhoff and Den Held (1969) made a significant remark. In the more saline parts of an estuary, the species-rich reed vegetations from the freshwater tidal area show a considerable reduction in numbers of species, without addition of many new ones. Thus the few species associated with the reed stems are additional evidence of the salinity of the environment around Rockanje during the Late Iron Age.

Grasses occur numerously, especially *Poa* and *Agrostis*, but also the rare species of *Parapholis strigosa* has been found.

The small samples yielded a moderate number of taxa, the number of seeds is very large though, especially when the small volumes are considered.

4.6.9 The macroremains of Nieuwenhoorn 09-89

The native Roman settlement found on this site consisted of four building phases, one above the other. It dates from between 57 AD and the first half of the second century AD, as dendrochronological datings have revealed (see *3.1.6*). Samples have been taken from a section of habitation layers about 1 m thick. The data provided by the analysis of the section carried out by W.J. Kuijper, will be discussed first. The individual samples each covered ca. 5 cm of the height of the section. Apart from the section, some other samples from other contexts have been analysed (see *table 24*). The location of the samples is indicated in figure 42.

The main results of the analyses of the section have been presented in a seed diagram (see *fig. 43*). The lower three samples, 3048, 3046 and 3044, consist of different heather species and *Sphagnum* remains. They belong to the natural subsoil on which the settlement had been founded. It was evidently a raised bog.

The following seven samples (3043-3037) consist of dung. Here, these same heathland species occur, but now substantially supplemented with waterside plants, in which *Scirpus maritimus* is the dominant element. *Myrica gale* also occurs regularly in these samples. The samples concerned show a splendid horizontal layering, which must be due to the deliberate spreading out of bundles of plant material, in which *Scirpus maritimus* predominated. These may have been obtained in the close vicinity of the site. The delicate layering is unlikely to have remained intact if livestock was trampling on it in a shed. The spreading out of the material in a very short time may explain the small extent of homogenization and fragmentation. In Feddersen Wierde, a native Roman settlement in northern Germany, Körber-

Table 23. The botanical macroremains of Rockanje 08-52. Counted numbers, * = carbonized.

Sample number Context Volume (l.)	DI-clay 0.15	230 hearth 0.5	282 hearth 0.5	405 hearth 1	407 hearth 0.1	1069 refuse 0.5	1070 subsoil 0.5	1073 dung 0.5	1074 refuse 0.5	1075 refuse 0.25	1076 dung 0.5	1077 dung 0.5	1078 dung 0.5	Alternative classes
Crop plants														
Camelina sativa	—	—	—	—	1*	—	—	—	—	—	—	—	—	
Camelina sativa silicle fr.	—	—	—	—	—	3	—	—	200	—	—	—	—	
Hordeum vulgare awn fr.	—	—	—	—	—	64*	—	—	—	—	—	—	—	
Hordeum vulgare	—	—	3*	3*	4*	17,1*	—	6	—	1	—	—	—	
Hordeum vulgare internode	—	—	—	2*	—	72,69*	—	17	—	2*	96	—	—	
Hordeum/Triticum spec.	—	—	—	—	—	4*	—	—	—	—	—	—	—	
Linum usitatissimum capsule fr.	—	—	—	—	—	9	—	—	—	1	65	—	—	
Linum usitatissimum	—	—	—	3,1*	—	11	—	54	—	—	1	4	—	
Triticum dicoccum glume base	—	—	2	9	12*	18	—	15	—	—	—	—	—	
Triticum dicoccum sp.f.	—	—	—	3	—	9	—	9	—	—	—	—	—	
Triticum spec.	—	—	—	—	—	1	—	—	—	—	1	—	—	
Waterplants (cl.5):														
Potamogeton spec.	—	—	—	3*	—	—	—	—	—	—	—	—	—	
cf. Potamogeton spec. leaf apex	—	—	—	1*	—	—	—	—	—	—	—	—	—	
Therophytic saltmarsh pioneers (cl.8):														
Salicornia europaea	—	—	—	1	—	580	—	104	—	—	576	176	2048	24
Tide-mark plants (cl.9):														
Atriplex littoralis-type	2	—	—	—	—	1	—	—	—	—	67	—	—	
Matricaria maritima	—	—	—	—	—	152	—	28	—	—	1024	—	16	
Suaeda maritima	4	—	—	3	—	260	—	170	—	—	1185	18	116	
Ephemeral plants (cl.10):														
Centaurium spec.	—	—	1	—	—	—	—	32	—	—	—	—	—	16,24
Juncus bufonius	—	—	10	—	10-s	20480	1024	21248	7000	4608	65000	3968	30000	12,13,16,24
Therophytic nitrophilous pioneers (cl.11):														
Chenopodium glaucum/rubrum	—	—	4	1	—	—	32	—	96	64	—	1024	12	
Summercrop weeds (cl.12):														
Polygonum aviculare	—	—	—	3*	—	12	—	5	—	—	197	1	12	24
Polygonum lapathifolium	—	—	—	11*	2*	20	—	47	3	14	435	—	47	11
Sonchus asper	—	—	—	—	—	52	—	12	—	4	996	—	20	
Sonchus cf. oleraceus	—	—	—	—	—	—	—	8	—	—	1	—	4	
Stellaria media	—	—	—	1	1,1*	212	—	216	3	4	2112	—	1118	
Tread resistant plants (cl.16):														
Alopecurus geniculatus	—	—	—	—	—	—	—	64	—	—	32	—	—	
Carex cf. hirta	—	—	—	—	—	—	—	4	—	—	—	—	—	25
Plantago major	—	—	—	24*	2,1*	1424	—	1288	—	32	2176	—	6196	10,12,13,24
Plantago major capsule fr.	—	—	—	—	1	8	—	—	—	—	—	—	—	10,12,13,24
Poa trivialis-type	—	—	—	—	11,72?*	2412	—	1472	6	32	3488	32	—	17,33
Potentilla anserina	—	—	—	—	—	8	—	—	—	4	—	—	—	10,24
Ranunculus repens-type	—	—	—	—	—	—	—	—	—	—	1	—	—	10,12,13,25
Ranunculus sardous	—	—	—	16*	4,19*	134	—	99	3	6	448	—	33	25
Triglochin palustris	—	—	—	—	—	—	—	81	—	—	66	—	—	24,27

Sample number	DI-clay	230	282	405	407	1069	1070	1073	1074	1075	1076	1077	1078	
Context		hearth	hearth	hearth	hearth	refuse	subsoil	dung	refuse	refuse	dung	dung	dung	Alternative
Volume (l.)	0.15	0.5	0.5	1	0.1	0.5	0.5	0.5	0.5	0.25	0.5	0.5	0.5	classes
Perennial ruderals (cl.17):														
Apium graveolens	—	—	—	—	4*	92,1*	—	604	—	—	448	16	1044	
Artemisia cf. vulgaris	—	—	—	—	—	—	—	64	—	—	—	—	—	12
Calystegia sepium	—	—	—	1*	—	—	—	1	—	—	3	—	1	12
Oenanthe cf. lachenalii	—	—	—	—	—	—	—	—	—	—	192	—	—	
cf. Solanum dulcamara buds	—	—	—	—	—	2	—	—	—	—	—	—	—	19,33,35
Urtica dioica	—	—	—	—	—	192	—	64	—	32	2624	—	3072	33,38
Reedswamp plants (cl.19):														
Carex paniculata-type	—	—	—	—	—	—	—	4	—	—	—	—	—	35
Carex pseudocyperus	—	—	—	—	—	—	—	—	—	—	32	2	—	
Cladium mariscus	—	1*	3*	11*	—	—	—	—	—	—	—	—	—	
Eleocharis palustris	—	—	—	4	—	—	—	—	—	—	—	—	—	10,16,24
Galium palustre	—	—	—	6*	—	20	—	24	—	—	195	—	—	10,16
Glyceria maxima	—	—	—	—	—	—	—	—	—	—	—	2	—	33
Iris pseudacorus	—	—	—	1,1*	—	1	—	—	—	—	—	—	—	33,35
Lycopus europaeus	—	—	—	4*	—	—	—	—	—	—	256	—	4	35
Phragmites australis	—	—	—	—	—	4	—	—	—	—	—	—	—	17,24,27
Phragmites australis stem	—	—	10*	100	—	1000	—	1000	—	2	—	10	1000	17,24,27
Rumex hydrolapathum	—	—	—	1?*	—	—	—	2	—	—	—	—	—	33
Scirpus lacustris tabernaemontani	—	—	—	4*	—	8	—	5	—	—	—	—	5	
Scutellaria galericulata	—	—	—	—	—	4	—	—	—	—	129	—	—	35
Saltmarsh plants (cl.24):														
Aster tripolium	2	—	—	—	—	—	—	—	—	—	—	—	—	17
Glaux maritima	—	—	—	8*	—	28	—	120	—	34	391	—	9	10,27
Glaux maritima capsule-fragm.	—	—	—	—	—	308	—	42	—	—	41	—	3078	10,27
Juncus gerardi	—	—	—	—	—	33280	—	28672	9000	21760	90000	3456	90000	10,16,25
Juncus gerardi capsule	—	—	—	—	—	1	—	3	—	—	1500	1	10	10,16,25
Limonium vulgare calyx	—	—	—	—	—	7	—	—	—	—	37	—	1	
Parapholis strigosa	—	—	—	—	—	—	—	1	—	—	—	—	—	
Plantago maritima	—	—	—	6*	—	42	—	107	—	—	157	—	42	12
Plantago maritima capsule fr.	—	—	—	—	—	62	—	139	—	—	900	—	17	12
Puccinellia cf. maritima	—	—	—	—	—	4	—	—	—	—	—	—	—	
Puccinellia distans	—	—	—	—	—	4	—	—	—	—	288	—	—	16
Scirpus maritimus	6	—	—	2*	1*	14	—	49	3	—	1	—	4	17,19
Spergularia maritima-type	—	—	—	76*	—	256	—	324	—	1	384	—	5132	16
Spergularia salina	—	—	—	—	—	—	—	—	—	—	4032	848	—	16
Triglochin maritima	—	—	—	—	—	20	—	125	—	—	205	—	14	
Plants of damp grasslands (cl.25):														
cf. Angelica sylvestris	—	—	—	—	—	—	—	4	—	—	—	—	—	33
Cirsium palustre	4	—	—	—	—	—	—	—	—	—	—	—	—	35
Festuca pratensis	—	—	—	—	—	—	—	19	—	—	—	—	—	
Lychnis flos-cuculi	—	—	—	8	—	—	—	72	—	32	896	—	2052	
Lysimachia vulgaris	—	—	—	—	—	68	—	4	—	—	96	—	—	19
Lythrum salicaria	—	—	—	—	—	192	—	544	—	—	1280	—	2048	19,35
Molinia caerulea	—	—	—	119*	4*	140	—	30	6	—	—	—	8	29,30,32,35
Stachys palustris	—	—	—	1*	—	—	—	—	—	—	—	—	—	12,13,33

Sample number	DI-clay	230	282	405	407	1069	1070	1073	1074	1075	1076	1077	1078	
Context		hearth	hearth	hearth	hearth	refuse	subsoil	dung	refuse	refuse	dung	dung	dung	Alternative
Volume (l.)	0.15	0.5	0.5	1	0.1	0.5	0.5	0.5	0.5	0.25	0.5	0.5	0.5	classes
Heathland and bog plants (cl.27-30):														
Andromeda polifolia	—	—	—	24*	—	—	—	—	—	—	—	—	—	
Calluna vulgaris	—	—	—	—	—	—	768	—	—	—	—	—	—	
Calluna vulgaris flower	—	—	—	—	—	—	88	—	—	—	—	—	—	
Calluna vulgaris leaf	—	—	—	—	—	—	16*	—	—	32*	—	—	—	
Calluna vulgaris twig	—	—	—	1	—	—	—	—	—	—	—	—	—	
Epilobium palustre	—	—	—	—	—	64	—	—	—	32	2496	—	1024	19
Erica tetralix	—	—	—	—	—	256	5120	512	—	256	—	640	—	25,32
Erica tetralix leaf	—	—	—	—	—	—	100,100*	—	—	4	—	—	4	25,32
Eriophorum vaginatum spindle	—	—	1*	10*	—	—	—	—	—	—	—	—		
Galium saxatile	—	—	—	—	—	—	—	32	—	—	64	—	—	
Hydrocotyle vulgaris	—	—	—	—	—	80	—	24	6	—	416	10	32	10,16,19,33
Menyanthes trifoliata	—	—	1*	8*	—	—	—	—	—	—	—	—	—	19
Ranunculus flammula	—	—	—	—	—	—	—	4	—	—	—	—	—	10,16
Shrubs (cl.32-34):														
Myrica gale	—	—	—	—	4*	20	143	16	200	108	1	46	—	
Myrica gale bud	—	—	—	—	—	12	200	5	2	—	—	1	30	
Myrica gale leaf	—	—	—	—	—	2	2	10	2	2	10	2	20	
Alder carr plants (cl.35-37):														
Thelypteris palustris leaf fr.	—	—	—	—	—	3	—	18	—	—	100	2	2	19
Betula spec.	—	—	—	—	—	—	—	4	—	—	—	—	—	
Plants of rich soils (cl.38):														
Moehringia trinervia	—	—	—	12	—	64	—	—	—	—	544	—	—	33
Various:														
Agrostis spec.	—	—	—	—	—	7262	64	23712	—	2304	35392	9024	30000	16,24,25
Atriplex patula/prostrata	40	1*	6*	192*	2,2*	1684	—	755	45,3*	540	12234	198	26692	11,12,16,17,24
Bromus cf. mollis	—	—	—	—	1,2*	21	—	26	—	—	272	—	5	
Carex distans/extensa	—	—	—	2*	—	—	—	—	—	—	—	—	—	16,24
Carex spec.	—	—	—	—	—	4	—	—	—	2	—	2	4	
Cirsium cf. arvense	—	—	—	—	—	—	—	—	—	—	1	—	—	13,17,25
Cochlearia officinalis	—	—	—	—	—	—	—	—	—	—	32	—	—	
Elymus spec.	—	—	—	—	—	—	1	—	—	—	—	—	—	
Eupatorium cannabinum	—	—	—	—	—	—	—	70	—	—	32	—	—	17,25
Euphrasia/Odontites spec.	—	—	—	—	—	4	—	36	—	—	64	—	—	
Festuca cf. rubra	—	—	—	—	—	24	—	—	—	—	19	1	5	
cf. Festuca rubra	—	—	1*	4*	27*	—	—	—	—	—	—	—	—	
Hippophae rhamnoides stellate hair	—	—	—	—	—	—	—	32	—	—	—	—		
Juncus articulatus-type	—	—	—	—	—	—	—	256	—	—	—	—	—	10,16,25
Juncus maritimus	—	—	—	—	—	—	—	—	—	—	1536	3328	6000	16
Juncus maritimus capsule	—	—	—	—	—	—	—	—	—	—	200	—	—	16
Juncus spec. capsule	—	—	—	1*	—	—	—	—	—	—	—	—	—	
Lotus/Trifolium spec.	—	—	—	1*	—	—	—	—	—	—	—	—	—	
Mentha aquatica/arvensis	—	—	—	3,28*	—	—	—	—	—	—	64	—	4	12,13,16,19
Menyanthes trifoliata	—	—	—	—	—	—	1	—	—	—	—	—	—	19
Molinia caerulea	—	—	—	—	4?*	140	—	30	6	—	—	—	8	

Sample number	DI-clay	230	282	405	407	1069	1070	1073	1074	1075	1076	1077	1078	
Context		hearth	hearth	hearth	hearth	refuse	subsoil	dung	refuse	refuse	dung	dung	dung	Alternative
Volume (l.)	0.15	0.5	0.5	1	0.1	0.5	0.5	0.5	0.5	0.25	0.5	0.5	0.5	classes
cf. Oenanthe spec.	—	—	—	—	—	4	—	108	—	2	—	—	—	
Papilionaceae pod fr.	—	—	—	—	—	—	—	—	—	—	2	—	6	
cf. Poa spec.	—	—	1*	16*	—	—	—	—	—	—	—	—	—	
cf. Rorippa palustris	—	—	—	—	—	—	—	—	—	—	64	—	—	
Sagina apetala/procumbens	—	—	—	—	—	1280	—	512	—	—	2048	—	—	10,16
Samolus valerandi	816	—	—	—	—	—	—	—	—	—	—	—	—	6,10
Samolus valerandi/Anagallis minima	—	—	—	—	—	—	—	544	—	—	4288	—	2000	6,10
Sphagnum spec. capsule lid	—	—	—	—	—	—	72	1	1	—	—	—	—	
Sphagnum spec. leaf	—	—	—	10-s	10-s	10000	100	100	100	1000	100	20	100	
Stellaria cf. palustris	—	—	—	5*	—	—	—	—	—	—	—	—	—	
Trifolium cf. repens	—	—	—	—	11*	—	—	—	—	—	—	—	—	10,16
Trifolium repens flower	—	—	—	—	10	200	—	93	—	—	34	—	6	10,16
Vicia cf. cracca	—	—	—	—	—	9	—	—	—	—	—	—	—	
Vicia spec.	—	—	1*	—	4*	—	—	—	—	—	—	—	—	

Grohne (1967) observed that in the drainage that served to let the dung flow out, reed and bulrush stems were preserved in their entire length. Fragmentation was much greater in the pure dung layers. However, this cannot be the case in Nieuwenhoorn, as the central part of the stall is sampled.

In the next nine samples (3036-3029), which all have a dung matrix, huge numbers of *Juncus gerardi* seeds occur, while the heathland species vanish. *Aster tripolium* shows maximum numbers in sample 3036. *Plantago major* and *Atriplex patula/prostrata* increase strongly. It is remarkable that in comparison with Rockanje II (see *4.6.10*), typical salt marsh plants are of limited importance in these samples, whereas freshwater species like *Lycopus* and *Lythrum* reach large quantities. *Juncus bufonius* reaches its highest densities in the uppermost two dung samples.

In the four uppermost samples, crop plants, mainly *Hordeum vulgare* (barley) and *Triticum* spec. (wheat), furthermore some *Vicia faba* (Celtic bean) and *Linum usitatissimum* (linseed, flax) begin to appear, apart from the occurrence of *Linum* in sample 3039 and some *Hordeum* in 3036 and 3031. These four samples were taken from hearths. The rarity of crop plants in samples 3043-3029, the delicate layering and the uniform composition of species is another indication that this deposit was formed in a short time. In another part of the same section, there is a hearth present below this uniform deposit. Therefore, the site was already inhabited before this deposit was formed. This indicates that the uniform layers were deposited after the building of the first house on the site. It cannot have served to allow for habitation of the raised bog prior to the first habitation phase. Possibly, it was added relatively rapidly in the course of habitation. At the moment, the reason can only be guessed at. The terrain could for instance have become wetter due to compaction or erosion of the underlying peat.

Such deliberate deposition of material to raise the settlement area reminds us of the practice in the northern part of the Netherlands and Germany. There, such raises resulted in the formation of dwelling mounds (*Terpen*, *Wierden*) during the first centuries AD or even already during the Iron Age. Apparently, the aquatic conditions were more favourable on Voorne-Putten, since high mounds were not formed there, despite the fact that habitation did occur in the second and third centuries AD.

The four uppermost samples of the section are from an ashy deposit, the hearth of the second building phase. Thus, sediments that belong to the third and fourth building phases are no longer extant.

The other samples studied come from different contexts. Highly remarkable was the discovery of excrements of goats/sheep inside the house of the first phase (sample 2002). Apparently, the lack of well-defined stalls, which are so characteristic of Iron Age farms on Voorne-Putten, does not mean that no domesticates were housed at all. Analysis of

Table 24. Botanical macroremains of Nieuwenhoorn 09-89. Counted numbers, * = carbonized.

Sample number	2002	3001	3009	3049	3056	3048	3046	3044	3043	3042	3041	3040	3039	3038	3037	3036	3035	3034	3033	3032	3031	3030	3029	3028	3027	3026	3025	
Context	goat? dung	hearth	hearth	hearth	hearth	subsoil	subsoil	subsoil	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	hearth	hearth	hearth	hearth	Alternative
Volume (l)	0.01	1.5	0.5	2.5	2	1.5	0.5	0.75	0.5	1.5	1	0.75	1	0.5	0.5	1.5	0.75	0.5	0.5	0.5	0.5	0.5	1	1.5	1	1	1.5	classes
Crop plants:																												
Brassica rapa	-	8*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Camelina sativa	-	5*	4,1*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cerealia indet.	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6*	2*	2*	-	
Cerealia indet. rachis base	-	-	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Hordeum vulgare	-	36*	23,18*	25*	1*	-	-	-	-	-	-	-	-	-	-	2*	-	-	-	-	-	-	-	23*	57*	4*	8*	
Hordeum vulgare internode	-	497*	6,83*	167*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1*	-	-	308*	362*	2*	39*	
Hordeum vulgare awn fr.	-	-	146*	42*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100-s*	10-s*	-	4*	
Hordeum vulgare lemma	-	-	6*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Linum usitatissimum	-	1	1	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	-	-	10*	2*	-	-	
Linum usitatissimum capsule fr.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Triticum dicoccum	-	1*	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1*	-	-	
Triticum dicoccum gl.b.	-	17*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9*	5*	1*	-	
Triticum dicoccum sp.f.	-	-	-	16*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2*	-	1*	-	-	
Vicia faba	-	-	-	7*	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6*	3*	-	-	
Therophytic saltmarsh pioneers (cl.8):																												
Salicornia europaea	-	592	8	-	-	-	-	-	-	-	8	-	-	-	-	128	32	-	-	-	-	-	-	-	-	-	72,16*	24
Tide-mark plants (cl.9):																												
Atriplex littoralis-type	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	19	42	-	1	-	-	-	-	-	-	-	-	
Matricaria maritima	-	40,32*	-	-	-	-	-	-	-	-	-	-	-	-	-	200	-	-	-	-	-	-	16*	-	-	-	-	
Suaeda maritima	-	40	-	-	-	-	-	-	-	-	-	-	1	-	-	264	16	-	-	4	-	-	-	-	-	-	-	
Ephemeral plants (cl.10):																												
Anagallis minima	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	256	-	-	-	-	-	-	-	-	-	-	-	16,24
Centaurium spec.	-	-	16	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Juncus bufonius	-	25344	208	520	-	-	-	768	720	3600	896	608	320	96	3072	1152	2560	145	544	3200	1344	6912	13312	960	-	-	192	12,13,16,24
Therophytic nitrophilous pioneers (cl.11):																												
Bidens tripartita	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	1	1	-	-	-	-	12,19
Chenopodium glaucum	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	4	-	1	-	-	-	-	-	-	
Chenopodium rubrum	-	5086,896*	-	-	32	-	-	-	4	10	-	-	12	-	56	8912	2320	28	-	-	7	28	-	5	-	-	8	12
Ranunculus sceleratus	-	72	2	6	-	-	-	-	12	10	-	24	20	8	4	648	200	-	50	32	11	44	-	-	8,8*	-	-	
Rumex maritimus	-	-	-	-	-	-	-	-	5	-	-	-	6	11	21	167	42	10	2	-	1	-	-	-	-	-	-	
Summercrop weeds (cl.12):																												
Chenopodium ficifolium	-	-	5	11*	-	-	-	-	-	20	-	4	4	-	-	-	-	-	-	-	-	-	-	9,4*	562	292	1123	
Polygonum aviculare	-	-	-	16*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1*	1	1	3	24
Polygonum lapathifolium	-	40	-	1,1*	-	-	-	-	-	-	-	-	-	-	-	-	8	1	-	-	-	-	-	-	1*	-	-	11
Polygonum persicaria	-	-	-	2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	19
Solanum nigrum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	97	328	-	-	-	-	-	-	-	-	-	-	11
Sonchus asper	-	16	14	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	
Sonchus cf. oleraceus	-	-	4	-	-	-	-	-	-	-	-	-	-	1	-	-	9	-	-	-	-	-	-	-	-	-	-	
Stellaria media	-	-	-	3*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4*	-	-	-	
Wintercrop weeds (cl.13):																												
Avena fatua flowerbase	-	1?*	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
Cuscuta epilinum	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tread resistant plants (cl.16):																												
Alopecurus geniculatus	-	-	-	-	-	-	-	-	-	60	-	-	-	-	-	-	-	-	-	-	-	-	-	2*	-	-	-	
Plantago major	-	1704,72*	5	58,127*	64	-	-	-	-	-	-	8	4	-	4	1224	616	22	4	130	134	10	32,8*	150,74*	48*	36*	-	10,12,13,24
Poa trivialis-type	-	2144	19	-	-	-	-	-	-	-	-	8	-	-	-	-	8	-	-	-	1?	-	2560	-	-	-	-	17,33
Potentilla anserina	-	16	-	21,3*	-	-	-	-	-	-	-	-	-	-	-	-	8	-	1	1	1	4	-	1,1*	1	1*	1,2*	10,24
Ranunculus sardous	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,25
Triglochin palustris	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24,27

Perennial ruderals (cl.17):

Sample number	2002	3001	3009	3049	3056	3048	3046	3044	3043	3042	3041	3040	3039	3038	3037	3036	3035	3034	3033	3032	3031	3030	3029	3028	3027	3026	3025	
Context	goat? dung	hearth	hearth	hearth	hearth	subsoil	subsoil	subsoil	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	hearth	hearth	hearth	hearth	Alternative
Volume (l)	0.01	1.5	0.5	2.5	2	1.5	0.5	0.75	0.5	1.5	1	0.75	1	0.5	0.5	1.5	0.75	0.5	0.5	0.5	0.5	0.5	1	1.5	1	1	1.5	classes
Apium graveolens	-	112	-	19,3*	-	-	-	-	-	-	-	-	-	-	-	192	32	-	-	-	-	-	-	-	8	-	-	
Artemisia vulgaris	-	-	-	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
Calystegia sepium	-	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
Oenanthe cf. lachenalii	-	752,24*	-	-	-	-	-	-	-	-	-	-	-	-	56	-	-	-	-	-	-	-	-	-	-	-	-	
Solanum dulcamara	-	16	-	-	-	-	-	-	1	-	-	-	1	-	-	-	16	6	-	-	-	-	-	-	-	-	-	19,33,35
Urtica dioica	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33,38
Reedswamp plants (cl.19):																												
Berula erecta	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25,33,35
Carex acuta-type	-	-	4	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Carex pseudocyperus	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cladium mariscus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1*	-	-	
Eleocharis palustris	-	664,104*	5	1645,2*	**2884,704***	-	-	-	3	8	16	12	59	60	326	1234	192	40	73	119	81,2*	210	6360,32*	1139,506*	65,119*	84*	13,110*	10,16,24
Galium palustre	-	72,8*	18,1*	-	-	-	-	-	-	4	-	-	5	5	8	-	-	-	1	-	-	-	-	-	-	-	-	10,16
Glyceria maxima	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	33
Iris pseudacorus	-	-	-	-	-	-	-	-	-	27,1*	7	-	1	-	-	-	-	-	-	-	-	-	-	1*	-	-	-	33,35
Lycopus europaeus	-	640,32*	49,12*	28,33*	-	-	-	-	19	30	16	8	5	8	32	876	112	12	35	28	7	62	-	4*	16,8*	-	8,12*	35
cf. Oenanthe fistulosa	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Phragmites australis	-	32	9	-	-	-	-	-	-	-	-	-	57	-	-	8	32	38	93	-	-	-	-	-	-	-	-	17,24,27
Phragmites australis stem	-	-	10,10*	-	-	-	-	-	-	-	-	-	-	-	-	10-s,10*	-	-	-	-	-	-	-	-	10-s*	-	-	17,24,27
Rumex hydrolapathum	-	-	1	-	-	-	-	-	1	25	2	3	5	2	4	-	-	-	-	-	-	1?	-	-	-	-	-	33
Scirpus lacustris tabernaemontani	-	3,2*	2	-	-	-	-	-	6	29	-	-	4	-	139	168	-	-	-	-	-	-	-	-	-	-	42	
Typha spec.	-	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25
Veronica beccabunga-type	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Saltmarsh plants (cl.24):																												
Aster tripolium	-	552,216*	-	3	-	-	-	-	-	-	-	-	-	4	38	625	90	-	7	1	3	1	-	-	-	-	-	17
cf. Puccinellia distans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3*	-	-	-	
Glaux maritima	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	10,27
Juncus gerardi	-	84480	560	10040	-	-	-	-	48	480	-	-	96	752	22400	55936	200192	110	2368	6272	7296	33280	61440	17280	2048	-	7744	10,16,25
Juncus cf. gerardi	-	-	48*	1610*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,16,25
Puccinellia distans	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
Scirpus maritimus	-	960,247*	264,7*	165,606*	-	-	-	-	40	540	1496,8*	425	532	383,2*	5688	9988	1109	66,1*	89	102	111	143	644,24*	184,280*	1,14*	20*	-	17,19
Spergularia maritima/salina	-	96	-	42,14*	-	-	-	-	-	-	-	-	-	4	-	-	-	2	-	-	-	-	-	-	-	-	-	16
Triglochin maritima	-	1	1	21	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	3	18	2	-	-	4	
Plants of damp grasslands (cl.25):																												
Carex disticha	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	4*	16
Cirsium cf. palustre	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	8	2	-	-	-	-	-	-	-	-	-	-	35
Filipendula ulmaria	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Hypericum quadrangulum	-	768	16	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Hypericum cf. quadrangulum	-	-	16*	14*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Lychnis flos-cuculi	-	48	-	2,9*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1*	-	-	-	
Lysimachia vulgaris	-	40	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19
Lythrum salicaria	-	**12768**,1536*	36	70,33*	-	-	-	-	4	30	128	16	272	16	36	640	128	12	8	128	1	1844	24	-	192	-	128	19,35
Lythrum salicaria capsule	-	-	8*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5*	-	-	19,35
Molinia caerulea	-	24	19	1*	-	-	-	-	-	-	-	-	-	-	12	-	-	-	-	1	2	-	-	-	-	-	-	29,30,32,35
Prunella vulgaris	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	10,33
Trifolium cf. arvense	-	-	-	21*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8*	-	-	-	10,33
Valeriana officinalis	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19,33
Heathland and bog plants (cl.27-30):																												
Andromeda polifolia	-	-	1	-	-	4	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Andromeda polifolia leaf	-	-	-	-	-	1,2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Calluna vulgaris	2	-	80	-	-	1920	-	-	48	480	512	64	32	36	-	10-s	-	-	1	-	-	-	-	-	-	-	-	
Calluna vulgaris flower	-	-	22	-	-	240	-	-	7	52	40	-	1	3	256	-	-	-	-	-	-	-	-	-	-	-	-	
Calluna vulgaris leaf	-	-	20	14*	-	1000-s	-	-	100-s	100-s	100-s	10-s	100-s	100-s	16,4*	-	-	-	-	10-s*	10-s*	-	-	-	-	-	-	
Calluna vulgaris twig	-	-	1	-	-	-	-	-	-	2	16	-	3	-	-	-	-	-	-	10-s	-	-	-	-	-	-	1	
Erica tetralix	-	-	48	-	-	2432	1792	4096	272	120	128	64	-	64	-	-	-	-	-	-	-	-	-	-	-	-	-	25,32
Erica tetralix leaf	9*	-	128,9*	-	-	1677	6	32,852*	100-s	100-s	10-s	10-s	10-s	10-s	8	-	-	-	-	10-s	10-s	-	-	102*	3*	-	1*	25,32
Erica tetralix twig	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25,32
Eriophorum vaginatum spindle	-	-	-	-	-	1	100-s	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Hydrocotyle vulgaris	-	48	-	3	-	-	-	20	1	-	-	-	-	-	4	24	-	-	-	-	-	-	-	-	8	-	-	10,16,19,33
Juncus subnodulosus	-	-	32	-	-	-	-	-	336	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19,25
Rhynchospora alba	-	-	-	-	-	-	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Sample number	2002	3001	3009	3049	3056	3048	3046	3044	3043	3042	3041	3040	3039	3038	3037	3036	3035	3034	3033	3032	3031	3030	3029	3028	3027	3026	3025	
Context	goat? dung	hearth	hearth	hearth	hearth	subsoil	subsoil	subsoil	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	dung	hearth	hearth	hearth	hearth	Alternative
Volume (l)	0.01	1.5	0.5	2.5	2	1.5	0.5	0.75	0.5	1.5	1	0.75	1	0.5	0.5	1.5	0.75	0.5	0.5	0.5	0.5	0.5	1	1.5	1	1	1.5	classes
Sphagnum spec. capsule	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sphagnum spec. capsule lid	-	-	-	-	-	176	22	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sphagnum spec. leaf	-	32	-	-	-	10000-s	1000-s	-	-	10-s	-	10-s	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Shrubs (cl.32-34):																												
Myrica gale	-	8	590,3*	-	-	-	-	-	2	5	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Myrica gale catkin axis	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Myrica gale bud	10	-	17	-	-	-	-	-	9	28	8	10-s	2	2	8	-	-	10-s	1	6	10-s	4	-	-	-	-	-	
Myrica gale leaf fr.	-	-	12	-	-	-	-	-	10-s	10-s	-	1	10-s	-	-	-	-	1	3	10-s	-	10-s	-	-	-	-	-	
Alder carr plants (cl.35):																												
Carex cf. elongata	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Various:																												
Agrostis spec.	-	4032	779	-	-	-	-	-	24	360	-	-	-	52	584	672	5248	31	28	33	69	788	256?	-	-	-	-	16,24,25
cf. Agrostis spec.	-	-	8*	51*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66*	-	-	-	-	-	-	16,24,25
Althaea officinalis	-	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	17
Arenaria serpyllifolia macrocarpa	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12,20,21
Atriplex patula/prostrata	-	368,64*	246,80*	171,68*	-	-	-	-	93	72	24	13	33	16	85	1504	467	4	4	2	3	16	8	23,49*	65,61*	28*	65,201*	11,12,16,17,24
Avena spec. awn fr.	-	-	-	23*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	164*	83*	-	-	
Betula spec.	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bromus mollis/arvensis	-	3*	8*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bromus spec.	-	-	3,10*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5*	4*	-	-	
Carex spec. bicarpellate	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2*	-	-	-	
Carex cf. rostrata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	19,28
Carex spec. tricarpellate	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4*	-	-	-	
Cerastium spec.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	1	-	-	-	-	-	-	
Elymus spec.	-	-	-	2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Eupatorium cannabinum	-	120	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17,25
Euphrasia/Odontites spec.	-	392,64*	15	18,42*	-	-	-	-	-	-	-	-	-	-	4	256	24	-	9	8	1	12	-	29,46*	8,32*	8*	44*	
Festuca rubra/ovina	-	7,3*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	
Gramineae indet.	-	-	10	1*	-	-	-	-	-	-	-	-	1	-	1	-	-	-	8	-	-	-	-	63*	1*	12*	8*	
Hordeum spec.	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Juncus articulatus-type	-	768	-	-	-	-	-	-	16	-	-	96	64	64	256	128	-	10	96	-	64	768	1280	160	-	-	-	10,16,25
Juncus maritimus	-	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
Juncus spec.	-	-	16	3	1000-s	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	320	-	4,128*	-	
Juncus spec. capsule	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	
cf. Lolium spec.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	
Lotus spec.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1*	-	-	-	
Luzula multiflora	-	-	1	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Lysimachia spec.	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	5	1	-	-	-	-	-	-	-	-	
Malvaceae indet.	-	-	-	3*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Malva/Althaea spec.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	
Medicago/Melilotus spec.	-	8*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Mentha aquatica/arvensis	-	1488	138,24*	15,3*	32	-	-	-	16	10	-	8	24	8	96	1536	120	20	27	8	7	4	8	12	16	-	-	12,13,16,19
cf. Oenanthe spec.	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	97	88	3	15	8	4	10	32	1,7*	26,1*	-	12	
Papilionaceae indet.	-	-	-	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Papilionaceae pod fr.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Peucedanum palustre	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19,27,35
Poa spec.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16*	-	-	
Potentilla spec.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8*	
Rhinanthus spec.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	
Rubus fructicosus s.l.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Rumex crispus/obtusifolius	-	-	-	2,1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Rumex spec.	-	8	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	8	4	-	-	-	
Sagina apetala/procumbens	-	768	-	-	-	-	-	-	-	-	128	-	32	-	128	-	-	-	-	-	-	-	-	-	-	-	-	10,16
Salix spec. bud	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Anagallis minima/Samolus valerandi	-	-	96,16*	-	-	-	-	-	16	-	-	-	-	-	768	-	512	-	-	-	128	-	-	-	-	-	-	
Trifolium spec. flower fr.	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	-	-	2	-	-	-	-	-	
Umbelliferae indet.	-	-	-	90,43*	64	-	-	-	-	-	8	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	

Table 25. Botanical macroremains of Rockanje II, trench 1. Counted numbers.

Sample depth (cm ÷ NAP)	131-133	140-145	145-150	153-158	163-168	
Context	heightening material for all samples					Alternative
Volume (l)	0.25	0.75	0.75	0.75	0.5	classes
Crop plants:						
Hordeum vulgare	1	—	—	5	—	
cf. Hordeum vulgare	—	—	—	35	—	
Hordeum vulgare internode	—	—	5	130	—	
Triticum dicoccum glume base	—	—	—	1	—	
Waterplants (cl.3-5):						
Chara spec. oospores	16	—	64	32	3	
Potamogeton spec.	—	—	—	1	—	
Zannichellia palustris	2	—	—	2	2	
Therophytic saltmarsh pioneers (cl.8):						
Salicornia europaea	1	—	—	4	—	24
Tide-mark plants (cl.9):						
Atriplex littoralis-type	—	—	—	3	—	
Matricaria maritima	—	5	8	259	5	
Suaeda maritima	—	7	2	—	—	
Ephemeral plants (cl.10):						
Centaurium spec.	16	—	—	16	—	16,24
Juncus bufonius	1175	432	528	320	14	12,13,16,24
Therophytic nitrophilous pioneers (cl.11):						
Alopecurus aequalis	—	—	—	32	—	
Chenopodium glaucum	—	92	—	4	—	
Chenopodium rubrum	1	138	11	157	9	12
Ranunculus sceleratus	16	—	13	4	9	
Rumex maritimus	—	—	—	5	—	
Summercrop weeds (cl.12):						
Capsella bursa-pastoris	—	13	1	7	—	11,16
Chenopodium ficifolium	8	477	50	657	13	
Erysimum cheiranthoides	—	110	52	—	—	
Euphorbia helioscopia	—	1	—	—	—	
Lepidium ruderale	—	—	1	2	—	
Polygonum aviculare	7	56	28	559	1	24
Polygonum lapathifolium	4	2000	54	93	—	11
Sisymbrium officinale	—	—	—	11	—	
Solanum nigrum	—	—	—	4	—	11
Sonchus asper	1	49	7	670	4	
Sonchus cf. arvensis	—	—	—	50	—	
Sonchus oleraceus	—	35	9	491	2	
Stellaria media	1	256	20	103	1	
Tread resistant plants (cl.16):						
Carex cuprina-type	—	1	2	4	—	25
Leontodon autumnalis	—	—	4	29	—	10,24,25
Plantago major	25	7000	33	1100	17	10,12,13,24
Poa annua	—	—	—	11	—	10,11,12
Poa trivialis-type	39	12	35	264	19	17,33
Potentilla anserina	14	6	20	251	2	10,24
Ranunculus repens-type	—	—	—	1	—	10,12,13,25
Perennial ruderals (cl.17):						
Apium graveolens	—	—	—	3	1	
Artemisia cf. vulgaris	—	—	—	2	—	12
Oenanthe lachenalii	—	—	—	2	—	
Reedswamp plants (cl.19):						
Berula erecta	—	2	5	11	—	25,33,35
Carex acuta-type	—	—	—	3	—	
Eleocharis palustris	4	1	5	40	2	10,16,24
Glyceria maxima	—	—	1	—	—	33

Sample depth (cm ÷ NAP)	131-133	140-145	145-150	153-158	163-168	
Context	heightening material for all samples					Alternative
Volume (l)	0.25	0.75	0.75	0.75	0.5	classes
Phragmites australis	6	80	33	25	6	17,24,27
Phragmites australis stem	—	100-s	100-s	—	—	17,24,27
Poa cf. palustris	—	—	—	4	—	16
Scirpus lacustris tabernaemontani	24	8	27	277	1	
Typha spec.	16	17	—	32	10	25
Saltmarsh plants (cl.24):						
Aster tripolium	—	—	2	54	—	17
Glaux maritima	3	—	1	12	—	10,27
cf. Glaux maritima capsule	—	—	—	1	—	10,27
Juncus gerardi	3310	1088	35000	30000	110	10,16,25
Plantago cf. maritima	—	—	1	—	—	
Puccinellia distans	—	4	1	70	—	16
Scirpus maritimus	5	36	4	22	—	17,19
Spergularia maritima/salina	95	144	139	1000	21	16
Triglochin maritima	6	3	—	45	—	
Plants of damp grasslands (cl.25):						
Daucus carota	—	—	—	1	—	
Lythrum salicaria	—	—	—	2	—	19,35
Scirpus sylvaticus	—	—	—	—	2	
Heathland and bog plants (cl.27-30):						
Menyanthes trifoliata	—	—	—	1	—	19
Potentilla erecta-type	—	—	—	7	—	
Ranunculus flammula	—	—	—	2	—	10,16
Various:						
Agrostis spec.	9	21	18	870	3	16,24,25
Atriplex patula/prostrata	33	1000	131	1500	15	11,12,16,17,24
Bromus cf. hordeaceus	—	—	—	15	—	
Carex distans	—	—	—	2	—	16,24
Carex oederi s.l.	—	—	—	3	—	
Carex spec. tricarpellate	—	—	—	1	—	
Cirsium arvense/palustre	—	1	2	3	—	
Eupatorium cannabinum	1	—	—	—	1	17,25
Euphrasia/Odontites spec.	—	—	1	11	—	
Gramineae indet.	21	—	—	271	—	
Juncus articulatus-type	—	—	—	16	—	
Juncus spec.	750	32	440	—	8	
Mentha aquatica/arvensis	—	—	—	4	—	12,13,16,19
Molinia-type stems	—	3	—	—	—	
Plantago coronopus	—	1	1	—	—	10,12,16,23
Rumex spec.	—	—	—	27	—	
Selaginella spec.	—	—	—	—	1	
Taraxacum officinale s.l.	—	—	—	1	—	16,25
Trifolium spec. flower	—	1	1	16	—	
Umbelliferae spec.	—	—	—	3	—	
Xanthium strumarium	—	1	spines	spines	—	

seeds as well as of pollen from these droppings revealed that it comprised of almost pure *Myrica gale* remains. Since present-day sheep are reputed to dislike the bitter taste of bog myrtle (cf. Therkorn *et al.* 1984; *5.2.1*), similar droppings with *Myrica* remains in the Assendelver polders are attributed to goats. However, the prehistoric demands made by domesticates may have differed from what can be observed today. Leaf-fodder for cows is very different from the present west European cow diet, but none the less this was widely used in prehistoric times (cf. Rasmussen 1990). The same might apply to sheep and bog myrtle.

The remaining samples concern hearths (3001, 3009, 3049 and 3056). The results correspond to those obtained by the analyses of the section samples. Stenoecious cropweeds are remarkably scarce. Whereas in Roman Rockanje especially *Sonchus* species occurred very regularly in considerable numbers (see *4.6.10*), in Nieuwenhoorn they were found only rarely. As a result of the presence of numerous seeds of

Table 26. Botanical macroremains of Rockanje II, trench 2. Counted numbers, * = carbonized.

Sample depth (cm ÷ NAP)	67-72	74-79	87-92	110-113	117-122	124-127	129-134	136-137	144-149	150-151	152-156	2-0-1	
Context					all heightening material							hearth	Alternative
Volume (l)	0.75	0.75	0.75	0.5	0.75	0.5	0.75	0.25	0.75	0.25	0.75	0.5	classes
Crop plants:													
Cerealia indet. embryo	—	—	—	—	—	—	—	—	—	—	—	4*	
Cerealia indet. fr.	—	—	—	—	—	—	—	—	—	—	—	100*	
Hordeum vulgare	—	—	—	—	—	—	—	1,2*	8	—	—	18*	
cf. Hordeum vulgare	—	—	—	—	—	—	—	1	2	—	—	40*	
Hordeum vulgare internode	—	—	—	—	—	9	—	10	24,12*	1	—	—	
Water plants (cl.3-5):													
Zannichellia palustris	—	—	—	1	—	—	1	—	—	1	1	—	
Chara spec. oospores	—	—	11	9	16	100	464	16	32	16	48	—	
Therophytic saltmarsh pioneers (cl.8):													
Salicornia europaea	—	—	—	—	4	—	5	—	2	—	—	—	24
Tide-mark plants (cl.9):													
Atriplex littoralis-type	—	—	—	—	—	—	5	—	—	—	—	—	
Matricaria maritima	—	—	—	2	23	56	18	16	240	28	10	—	
Suaeda *maritima*	—	—	—	—	—	1	1	—	2	—	—	—	
Ephemeral plants (cl.10):													
Centaurium spec.	—	—	—	72	16	38	—	32	32	—	—	—	16,24
Juncus bufonius	—	8	—	18	11	—	64	—	320	—	32	1	12,13,16,24
Therophytic nitrophilous pioneers (cl.11):													
Chenopodium rubrum	—	—	—	—	6	4	8	7	68	7	2	—	12
Ranunculus sceleratus	—	—	—	2	4	1	2	2	8	3	4	—	
Rumex maritimus	—	—	—	—	2	—	—	—	—	1	—	—	
Summercrop weeds (cl.12):													
Capsella bursa-pastoris	—	—	—	—	—	2	—	—	8	—	—	—	11,16
Chenopodium ficifolium	—	—	—	19	8	13	111	38	884	53	10	—	
Lepidum ruderale	—	—	—	—	—	8	1	16	—	—	—	—	
Polygonum aviculare	—	—	—	5	20	112	127	83	420	73	9	2	24
Polygonum lapathifolium	—	—	—	—	1,1*	16	5	5	20	5	—	—	11
Sonchus asper	—	—	—	11	10	92	11	28	220	12	2	1	
Sonchus oleraceus	—	—	—	9	18	29	19	23	16	6	1	—	
Stellaria media	—	—	—	—	7	13	13	4	24	1	—	—	
Wintercrop weeds (cl.13):													
Matricaria recutita	—	—	—	—	—	—	—	—	16	—	—	—	
Tread resistant plants (cl.16):													
Alopecurus cf. geniculatus	—	—	—	1	—	—	—	3	18	—	—	—	
Carex cuprina-type	—	—	—	3	1	—	—	—	—	—	—	—	25
Carex hirta	—	—	—	21	2	—	—	1	8	1	—	—	25
Leontodon autumnalis	—	—	—	1	31	18	13	83	—	—	—	—	10,24,25
Plantago major	—	—	—	125	785	764	305	77	348	37	73	1	10,12,13,24
Poa annua	—	—	—	9	—	—	99	16	8	8	8	—	10,11,12
Poa trivialis-type	—	—	—	34	8	—	23	76	100	32	32	32	17,33
Potentilla anserina	—	—	—	62	292	82	122	22	110	21	17	—	10,24
Ranunculus repens-type	—	—	—	—	—	—	—	1	4	—	—	—	10,12,13,25
Ranunculus sardous	—	—	—	—	1	1	3	—	2	1	—	—	10,25
Perennial ruderals (cl.17):													
Apium graveolens	—	—	—	—	4	—	2	1	—	—	—	—	
Artemisia cf. vulgaris	—	—	—	—	—	—	170	32	28	8	—	—	12
Cirsium cf. vulgare	—	—	—	—	—	—	—	1	—	—	—	—	25
Juncus maritimus	—	—	—	—	—	—	—	—	—	—	32	—	16
Solanum dulcamara	—	—	—	—	—	—	—	—	4	—	—	—	19,33,35
Reedswamp plants (cl.19):													
Alisma spec. embryo	—	—	—	—	—	—	—	1	—	—	—	—	33
Berula erecta	—	—	—	3	1	6	—	3	—	—	—	—	25,33,35

Sample depth (cm ÷ NAP) Context Volume (l)	67-72 0.75	74-79 0.75	87-92 0.75	110-113 0.5	117-122 0.75	124-127 all heightening material 0.5	129-134 0.75	136-137 0.25	144-149 0.75	150-151 0.25	152-156 0.75	2-0-1 hearth 0.5	 Alternative classes
Carex riparia	—	—	—	—	1	—	—	—	—	—	—	—	35
Cladium mariscus	—	—	—	4,1*	—	—	2	1	10	1	48	—	
Eleocharis palustris	—	—	—	20	3	4	3	11	4	2	1	—	10,16,24
Lycopus europaeus	—	—	—	5	—	—	—	2	4	—	—	—	35
Phragmites australis	—	—	1	36	24	—	16	3	2	—	—	—	17,24,27
Scirpus lacustris tabernae-montani	—	—	—	63,2*	114	43	152	60	216	101	414	2	
Typha spec.	—	2	8	—	4	50	17	17	32	48	32	—	25
Plants of dry grasslands (cl.21):													
Trifolium arvense	—	—	—	—	—	—	—	—	—	—	—	10*	
Saltmarsh plants (cl.24):													
Aster tripolium	—	—	—	21	2	3	1	1	44	—	1	—	17
Glaux maritima	—	—	—	—	7	3	1	1	—	—	—	—	10,27
Juncus gerardi	32	227	375	4500	318	6000	8000	1842	5720	360	480	118	10,16,25
Plantago maritima	—	—	—	8	—	8	1	—	—	—	—	—	12
Puccinellia distans	—	—	—	—	—	—	2	4	—	—	—	—	16
Scirpus maritimus	—	—	—	—	1	—	—	4	12	2	2	—	17,19
Spergularia maritima/salina	—	—	—	27	16	300	400	134	432	210	112	48	16
Triglochin maritima	—	—	—	43	56	—	33	39	8	2	1	—	
Plants of damp grassland (cl.25):													
Carex disticha	—	—	—	3	1	—	—	3	4	4	—	—	16
Lythrum salicaria	—	—	—	—	—	—	—	18	—	—	—	—	19,35
Heathland and bog plants (cl.27-30):													
Erica tetralix	—	—	—	—	—	—	—	16	16	—	—	—	25,32
Erica tetralix leaf	—	—	—	—	—	—	—	1	—	—	—	—	25,32
Hydrocotyle vulgaris	—	—	—	2	2	—	—	—	—	4	—	—	10,16,19,33
Potentilla erecta-type	—	—	—	—	—	—	—	—	4	—	—	—	
Sphagnum spec. leaf	—	—	—	—	—	1	—	—	—	—	—	—	
Various:													
Agrostis spec.	—	—	—	36	20	—	48	27	64	8	—	—	16,24,25
Atriplex patula/prostrata	—	—	—	69	127	176	281	140	868	46	12	29	11,12,16,17,24
Avena spec. awn fr.	—	1	—	—	—	—	—	—	—	—	—	—	
Carex acuta-type	—	—	—	3	—	—	—	—	—	—	—	—	15
Carex oederi s.l.	—	—	—	3	—	—	—	—	4	—	—	—	
Centaurea spec. non cyanus	—	—	—	—	—	—	—	—	—	1	—	—	
Cirsium cf. arvense	—	—	—	—	—	—	2	—	16	—	—	—	13,17,25
Compositae indet.	—	—	—	—	—	—	—	—	36	—	—	—	
Eupatorium cannabinum	1	1	5	—	—	—	—	—	—	—	—	—	17,25
Euphrasia/Odontites spec.	—	1	—	1	19	14	1	4	4	—	—	1,1*	
Gramineae indet	—	—	—	27	30	45	80	2	36	16	16	16	
Juncus articulatus-type	—	—	—	—	—	—	—	28	—	—	—	—	10,16,25
Juncus spec.	18,1*	31	30	—	6	—	—	85	160	16	—	288	
Mentha aquatica/arvensis	—	1	—	6	1	7	1	1	—	2	—	—	12,13,16,19
Rumex spec.	—	—	—	—	—	—	1	1	4	—	—	2	
Sagina apetala/procumbens	—	—	—	—	—	—	—	16	—	—	—	—	
cf. Selaginella spec.	1	—	6	—	—	—	32	—	32	8	—	—	
Taraxacum officinale s.l.	—	—	—	—	—	—	—	—	—	1	—	—	16,25
Trifolium spec. flowers	—	—	—	—	5	5	4	1	—	—	—	1	
Umbelliferae indet.	—	—	—	7	—	—	—	1	4	—	—	—	
Xanthium strumarium	—	—	—	—	—	24	spine	spines	spines	—	—	—	

Scirpus maritimus, the salt marsh plants are strongly represented. In view of the fact that habitation was founded on a raised bog, the salt marsh plants will most probably not have occurred locally, but will instead have been collected for hay at some distance from the site. Several of the species found in Nieuwenhoorn characterize the transition from salt to fresh conditions (compare *4.6.1.3*).

The presence of some carbonized *Vicia faba* seeds might

Table 27. Botanical macroremains of Rockanje II, trench 10. Counted numbers, * = carbonized.

Sample	10-1-4	10-1-5	10-2-52	10-2-53	10-2-56	10-2-58	
Volume (l)	4	2.5	4	4	4	3	Alternative
Context	floor	hearth	pit	pit	floor	floor	classes
Crop plants:							
Cerealia indet.	12*	2*	—	—	—	—	
Cerealia indet. embryo	6*	—	—	—	—	—	
Hordeum vulgare	67*	—	—	—	25*	—	
cf. Hordeum vulgare	1*	—	—	—	—	—	
Hordeum vulgare internode	163*	3*	4,2*	—	1,57*	—	
Hordeum spec. awn fr.	—	—	—	—	12*	—	
Hordeum/Triticum spec.	2*	—	—	—	—	—	
Hordeum/Triticum internode	1*	—	—	—	—	—	
Triticum cf. aesticum	1*	—	—	—	—	—	
Triticum cf. dicoccum	4*	—	—	—	—	—	
Triticum dicoccum glume base	6*	—	—	—	—	—	
Water plants (cl. 5):							
Ceratophyllum spec.	—	—	—	—	1	—	
Chara spec. oospores	—	—	—	—	132	—	
Potamogeton spec.	—	—	—	2	8	—	
Zannichellia palustris	—	—	3	23	84	20	
Therophytic saltmarsh pioneers (cl. 8):							
Salicornia europaea	1*	—	4	98	20	18	24
Tide-mark plants (cl. 9):							
Atriplex littoralis-type	—	—	6	9	4	4	
Matricaria maritima	7*	—	21	—	—	82	
Suaeda maritima	—	—	9	108	4	—	
Ephemeral plants (cl. 10):							
Centaurium spec.	800	—	244	—	60	19	16,24
Juncus bufonius	405	—	80	200	768	550	12,13,16,24
Linum catharticum	—	—	4	—	32	—	10,25
Therophytic nitrophilous pioneers (cl. 11):							
Alopecurus aequalis	—	—	4	—	—	—	
Chenopodium rubrum	94,15*	—	31	16	159	229	12
Ranunculus sceleratus	—	—	4	2	68	10	
Summercrop weeds (cl. 12):							
Chenopodium ficifolium	25	—	—	—	29	—	
Echinochloa crus-galli	3*	—	—	—	—	—	
Lepidium ruderale	—	—	—	—	—	23	
Polygonum aviculare	8*	1*	174	—	4	—	24
Polygonum lapathifolium	—	—	16	—	11,2*	—	11
Solanum nigrum	—	—	—	2	—	—	11
Sonchus cf. arvensis	—	—	—	—	27	—	
Sonchus asper	—	—	14	1	60	186	
Sonchus oleraceus	—	—	6	92	20	208	
Stellaria media	18	—	35	2	21	—	
Tread resistant plants (cl. 16):							
Alopecurus geniculatus	—	—	4	—	12	2	
Carex cuprina-type	1*	—	—	—	13	—	25
Carex hirta	—	—	17	—	18	1	25
Juncus effusus-type	1620	—	—	—	—	—	
Leontodon autumnalis	2*	—	58	—	2	4	10,24,25
Plantago major	10*	1*	419	336	93,12*	144,51*	10,12,13,24
Poa annua	6?*	—	—	—	—	4	10,11,12
Poa trivialis-type	—	—	92	—	120	16	17,33
Potentilla anserina	9	—	34	—	181	2	10,24
Ranunculus repens-type	—	—	—	—	7	—	10,12,13,25
Ranunculus sardous	—	—	2	—	18	—	10,25

Sample	10-1-4	10-1-5	10-2-52	10-2-53	10-2-56	10-2-58	
Volume (l)	4	2.5	4	4	4	3	Alternative
Context	floor	hearth	pit	pit	floor	floor	classes
Perennial ruderals (cl. 17):							
Apium graveolens	—	—	10	242	76	364,69*	
Cirsium cf. vulgare	—	—	—	—	1	—	25
Juncus maritimus	—	—	680	9700	—	2775	16
Juncus cf. maritimus	—	—	—	—	—	1550*	16
Juncus maritimus capsule	—	—	—	—	—	359	16
Solanum dulcamara	—	—	—	—	4	—	19,33,35
Urtica dioica	4	—	—	—	4	2	33,38
Reedswamp plants (cl. 19):							
Carex paniculata-type	—	—	6	—	—	—	35
Cladium mariscus	8*	—	98,2*	4	37	—	
Eleocharis palustris	7*	—	65	2	154,4*	2	10,16,24
Glyceria maxima	—	—	4	—	—	—	33
Glyceria spec.	—	—	4	—	—	—	
Lycopus europaeus	—	—	4	—	—	—	35
Oenanthe aquatica	—	—	2	—	—	—	
Phragmites australis	—	—	757	877	136	104	17,24,27
Phragmites australis stem	—	—	100-s	—	—	—	17,24,27
Poa cf. palustris	—	—	4	—	—	—	16
Scirpus lacustris tabernaemontani	2,14*	—	355	187	165	12	
Scutellaria galericulata	—	—	—	—	1	—	35
Typha spec.	—	—	80	59	24	29	25
Plants of dry grasslands (cl. 21):							
Trifolium cf. arvense	2*	—	—	—	—	—	
Saltmarsh plants (cl. 24):							
Aster trifolium	—	—	27	39	54	8	17
Glaux maritima	—	—	8	17	54	6,4*	10,27
Juncus gerardi	51000	—	1520	3370	4716	175	10,16,25
Plantago maritima	—	—	9	4	—	4	12
Plantago maritima capsules	—	—	6	—	—	—	12
Puccinellia distans	—	—	24	—	8	95	16
Scirpus maritimus	1*	—	11	—	31	—	17,19
Spergularia maritima/salina	—	—	1150	213	276,12*	242	16
Triglochin maritima	—	—	60	230	312	75	
Plants of damp grasslands (cl. 25):							
Daucus carota	—	—	—	—	46	—	
Lychnis flos-cuculi	2	—	40	—	—	—	
Lythrum salicaria	—	—	10	—	—	—	19,35
Prunella vulgaris	1*	—	—	—	4	—	10,33
Scirpus sylvaticus	—	—	—	—	20	16	
Stachys palustris	—	—	4	—	—	—	12,13,33
Heathland and bog plants (cl. 27-30):							
Danthonia decumbens	—	—	—	—	94	—	25
Erica tetralix leaf	1	—	—	—	—	2*	25,32
Eriophorum vaginatum spindles	—	—	—	19	—	—	
Hydrocotyle vulgaris	—	—	10	—	12	—	10,16,19,33
Menyanthes trifoliata	—	—	—	—	143,10*	—	19
Potentilla erecta-type	—	—	—	7	69	—	
Ranunculus flammula	—	—	—	—	31	—	10,16
Rhinanthus cf. *minor*	—	—	—	—	35	—	
Rhynchospora alba	—	—	2	—	—	—	
Sphagnum spec. leaf	—	—	—	—	2	—	
Various:							
Agrostis spec.	—	—	239	22	188	52	16,24,25
Atriplex patula/prostrata	22,54*	—	173	45	745,1*	34	11,12,16,17,24
Avena spec.	2*	—	—	—	—	—	
Carex distans/extensa	514	—	5	—	2	—	16,24

Sample Volume (l) Context	10-1-4 4 floor	10-1-5 2.5 hearth	10-2-52 4 pit	10-2-53 4 pit	10-2-56 4 floor	10-2-58 3 floor	Alternative classes
Carex oederi s.l.	21	—	5	—	384	1	
Carex cf. pilulifera	—	—	—	—	8	—	
Carex cf. remota	—	—	—	2	11	—	
Carex spec.	—	1	—	—	—	—	
Anagallis minima/Samolus valerandi	—	—	—	119	—	10	6
Cerastium spec.	—	—	4	7	1	—	
Elymus repens/athericus	—	—	17	—	—	—	
Eupatorium cannabinum	8	—	—	—	—	1	17,25
Euphrasia/Odontites spec.	6,10*	—	58	7	464	—	
Festuca rubra	—	—	4	—	8?	—	
Gramineae indet.	—	4*	126	22	40	—	
Juncus articulatus-type	3240	—	80	—	480	—	10,16,25
Juncus spec.	8*	—	—	—	—	—	
Lotus spec.	1*	—	—	—	—	—	
Mentha aquatica/arvensis	2	—	53	15	8	4	12,13,16,19
Oenanthe spec.	—	—	—	18	—	6	
cf. Rosa spec.	—	—	—	—	1	—	
Rumex acetosella	—	—	—	—	8	—	12,13
Rumex spec.	—	—	—	—	17	—	
Trifolium spec. calyx	—	—	—	—	5	—	
Trifolium spec. flower	—	—	7	—	—	—	
Umbelliferae indet.	—	—	—	—	5	—	

indicate large scale use in view of their small chance to get carbonized (see *4.4.7*). Unfortunately, uncarbonized bean straw could not be demonstrated in the samples analysed.

4.6.10 THE MACROREMAINS OF ROCKANJE II

In this native Roman settlement, located on clayey sediments, two sections were sampled, in two different houses. In one of these houses, a hearth was also sampled (sample 2-0-10). Another six samples from a third house were analysed, one from a hearth (10-1-5), three from floor-layers (10-1-4; 10-2-56 and 10-2-58) and two from pits (10-1-5 and 10-2-52). The location of the samples is indicated in figure 44a and b. The results are presented in tables 25-27.

The lowermost samples in both sections already show many traces of human influence, although the natural subsoil was reached. Settlement evidently started directly on the natural subsoil.

The semi-marine location is clearly expressed in the number of seeds of salt marsh plants in the samples. These numbers are, with those of Rockanje 08-52, by far the largest of all the sites examined (see further *4.7.2.1*). The share of summercrop weeds is indisputably the largest of all sites, wheras in contrast grassland species are much scarcer than on most other sites, even if the species of class 24 are also looked upon as representing grazing territory.

The tread resistant plants are present in large numbers again. Of this class, several species are also indicative of grazing, particularly *Leontodon autumnalis*, *Trifolium repens* and *Potentilla anserina* (Van Zeist 1974: 334). It is remarkable that the samples from the third house (trench 10) differ from the other two houses. Crop weeds and tread resistant plants are less important, while salt marsh plants in contrast are of much greater importance in this house. One possibility is that the third house actually was a cattle shed. The different architecture of this house, with an A-frame, may be the result of its different function. However, the fact that a hearth with many carbonized crop plant remains occurs in the third house pleads against a shed. Hearths where food was processed are generally found in those parts of houses where people lived (see also Haarnagel 1984: 168). The different composition of species can also be explained by assuming that the third house was the first to be built, in a relatively undisturbed salt marsh environment. Later, when houses one and two were inhabited, vegetation was more strongly influenced by man. If this assumption is correct, the environment must have desalinated in the course of the 2nd and 3rd centuries AD, in view of the lower quantities of salt marsh plants in the first and second house.

4.6.11 CONSPICUOUSLY ABSENT WILD PLANTS

It is not very informative to list all the plants that have not been found in the present study. However, one absentee is otherwise very common in palaeo-ethnobotanical studies and its absence does provide useful information. It concerns *Chenopodium album*. From anthropogenic deposits from the *Linear Bandkeramik* onwards, this is often the weed most frequently reported. Still, it is completely absent in the material from Voorne-Putten. This species favours high nitrogen

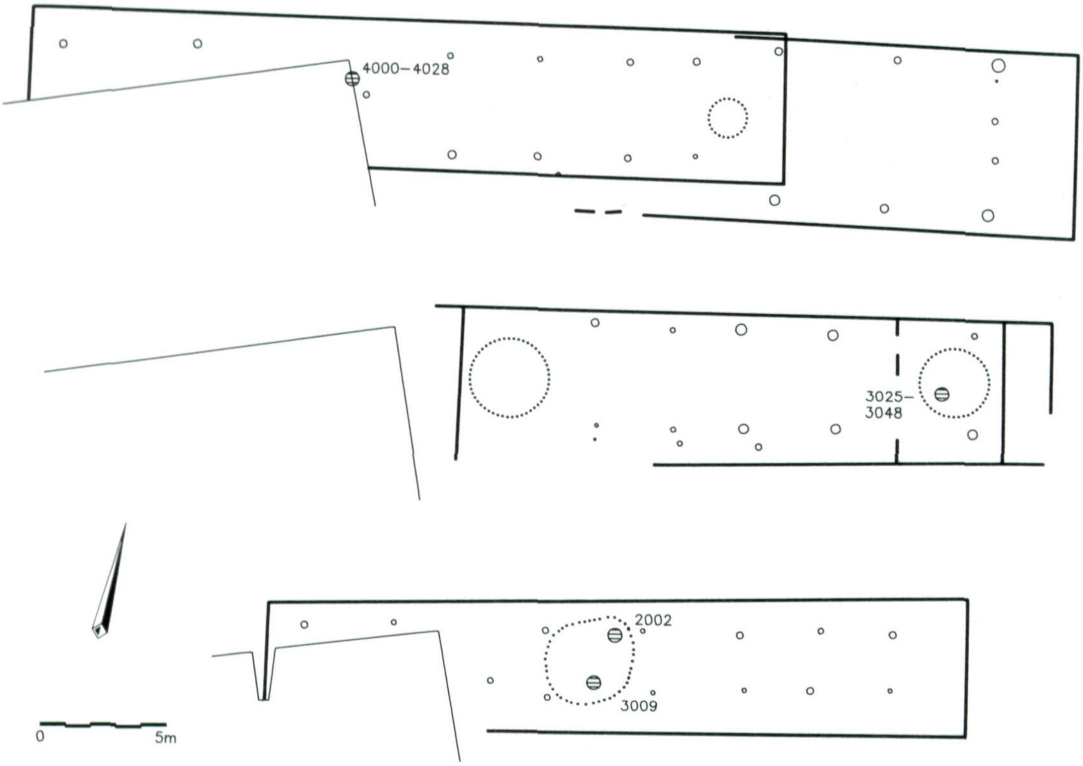


Fig. 42 Location of samples for botanical macroremains in the houseplan of Nieuwenhoorn 09-89, scale 1:300. Dotted line = hearth.

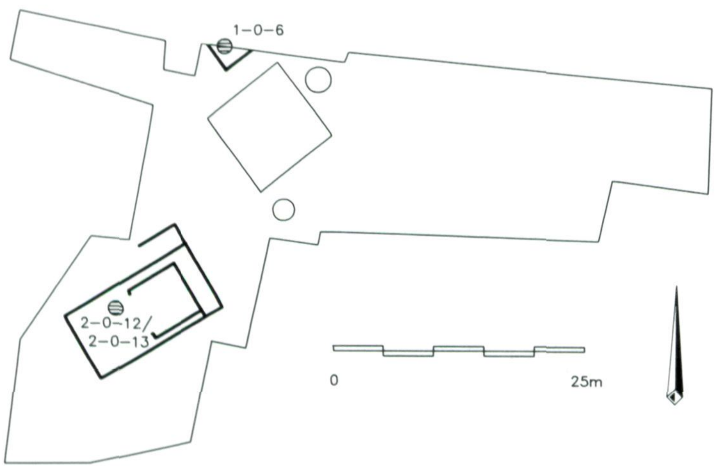


Fig. 44a Location of samples for botanical macroremains in the houseplans 1 and 2 of Rockanje II, scale 1:750. The two wells and the square granary have been indicated.

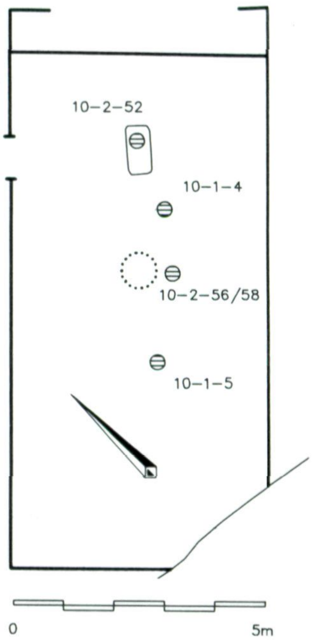


Fig. 44b Location of samples for botanical macroremains in the houseplan 3 of Rockanje II, scale 1:150. Dotted line = hearth.

contents and occurs among others in arable fields and ruderal places.

A second absent species is *Plantago lanceolata.* In pollen diagrams this species commonly occurs. Its presence has often been regarded as an indication of pastoralism (see *2.4.1*). The seeds, however, are not only absent on Voorne-Putten, but are rarely found in any palaeo-ethnobotanical studies (see Behre 1983).

4.7 A comparison of the sites on Voorne-Putten.

4.7.1 Multivariate analyses

It will be clear from the above that the data discussed are quite heterogeneous. For further exploration of these data, numerical analyses can be a fruitful approach to discover patterns. As Hodson (1971) stated,

> "the method of proceeding from the relevant raw material to a useful interpretation depends on the basic, simple axiom that patterns or regularities in material remains may be expected to reflect patterns in the agency that produced them".

Therefore, the present data have been subjected to multivariate analyses to discover patterns that might be interpreted in terms of past environment, human behaviour, etc. For this study, the statistical software of C.S.S. (Complete Statistical System) has been used.

For further statistical treatment of data, in which many variables are involved, deductive procedures of multivariate analyses can be applied. As Madsen (1988) observed,

> "inductive statistics require a detailed knowledge of distributional qualities of the populations to which we apply the inferences. At the same time, they require that we have complete control of the formation of the samples from which we infer. None of these requirements are met in archaeology".

Only deductive procedures can be used with confidence. Concerning these deductive procedures, Madsen (1988) stated that

> "it is very important to stress that deductive statistics are descriptive. They have no inferential value whatsoever. (...) They cannot in any way produce the conclusions for us".

These deductive procedures can be subdivided into two groups, of which Principal Components Analysis (P.C.A.) and Cluster Analysis are the major representatives.

P.C.A. is a procedure which orders the data. Formally, this ordering should be compared with hypotheses formulated beforehand. It is a problem-oriented procedure (cf. G.E.M. Jones 1991). Cluster analysis is a pattern-searching procedure in which no predetermined hypotheses need to be formulated. It allows unexpected patterns to emerge, which can subsequently be interpreted (G.E.M. Jones 1991: 70). In P.C.A. and the related Factor Analysis, higher demands are made on the basic data than in cluster analysis. Madsen (1988) stated that

> "P.C.A. can be used safely only with data to which it is meaningful to apply the concepts of covariance and correlation, and this is true with reasonably normally distributed measurement data only".

These requirements are not met with in palaeo-botanical data. Especially the large numbers of zero scores are problematic (Dr. P. van der Velde *pers. comm*; Drs. E. Meelis *pers. comm.*). The newest ordination method, Correspondence Analysis, does not make such high demands on the data.

Whittaker and Gauch (1973) showed, in a comparison of then available techniques for ordination, that the mathematically more formal procedures of P.C.A. and Factor Analysis produced the worst results when applied to plant community research. Similarity indices were more effective "in the sense of producing interpretable results at least". Thus, cluster analysis seems to be the most appropriate method to apply to the present material. Canonical Correspondence Analysis would present the opportunity to obtain information by means of an alternative method. Unfortunately, this method is not included in C.S.S. It appeared impossible to use the S.P.S.S. version of Correspondence Analysis in the short time available.

Results of a cluster analysis are presented in dendrograms. The "distance" of all samples in relation to each other can be assessed by a range of indices. All are in some way based on presence/absence data (qualitative distance indices) or on the quantitative information (quantitative indices). For the present material, the quantitative distance index "Pearson's r" was found to produce dendrograms that could be interpreted more satisfactorily than those resulting from Euclidean, Squared Euclidean or Manhattan City-Block distances. The linkage of the distance data to dendrograms was by means of the "weighted pair-group average" method, which largely prevents "chaining" (clustering of many variables at a single level), which does occur in single linkage.

For numerical analyses, the results of all sites were stored in two large databases, one for waterlogged (uncarbonized) and one for carbonized remains. Subsequently, the numbers of seeds were standardized to numbers per litre of sediment. To reduce the effect of very large numbers, the logarithm ($^{10}\log$) of the data has been used. Next, samples with less than two taxa in the uncarbonized matrix were deleted. These were sample numbers 10-1-5 from Rockanje II and 230 from Rockanje 08-52. In the matrix for the carbonized remains, 68 samples contained at least two taxa. In the following, the results obtained through cluster analyses will be discussed and interpreted. Probably, the robustness of these results can be controlled by means of Canonical Correspondence Analyses in the future.

4.7.2 Cluster analyses of the samples on the basis of waterlogged botanical macroremains

In C.S.S., the data matrix may contain 80 variables at the maximum. Since the matrix of uncarbonized remains consists of 107 samples, only part of the matrix can be processed at the same time. It was decided to run a cluster analysis of all samples from sites on Putten first.

Figure 45 shows the results of this cluster analysis (of the sites discussed in *4.6.2* to *4.6.7*) on the basis of uncarbonized remains.

The first cluster (I) is composed of the two samples from the Early Iron Age site of Rotterdam-Hartelkanaal. The second cluster contains one sample each from Spijkenisse 17-30 and 17-34. These four samples in the first two clusters are very different from all other samples. These samples have in common that they revealed very low numbers of species.

Cluster III consists of six of the nine samples from Spijkenisse 17-30 and five of the eight samples from 17-35. In cluster IV, we find the remaining two samples from 17-30. These first four clusters contain all the Early Iron Age samples, except the samples 598 and 600 from 17-35, which occur in cluster V. Particularly these two samples were suspected of not being *in situ*, although they were assumed to date to the Early Iron Age (see *4.7.3*). Only two Middle Iron Age samples (17-35: 615 and 616) belong to these four clusters.

The large cluster V contains nearly all the samples from Spijkenisse 17-34 (M.I.A.). The above-mentioned two redeposited samples from 17-35 as well as the sample from Abbenbroek 17-22 are also included. Cluster Va contains most samples from the ditch of 17-34, as well as the floor sample (279), one sample from dung (289) and one hearth sample (580). Cluster Vb comprises the remaining ditch samples (311) and three samples from layers of dung (411, 534 and 535). Apparently, there is a difference in these samples, depending on the context. Thus, the variation on this site would have been underestimated if a particular type of context had not been sampled.

The sixth cluster consists of the three samples from Geervliet 17-55 (M.I.A.), the two samples from Zuidland 17-27 (L.I.A.), both in separate smaller clusters, and the remaining Middle Iron Age sample from 17-35. Cluster VII comprises the single sample from Zuidland 16-15 (L.I.A.) and a dung sample from 17-34, the last cluster (VIII) contains the two remaining samples from 17-34, one hearth- and one dung sample.

In view of the results, it seems justified to conclude that the samples are adequate to characterize the sites and to reveal differences between the sites. Since all the samples can be conceived as "judgement samples", this observation is of great interest in the discussion on sampling strategies. At least in the present study on wetland sites, the random sampling strategy advocated by M. Jones (1978, 1985, 1991) and Van der Veen (1984, 1987) appears to be not the only way to make inter-site comparisons. Van der Veen (1987) also admitted that on upland sites the results produced by judgement sampling are comparable to those produced by random sampling. She stated:

> "when we compare the diagrams of the random samples and the judgement samples, the similarity is striking. The main difference lies in the fact that the quantity of seeds in the judgement samples is greater than in the random samples: (...) the excavators prefer to select the rich, ashy deposits on the site."

Thus, the sampling of all different contexts represented on a site seems to be of greater importance than the need for random sampling. Interestingly, Van der Veen (1991), in a recent paper also stated that random sampling or an attempt to collect samples from all contexts is required for inter-site comparisons.

The second cluster analysis concerned all the sites on Voorne. The Late Iron Age site of Rockanje 08-52 as well as the native Roman settlements of Nieuwenhoorn 09-89 and Rockanje II are included. The resulting dendrogram is presented in figure 46.

The first cluster consists of two distinctly separated samples from Nieuwenhoorn, the goat droppings of sample 2002 and the hearth sample 3009. Cluster II also includes samples from Nieuwenhoorn exclusively. It consists of the *Scirpus* dominated samples from the section (samples 3037-3043), in which *Juncus gerardi* is not abundant (see also *4.6.9*). Furthermore, hearth sample 3056 is also included in this cluster.

The third cluster contains all the samples from natural subsoils, three from Nieuwenhoorn and one from Rockanje 08-52. These subsoils were all composed of *Sphagnum* peat. The fourth cluster comprises the samples from the upper part of the section (3025-3036) and sample 3049, which is the hearth of the second building phase, also present in the top of the section (next to samples 3027 and 3028). Sample 3001, which is also a hearth belonging to the second building phase, is included in this cluster as well. One single sample from Rockanje (10-1-4) occurs in this cluster, too. In the first four clusters, there are only two samples which have not come from Nieuwenhoorn. Furthermore, only one sample from Nieuwenhoorn is not present in these four clusters. This is sample 3026, which is distinctly different, as is demonstrated by the very high linkage level. This sample contains hearth material with only three waterlogged taxa.

Cluster V exclusively comprises samples from Roman Rockanje, in which the samples from the third house (trench 10) in cluster Va, are separated from those from the first and second house. This confirms the observation in paragraph 4.7.9 on the deviating character of the samples from the third house. The first and second house are represented in cluster Vb. All remaining samples from Roman Rockanje are represented in cluster VI, all taken from the second house.

The seventh cluster consists of two hearth samples from Rockanje 08-52 (L.I.A.) and cluster VIII represents all the samples from the stalls of this site. Again, within a single site, the samples are separated corresponding to their context, as in Spijkenisse 17-34. The last cluster (IX) contains two samples that are highly dissimilar to all other samples. One sample has been taken from the hearth of 08-52 and one from a hearth in Nieuwenhoorn.

Again, the results show that the variation within the sites is smaller than the variation between the sites, although within the sites some subgroups of samples can be observed.

To decide whether the environmental setting of the sites is the dominant factor, or whether the dating of the sites is of primary importance, the sites represented in the two cluster analyses discussed above should be combined in one analysis. Since only a maximum of 80 variables (in this case samples) can be clustered, 25 samples will have to be excluded (Rock.10-1-5 and Ro08-52: 230 had already been excluded because only one uncarbonized taxon occurs in these samples). Firstly, all natural subsoils were excluded. They are Nh09-89: 3044, 3046 and 3048 and Ro08-52: 1070. They are clearly distinguished in the previous cluster analysis and do not provide information on the site during habitation. For further selection, the previous two cluster analyses were used to select the remaining 21 samples to be excluded. Pairs of samples were selected with low clustering-distances between the pairs. The samples must also have come from the same site within each pair. From 21 of these pairs, one sample has been excluded in the following cluster analysis. Thus, the remaining samples still showed as much variation as possible. The following samples were excluded: Sp.17-30: 152; Sp.17-34: 278, 327, 337, 411; Sp.17-35: 598, 604; Gv.17-55: 2; Ro08-52: 1069, 1076; Nh09-89: 3027, 3029, 3031, 3035, 3037, 3043; Rock: 1-131, 2-67, 2-110, 2-129, 10-2-53.

The dendrogram resulting from the 80 remaining samples is presented in figure 47. The clusters that resulted from this cluster analysis closely follow the results obtained from the first two cluster analyses. The samples from Putten and those from Voorne are separated with surprising accuracy. Only one sample (Sp17-34: 515) does not occur among the clusters of Putten.

Since the main division is between sites on Putten on the one hand and sites on Voorne on the other, it can be concluded that the location is of greater influence than the age of the sites. If age was the dominating factor, the Late Iron Age sites on Putten and the one on Voorne would have formed closely related clusters. Any changes in economic conditions at the beginning of the Roman occupation are overshadowed by environmental differences influencing the vegetation around the sites (see further *4.8*). Therefore, it is all the more regrettable that no reliable samples from Roman sites around the Bernisse could be included in this study.

4.7.3 Cluster analysis of the samples on the basis of crop plants

Since crop plants are a very important source of information on the economy of the sites, they were included in a third data matrix for cluster analysis. The evidence of crop plants is provided by waterlogged as well as carbonized remains. For this reason both categories have been included in this cluster analysis. In total, 68 samples contained crop plant remains.

The resulting dendrogram is given in figure 48. The first cluster consists of nearly all the samples from Spijkenisse 17-30, where *Brassica rapa* is an important element and *Hordeum vulgare* is completely absent. Most of the remaining clusters are very heterogeneous with respect to the sites from which the samples originated. Only the samples from Geervliet 17-55 and those from Zuidland 17-27 form homogeneous clusters.

Summarizing the results, we can conclude from this cluster analysis that the Early Iron Age site of Spijkenisse 17-30 is the only site that differs from all other sites. These results will be further evaluated in chapter 6 in the light of the economy of the sites.

Since it is also of great interest to know whether there are differences (or similarities) in the crop weeds of the sites, it was decided to run another cluster analysis on the uncarbonized macroremains, now only on the basis of crop weeds. If the resulting clusters are dominated by one or two sites, as in the clusters of all the uncarbonized remains discussed above, this will then indicate that the crops of the various sites differ in their crop weed vegetation. This in turn indicates different locations for the cultivated fields, with respect to soil type, moisture and probably other key factors regulating crop weed vegetation. In this cluster analysis, not only the character species of the crop weeds (class 12) were included, but also differential species. They are particularly important for separating weed vegetations with different reactions to moisture, too important a factor to be neglected in the wetland area studied. In total, 98 samples contained one or more crop weeds. Because of the low number of species concerned, all samples could be included.

The resulting dendrogram does not show the sites separately (*fig. 49*). This means that the fields of all periods concerned did not differ markedly in their weeds. Even the site of Spijkenisse 17-30, which was clearly separated in the cluster analysis on crop plants, is now mixed in with the other sites.

4.7.4 Cluster analyses of the taxa

In all the cluster analyses discussed so far, samples were clustered. It is also possible to make the different taxa the subject of cluster analysis. This has been carried out for two data sets. The resulting clusters ideally consist of taxa belonging to similar vegetation types, since such taxa have a greater chance to occur combined in the samples.

The results of the cluster analysis of the waterlogged taxa from Nieuwenhoorn are presented in figure 50. Only cluster X, which contains only bog plants, corresponds to the ideal situation. All other clusters are very heterogeneous with regard to vegetation types represented by the taxa. This can only lead to the conclusion that the great majority of the samples contain seeds from very different origins. Körber-Grohne's (1967) "*reine Proben*" ("pure samples"), which contain the remains of only one type of vegetation, are apparently hardly represented in Nieuwenhoorn.

A second cluster analysis of waterlogged taxa has been executed for the Roman site of Rockanje. Figure 51 shows the resulting dendrogram. Although some smaller clusters, which ecologically make sense, can be designated (e.g. *Apium graveolens*, *Salicornia europaea* and *Atriplex littoralis*-type), the overall picture is a combination of ecologically very different taxa. As in Nieuwenhoorn, the samples contain a heterogeneous mixture of plants from different habitats. Thus, the waterlogged samples in most cases do not represent an original combination of taxa (*palaeobiocoenosis sensu* Willerding 1979, 1991) but a secondary mixture of plants from different vegetation types (*thanatocoenosis*).

4.7.5 Cluster analysis of the samples on the basis of carbonized botanical macroremains

The data matrix of the carbonized remains consists of 66 samples, in which 134 taxa are found. Figure 52 shows the dendrogram of the cluster analysis of these samples. In the waterlogged remains, the corresponding dendrogram gave a fairly good separation concerning the different sites. Especially the sites on Voorne on the one hand and those on Putten on the other were distinctly separated.

The dendrogram of the carbonized remains shows a much greater mixture of the different sites. The carbonized remains are, therefore, not as characteristic of a particular site as the waterlogged material. Several causes may be put forward to explain this observation. Firstly, carbonized remains are much scarcer than waterlogged ones. In most samples, only few carbonized taxa were found. The result is that the combined occurrence of taxa in two samples (which is the basis of cluster analysis) is very much influenced by chance processes. Secondly, some taxa have a much greater chance than others to become carbonized. Cultivated plants, especially hulled/glume cereals, and waste products from crop processing run a much greater risk of carbonization than plants from the natural vegetation around the sites. These crops and crop weeds belong to a limited set of species, with relatively large similarities between the sites. This also results in a great inter-site similarity.

This observation is of great interest, as in many upland archaeological sites only carbonized material is preserved. In a comparison between such "upland sites", the differences between sites will, therefore, be smaller than in "wetland sites". On the other hand, the processed sample volume is in general much larger when only carbonized remains have survived as flotation techniques allow processing of large samples. As a result, in general more taxa of carbonized macroremains are found in samples from upland sites. This offers better possibilities for cluster analysis, as samples with very few common taxa will easily resemble each other. The recovery of more taxa provides possibilities of detecting differences.

In the cluster analyses discussed here, the total of the waterlogged remains produced the greatest inter-site differences, crop plants (both waterlogged and carbonized) still showed some, but less distinctive, inter-site variation. Crop weeds showed an even greater similarity between the sites, while the carbonized remains showed the greatest resemblance. In order to investigate the nature of the dissimilarities in waterlogged remains between the sites, some detailed information has been worked out in the following paragraphs.

4.8 The nature of differences and similarities between the sites

The cluster analyses revealed differences between the sites investigated, but they did not demonstrate the underlying cause of these differences. In order to obtain further knowledge about these differences, the information provided by the botanical macroremains has been examined from several angles.

In view of the results of the cluster analyses discussed above, it seems justified to lump together the data per site, as most of the remains are waterlogged. This allows a manageable summary of the data. The results for Spijkenisse 17-35, the two-period site, should be treated with extra caution, in view of the results of the cluster analyses.

For a first summary of the data, it was decided not only to lump together the data per site but also per syntaxonomical class (see *4.6*). The total values thus obtained are still absolute ones. Owing to the great differences in the total numbers of "seeds" per site, they still cannot be compared directly between the sites. Therefore, the number of seeds belonging to each class per site have been calculated as a percentage of the total number of seeds per site.

Before applying such percentage ratios, several constraints must first be made clear. Miller (1988) discussed relevant assumptions in the use of ratios. Although she claims that the ratio eliminates the effects of varying conditions of deposition and preservation, Kadane (1988) in the same volume showed that differential decay of the taxa in the numerator in comparison to the denominator, may result in apparent changes through time caused by post-depositional processes irrespective of possible similarities at deposition. The influence of these post-depositional processes is even more distorting if one particular class comprises many species that are highly susceptible to decay. In view of the waterlogged preservation of organic remains on all the sites examined, it is considered improbable that differential decay produced differences between the sites. Besides, any trend of increasing numbers of taxa on younger sites, which may be the result of a shorter period of decay, cannot be observed in the present data. Moreover, samples that showed traces of less favourable preservation, e.g. a small number of mainly very resistant seeds (*Scirpus*, *Atriplex*, *Eleocharis*), were discarded.

To calculate an average ratio, as is the case for the percentages per class per site, we must ask ourselves whether all the samples should be given the same weight, or whether a weighting factor for each sample must be assessed. In the present case, it might be expected that the larger samples provide a more accurate reflection of the importance of the different taxa on a site. By not standardizing the samples according to volumes, the larger samples are given a correspondingly larger importance in the ratio. For this reason, the volumes of the samples were not standardized.

Differences in seed production and retrievability may also be relevant. For instance, the class of ephemeral plants, which are pioneers of open soils (the present Isoeto-Nanojuncetea), has relatively few character species. These plants frequently produce extremely small seeds that will often be washed through the sieves (even through a 0.25 mm mesh). It is therefore not surprising that this class is of minor importance on all sites. Its share relative to other classes may not be very conclusive, however, the share of such a class can still be compared between different sites.

In the calculations of the importance of the different classes per site, seeds of plants that are regularly over-represented have been omitted. The taxa concerned show a very uneven distribution in the samples, they are either absent or they are found in vast numbers. The taxa omitted are all *Juncus*, *Typha*, *Sagina* and *Centaurium* species. They are also the most important species of the 0.25 mm sieve fraction. Furthermore, awn fragments have been excluded and remains of cryptogams (*Chara*, *Sphagnum*, etc.) have not been considered either. The share of seeds of unknown ecology differs greatly from site to site. Since this category does not provide useful information, it was also left out in the calculations. The share of crop plants fluctuates considerably among the various sites. Although this fact is of great interest, it does have a strong influence on the ratios of the other classes. The most elegant solution to this problem seems to be the calculation of the importance of crop plants on the basis of the sum of the other classes (excluding seeds of unknown ecology), which is analogous to assessing percentages outside the pollen sum in pollen diagrams.

4.8.1 Ratios of syntaxonomical classes

In table 28, the percentages per class (crop plants and "unknown" excluded in the denominator) are listed. Crop plants are especially common in Geervliet, where the many threshing-remains of mainly *Camelina sativa* account for the high score, and in Zuidland 17-27, where *Linum usitatissimum* is predominant. On all other sites, cultivated plants play only a very minor part in all botanical macroremains.

The data about the other classes will be briefly discussed per site. Most information has already been presented in paragraph 4.6. The predominance or scarcity of a syntaxonomical class in table 28 can only be evaluated with regard to the presence of this class on other sites, as in general some classes are better or worse represented, as explained above.

In Spijkenisse 17-30, the most remarkable result is the extremely low representation of crop weeds (cl. 12), despite the fact that crop plants are fairly well represented. Plants from damp grasslands (cl. 25) in contrast reach a high share. In my opinion, this is a reflection of the economy of the site, which will be discussed in more detail in chapter 6.

In Spijkenisse 17-35, the other (partly!) Early Iron Age site, the crop weeds are much better represented. Remarkable is the high score of perennial ruderals (cl. 17) in a Middle Iron Age sample from Spijkenisse 17-35 (nr. 612). Lambrick (1978) conceived the presence of perennials as an indication for prolonged habitation. However, in contrast is the observation that more intense cultivation conditions result in the increase of annuals. Similarly, deficient manuring causes a reduction of annual weeds, whereas perennials flourish on such plots (Brenchley/ Warington 1930: 264). Apparently, the subject is too complex to allow very straightforward interpretations.

The samples of Spijkenisse 17-34 clearly show the influence of the ditches near the house. Both water plants (cl. 5) and reed marsh (or belt) vegetations (cl. 19) predominate. Crop weeds show a low share while damp grasslands show the highest value of all sites examined.

In Geervliet 17-55, crop weeds are better represented, which is no surprise in view of the wealth of threshing-remains on this site. Remarkable is the universality of remains of *Myrica gale* (cl. 32). It could probably spread on the peat which was desiccated due to drainage by gullies during the Dunkirk I transgression phase. The predom-

Table 28. Relative importance of syntaxonomical classes per site (crop plants and unknown excluded from "seed-sum"). **xx** = high value for that class, *xx* = low value for that class, 0.0 = < 0.05%.

class	RH.10-69	Sp.17-30	Sp.17-35	Sp.17-34	Gv.17-55	Ab.17-22	Zl.16-15	Zl.17-27	Ro.08-52	Nh.09-89	Rock.1	Rock.2	Rock.10
Cl. 5	—	—	0.0	**12.9**	0.2	0.7	—	—	0.0	—	0.0	0.0	1.4
Cl. 8	—	0.6	0.0	0.0	—	—	—	0.2	**5.8**	0.8	0.0	0.1	1.4
Cl. 9	—	—	0.0	0.0	—	—	—	0.0	**5.1**	0.7	1.8	**4.4**	2.6
Cl. 10	—	—	—	—	—	—	—	—	—	—	—	—	1.7
Cl. 11	3.7	**29.9**	14.8	12.2	6.6	**39.5**	**29.5**	13.9	2.0	18.5	16.0	1.4	6.7
Cl. 12	—	0.2	9.9	3.7	11.2	7.8	4.9	13.4	9.4	2.7	**22.7**	**28.5**	10.4
Cl. 13	—	—	—	0.0	—	—	—	—	—	0.0	—	0.1	—
Cl. 16	22.2	6.6	11.5	9.1	**31.1**	1.3	4.7	16.9	**33.0**	9.2	**54.3**	**43.1**	20.4
Cl. 17	—	7.4	**23.2**	2.6	0.2	3.1	**23.1**	0.2	14.2	1.2	0.0	2.7	8.2
Cl. 19	11.1	**34.9**	27.7	**38.0**	22.2	**33.9**	**32.8**	**48.1**	*1.2*	19.6	3.5	14.5	29.5
Cl. 24	—	—	0.0	0.0	—	5.8	—	1.2	**4.8**	**25.3**	1.6	3.5	**11.5**
Cl. 25	**18.5**	**16.3**	**11.7**	**19.1**	**14.5**	3.1	3.1	3.1	**12.5**	**18.8**	0.0	1.2	1.6
Cl. 27-30	3.7	3.3	1.0	1.3	2.1	4.0	1.9	2.5	10.0	2.3	0.1	0.5	4.6
Cl. 32	—	—	0.0	0.6	**9.8**	0.9	—	0.0	0.7	0.7	—	—	—
Cl. 35	40.7	0.8	0.1	0.4	2.1	—	—	0.3	0.2	0.0	—	—	—
Cl. 38	—	0.0	0.8	0.0	—	—	—	0.0	1.0	—	—	—	—
Crop plants	—	3.2	1.0	2.1	**48.2**	0.8	4.1	**21.9**	1.2	1.8	1.1	2.5	3.8
# seeds	27	6,056	44,707	245,165	1101	627	913	8872	58,494	101,610	16,521	9275	9454
# samples	2	9	8	19	3	1	1	2	11	23	5	12	6
total vol. (l)	0.75	10.15	15.0	30.1	1.5	3	3	9.5	5.35	21.51	3.0	7.25	21.5

inance of *Myrica* remains in sheep/goat excrements found in Nieuwenhoorn is interesting. Similar observations are known from Iron Age contexts in the Assendelver Polders (Therkorn *et al.* 1984) and in Midden-Delfland (Kuijper *pers. comm.*). *Myrica* seems to have been collected deliberately for animal fodder. It was also used for brewing beer in medieval times, as is evidenced by botanical investigations as well as by written sources (cf. Behre 1984b; Greig 1991). Whether or not this was already practised in prehistoric times cannot be decided on the basis of the available data. As in the sites discussed above, the proportion of grassland plants in Geervliet 17-55 is high. Remarkably enough, the four sites dating from the Early and Middle Iron Age show the highest share of grassland plants of all sites examined.

The samples from Abbenbroek and Zuidland 16-15 (each one sample) show high percentages for therophytic pioneers of places rich in nitrogen (dried-up ditches and the like; cl. 11). As in all sites on Putten, salt marsh vegetations (cl. 8, 9 and 24) are of less importance.

Zuidland 17-27, where many remains of cultivated plants occurred (see above), also shows a strong representation of crop weeds. The numbers of grassland plants in the three Late Iron Age sites on Putten are remarkably low compared to their older counterparts. On all sites on Putten, plants from heathlands and bogs (cl. 27-30) are scarce. This is a reflection of the location of the sites, which is in eutrophic reed vegetations (see also *2.5.1*).

On the Late Iron Age site near Rockanje (08-52), the heather and bog plants do show a high percentage, reflecting the location of this site on a raised bog (see *4.6.8*). All salt marsh vegetations (cl. 8,9 and 24) are also important. These two groups of vegetations are mutually exclusive as salinity prevents the further growth of raised bogs. Bog plants are concentrated in the sample of the natural subsoil, which is likely to reflect an earlier time than that in which human habitation coincided with the occurrence of the salt marsh plants. This confirms the data provided by the pollen diagram from this site, which also shows sharply increasing saline conditions during the habitation of the site. In Rockanje 08-52, the reed vegetations hardly occur at all, which in all probability is a result of the high salinity. Stems of *Phragmites*, however, are abundantly present. Nowadays, reed does occur at higher salt levels, but in this case remains in a vegetative state. Most other species of (fresh) reed vegetations (cl. 19) do not occur (see further *4.6.7*).

In Nieuwenhoorn, plants of damp grasslands are as important as in the Early Iron Age sites. This site was founded on a desiccated raised bog, as was shown by the analysis of section samples from this site (see *4.6.9*). Here too, perennial salt marsh plants predominate, mainly on account of *Scirpus maritimus*. This species mainly occurs in brackish environments. This implies that the surroundings of Nieuwenhoorn were not as saline as those of Rockanje.

The three houses excavated in the native Roman site near Rockanje do not all provide the same picture. The third house, in trench 10, is different from the other two houses. In the third house, salt marsh plants are more important, while in houses one and two crop weeds and tread resistant plants predominate. The third house has a deviating, A-shaped construction, which might also point to a deviating date. The more natural vegetations represented in the remains in the third house and the indicators of anthropogenic activity in the first and the second houses suggest that the third house was built first, in a relatively undisturbed environment. The first and the second house were built in an environment which showed traces of longer occupation.

4.8.2 Conspicuously absent classes

In the list of classes represented on the sites of Voorne-Putten, several classes are not included, as they are absent on all investigated sites. Since the absence of several classes is also informative, these classes will be discussed here.

The most saline type of vegetation in the Netherlands is characterized by *Zostera* species (cl. 2). They occur in the range between well below Mean Low Water level through Mean High Water level. They have never been described in archaeological contexts, only Raven and Kuijper (1981) found *Zostera* seeds in a natural deposit in the Netherlands. Their absence in the Voorne-Putten material is an indication that the sites were not founded in the littoral zone of a salt marsh, which is the logical way to avoid daily inundations.

Spartina species, characterizing class 14, occur around M.H.W., especially on soft mud flats. They grow above the zone characterized by *Salicornia* species that have been found in the present study. As far as I know, *Spartina* has never been reported from archaeological material.

Species of the present Ammophiletea (cl. 15) occur in the sandy habitats between the coastline and the dunes. If such vegetations were exploited, for instance for animal fodder, their seeds might be found on the sites. As these seeds are absent, the exploitation of the dunes is not demonstrated.

Plants that characterize places with felled or burnt trees (cl. 18) are also wanting. This absence is a first indication of the openness of the terrain. This is further evidenced by the extreme scarceness of plants characterizing brushwood (cl. 32-34) and forests (cl. 35-38), as well as the absence of herbal taxa that occur on the fringes of forests on dry soils (cl. 31). Character species for riverine willow shrubs and -forests (cl. 33: *Weichholz-Aue*) have not been found in the present study. Unfortunately, only *Salix* species are character species for this class, and *Salix* seeds do notoriously preserve badly. They have, for instance, never been found in the German settlements on the levees along the Ems either (Behre *pers. comm.*). Of the differential species, many potential indicators of this class do occur very regularly (e.g. *Alisma*, *Eleocharis*, *Hydrocotyle*, *Berula*, *Stachys*, etc.). Since these are character species of other very common classes, the importance of willow shrubs and -forests is difficult to assess. *Moehringia trinervia*, character species of forests on rich soils (cl. 38), may also have come from riverine forests. It is regularly represented in peaty environments on the sites on Voorne-Putten. Van Zeist (1989) found this species in Middelstum-Boerdamsterweg. This site lies in the former coastal area in the vicinity of peaty areas in northern Groningen. In the publication by Westhoff *et al.* (1971), a possible explanation of the occurrence of *Moehringia* can be found; in medieval times, it also occurred on peaty ridges along drainage ditches. Apparently, decomposing peat provides suitable growing conditions.

Species of dry grasslands on sandy and calcareous soils (cl. 20 and 21) are also lacking. This indicates that dry soils were not present in the immediate surroundings of the sites, or at least were not used for grazing livestock.

4.8.3 Salt marsh plants versus freshwater plants

In his investigations of the northern German coastal area, Behre (1985) calculated the importance of halophytes (salt marsh plants) versus glycophytes (freshwater plants) for several sites. He developed this method during his investigation into early medieval Niens (Behre 1991b). The large difference in numbers of seeds preserved, related to different seed production per species, led Behre to conclude that quantitative ratios, based on numbers of seeds, are not applicable. He therefore selected sixteen halophytes and as many glycophytes, and recorded presence or absence on the site. The ratio of the number of these halophyte- and glycophyte-taxa gives an indication of the salinity of the environment of a site, respectively of different periods within a site. The taxa concerned are listed in table 29. Behre selected the taxa on the following criteria:

1. regular occurrence in fossile salt marsh samples; identification possible with certainty.
2. limitation to grassland species, which are the best indicators of salinity; weeds and ruderals are excluded.
3. exclusion of reed swamp species (*Phragmites*, *Typha*, *Scirpus*), which may have been transported from afar for roofing, litter and the like.

The proposed use of qualitative data (presence/absence) only, has one major implication. On thoroughly investigated sites, the scarcer category (halophytes in a freshwater environment and glycophytes in salt marshes) can still be reasonably well represented in the number of taxa, although only in a few samples and in small quantities. For this reason, not only Behre's purely qualitative ratio has been applied for the sites in the present study, but so has a second ratio, for the sake of comparison. This second ratio was established on the basis of the frequencies of the species concerned. The frequency equals the number of samples per

Table 29. Presence and frequency of halophytes and glycophytes and their ratios for the sites studied.

	Sp.17-30	Sp.17-35	Sp.17-34	Gv.17-55	Ab.17-22	Zl.16-15	Zl.17-27	Ro.08-52	Nh.09-89	Rock.1	Rock.2	Rock.10
number of samples:	9	8	19	3	1	1	2	8	26	5	12	6
Halophytes												
Salicornia europaea	2	2	1	—	—	—	1	5	5	2	3	5
Suaeda maritima	—	—	—	—	—	—	—	5	4	2	3	3
Puccinellia maritima	—	—	—	—	—	—	—	1	—	—	—	—
Aster tripolium	—	1	—	—	1	—	2	—	9	2	7	4
Limonium vulgare	—	—	—	—	—	—	—	3	—	—	—	—
Triglochin maritima	—	—	1	—	—	—	—	4	7	3	7	4
Spergularia marginata/salina	—	—	1	1	—	—	2	6	3	5	9	4
Cochlearia anglica/officinalis	—	—	—	—	—	—	—	1	—	—	—	—
Puccinellia distans	—	—	—	—	—	—	—	2	1	3	2	3
Plantago maritima	—	—	—	—	—	—	—	4	—	1	3	3
Glaux maritima	—	—	1	—	—	—	—	5	1	3	4	4
Juncus gerardi	8	2	8	1	—	—	—	7	18	5	12	5
Armeria maritima	—	—	—	—	—	—	—	—	—	—	—	—
Carex distans	—	—	—	—	—	—	—	—	—	1	—	3
Apium graveolens	—	—	—	—	—	—	—	5	4	2	3	4
Centaurium cf pulchellum	—	—	—	—	—	—	1	1	2	2	5	4
Glycophytes												
Lycopus europaeus	8	8	16	3	1	1	2	2	19	—	3	1
Bidens tripartitus	—	4	5	3	—	1	2	—	4	—	—	—
Galium palustre	4	7	7	2	—	—	1	3	6	—	—	—
Rhinanthus cf minor	—	2	4	2	—	1	—	—	3	—	—	1
Lythrum salicaria	7	8	15	2	—	1	2	4	19	1	1	1
Lychnis flos-cuculi	5	5	14	3	1	1	1	4	2	—	—	2
Ranunculus lingua	—	—	—	—	—	—	—	—	—	—	—	—
Hydrocotyle vulgaris	5	6	15	1	1	1	1	6	6	—	3	2
Phalaris arundinacea	1	2	4	—	—	—	1	—	—	—	—	—
Stachys palustris	7	7	10	—	—	1	1	—	—	—	—	1
Hippurus vulgaris	—	—	1	—	—	—	—	—	—	—	—	—
Prunella vulgaris	—	1	2	2	—	—	2	—	2	—	—	2
Ranunculus flammula	—	—	—	—	—	—	—	1	—	1	—	1
Alisma plantago-aquatica	—	3	15	—	1	1	1	—	—	—	1	—
Filipendula ulmaria	—	2	8	3	—	—	—	—	1	—	—	—
Glyceria fluitans	—	3	15	1	—	—	2	—	—	—	—	—
Presence ratio	22.2	18.8	26.3	16.7	20.0	0.0	21.4	68.4	52.6	85.7	73.3	63.2
Frequency ratio	21.3	7.9	8.4	8.3	20.0	0.0	27.3	71.0	46.2	93.9	87.9	82.1

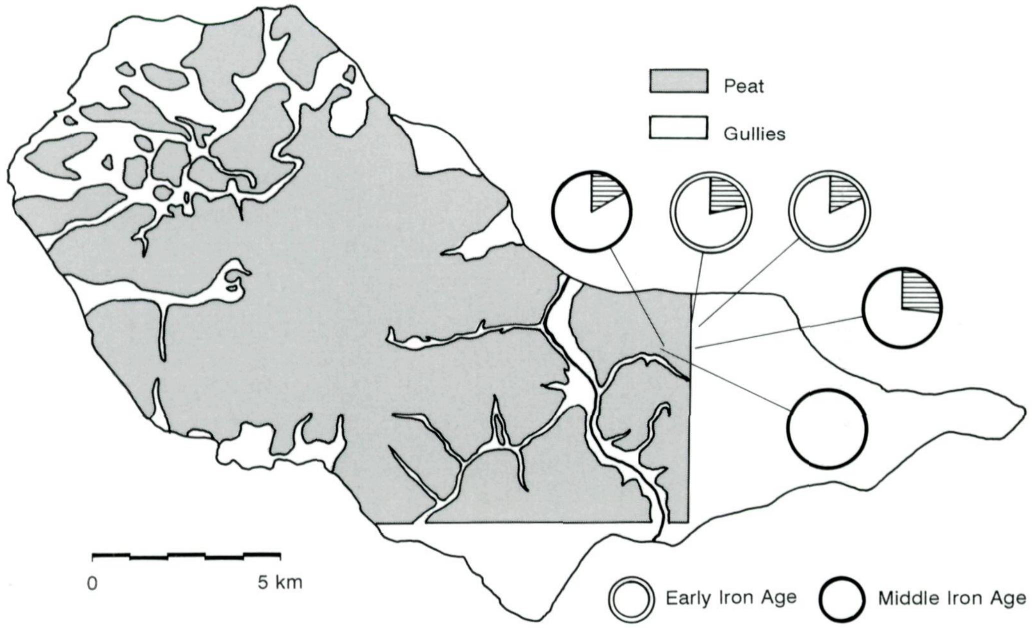


Fig. 53a Salinity ratios based on presence in the Early and Middle Iron Age. Hatched = halophytes, White = glycophytes.

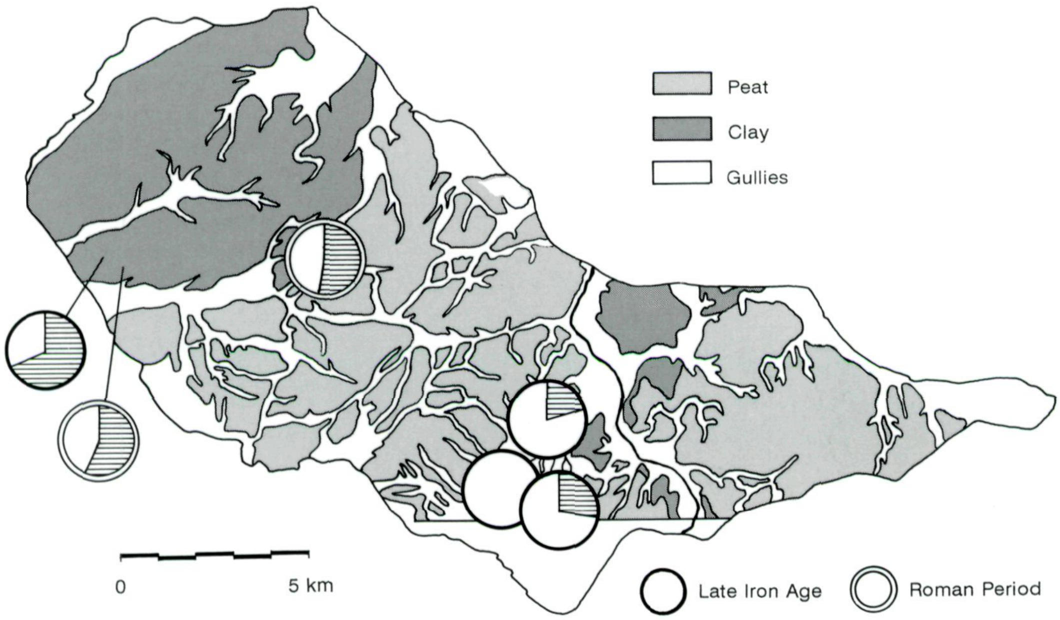


Fig. 53b Salinity ratios based on presence in the Late Iron Age and Roman Period. Hatched = halophytes, White = glycophytes.

site in which a species occurs, irrespective of quantity, divided by the total number of samples of the site concerned. In this way, absolute numbers are avoided but some quantitativeness is introduced. The following example may elucidate the calculation of the frequency ratio. In Spijkenisse 17-30, the sum of the frequencies of the 16 halophytes is 10 and

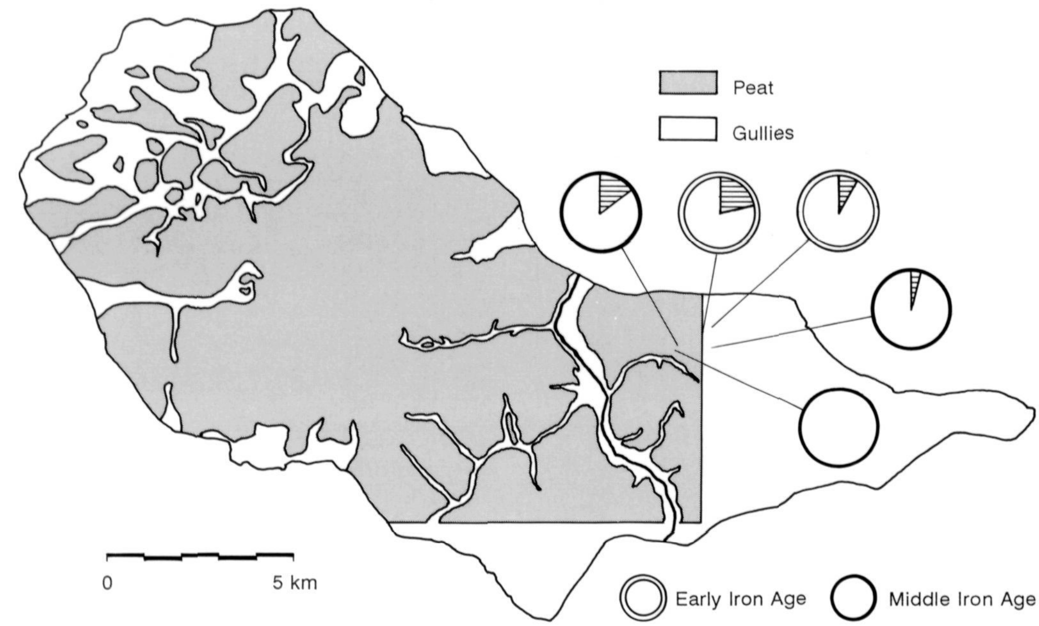


Fig. 54a Salinity ratios based on frequency in the Early and Middle Iron Age. Hatched = halophytes, White = glycophytes.

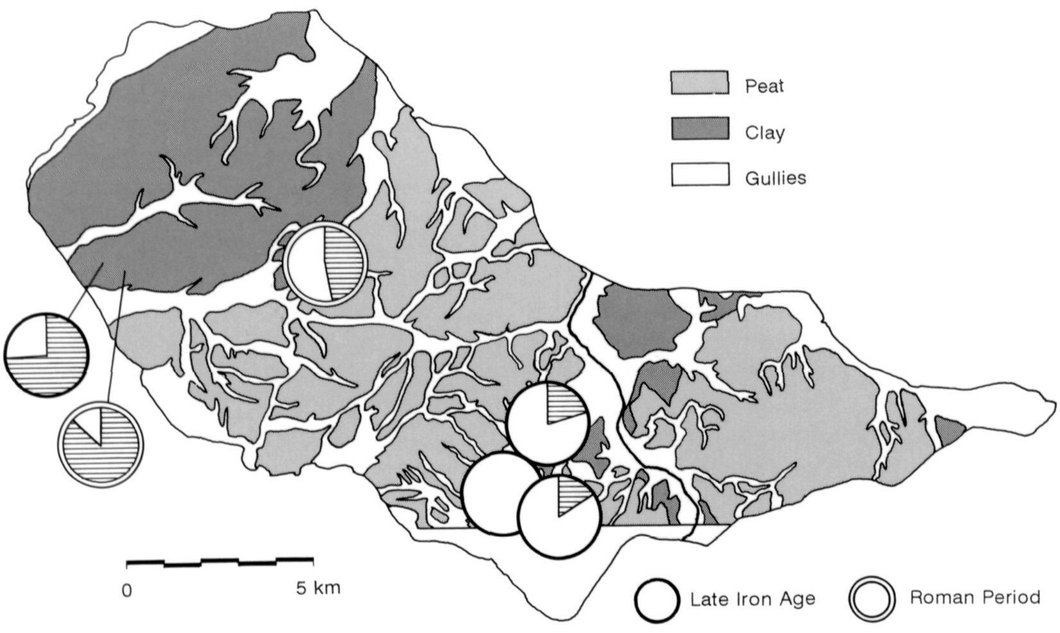


Fig. 54b Salinity ratios based on frequency in the Late Iron Age and Roman Period. Hatched = halophytes, White = glycophytes.

that of the 16 glycophytes is 37. The corresponding ratio is 10/47 or 21.3%. This may lead to a refinement of Behre's ratio. Both ratios have been listed in table 29.

A visual representation of the ratios based on presence is shown in figure 53a and b and that for frequency ratios in figure 54a and b. Particularly table 29 shows that rarely occurring salt marsh plants greatly influence the presence ratios. This occurs most markedly in Spijkenisse 17-34, of which a relatively large number of samples were analysed. The ratio based on frequency, in my opinion, gives a better reflection of the salinity or non-salinity of a site. Similarly, the presence-based ratio on the sites near Rockanje is influenced by scarcer glycophytes and the frequency ratios show higher salinity values here.

Behre (1991b) arranged the species in a descending order of salt tolerance. This order is also used in table 29. The lowermost taxa (*Phalaris arundinacea — Glyceria fluitans*) are indeed scarce on the coastal sites. Remarkable is the occurrence of *Ranunculus flammula*, which has only been found on the sites near Rockanje, albeit in small numbers. These sites have the highest salinity. According to Weeda *et al.* (1985), *Ranunculus flammula* occurs in the coastal area in desalinated, wet dune valleys and in marshy grasslands. Its presence on the sites with the highest salinity is thus very remarkable, but must remain unexplained.

4.8.4 Crop weeds versus meadow plants

Reconstructions of the economy of the sites is one of the major aims of the present investigations. The role of pollen analysis in this respect appears to be limited at the present state of palynological research (see *2.4.1*). Moreover, the faunal remains do not provide any information on the relative importance of arable farming or pastoralism in the economy of the site concerned. For this reason, an attempt is made here to gain an insight into this special problem. A more extensive discussion of the agricultural economy will be presented in a later chapter (*ch. 6*).

In this paragraph, the relative abundance of arable weeds and meadow plants will be discussed. The underlying thought is that on a site where cultivation of crops is the main farming activity, arable weeds will be of greater importance than plants from meadows and pastures, which in their turn are supposed to be more common on "pastoral" sites. I realize that when a purely pastoral site imports its vegetable food products, arable weeds will still end up on this site, but they will mainly be crop impurities that are not removed until the final preparation of the product. They will be much less important than on an "arable" site, where far larger quantities of crops and their weeds circulate. Furthermore, "pastoral" and "arable" sites are of course part of a continuum. However, the relative share of meadow/pasture plants and arable weeds may roughly indicate the place of a site in this continuum. Since the processes related to deposition are completely different for crop weeds and hay plants, no 1:1 relationship in comparing these categories may be assumed. It is to be expected that hay plants will in general be less well represented, since the hay will have been "harvested" before most seeds have ripened. By the time seeds are ripe, the nutritional value of hay has strongly decreased (cf. Knörzer 1979; Jacomet *et al.* 1989). Greig (1984) observed that grassland plants in general produce fewer seeds than crop weeds, which also favours the quantity of crop weeds relative to grassland plants. Thus, if on a site "pasture" scores 60%, this is only significant in relation to other sites (with "more" or "less" "pasture"), no absolute value may be given to this percentage.

If single samples were dominated by one of these categories (for instance in residues from crop processing or from hay), this would introduce a severe bias. If only few samples of a site have been investigated, this can distort the ratio considerably. However, it has been attested by means of cluster analyses that the samples within the site discussed here are relatively homogeneous, great differences between samples of one site are exceptions. Combined with the fact that of most sites several different contexts were analysed botanically, this homogeneity might meet any distortions to a certain degree.

This first attempt to quantify the economy of a site with botanical macroremains can undoubtedly be improved upon. However, in view of the fact that pollen and bones hardly ever provide reliable data, the potential of macroremains should in my opinion be exploited. Application of possibly adjusted ratios on other sites may show the value of the present approach.

For calculation of the ratios, ten crop weeds and as many meadow/pasture plants have been selected. The crop weeds are all from summercrops, since no wintercrop weeds occur in the present study. As in Behre's salinity indicators, the commonness of taxa in palaeo-ethnobotanical literature has been considered. *Spergula arvensis* was therefore included, despite its absence in the present study. On a site with both summer- and wintercrop weeds, it might be necessary to calculate another ratio.

In table 30, the presence- as well as the frequency ratios were calculated again. The results seem to indicate that the role of arable farming in the Early Iron Age was very limited. Especially the frequency ratios show a more or less steady increase of crop weeds through time. The ratios of the three Late Iron Age sites around the Bernisse are based on only one or two samples, which makes these ratios more liable to bias. The sites near Rockanje show relatively high arable components. The native Roman site of Nieuwenhoorn shows a much lower ratio than the sites near Rockanje do.

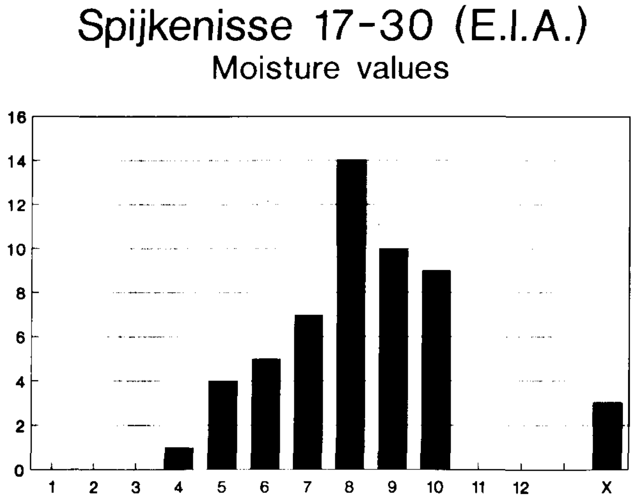
In chapter 6, the implications of these data will be discussed in a more general view, in relation to existing models of prehistoric agriculture.

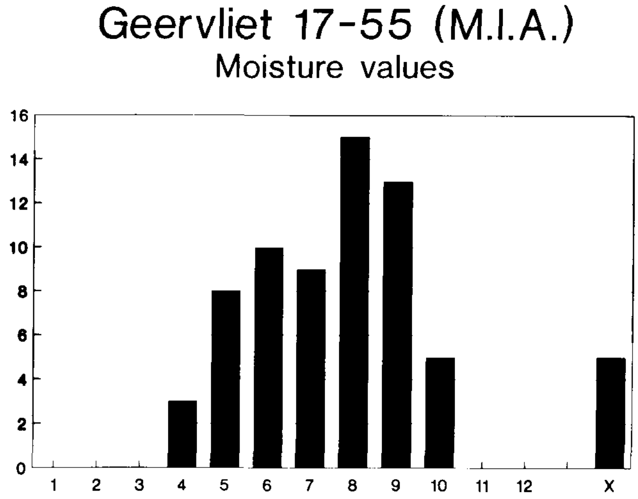
4.9 The use of indicator values

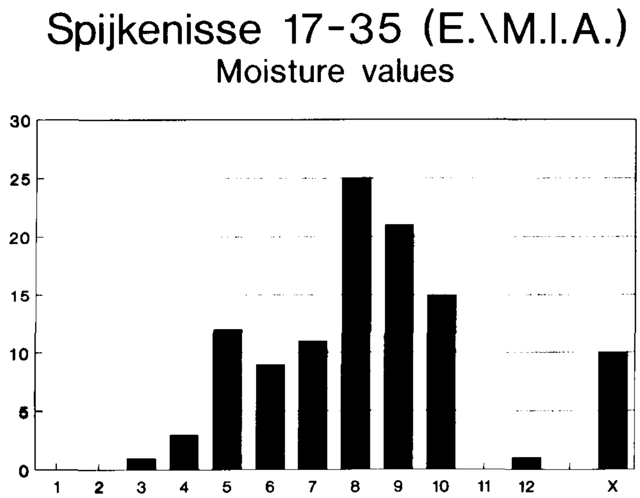
A different approach to the results obtained by the analysis of botanical macroremains is furnished by the use of indicator values. These indicator values, as published by Ellenberg

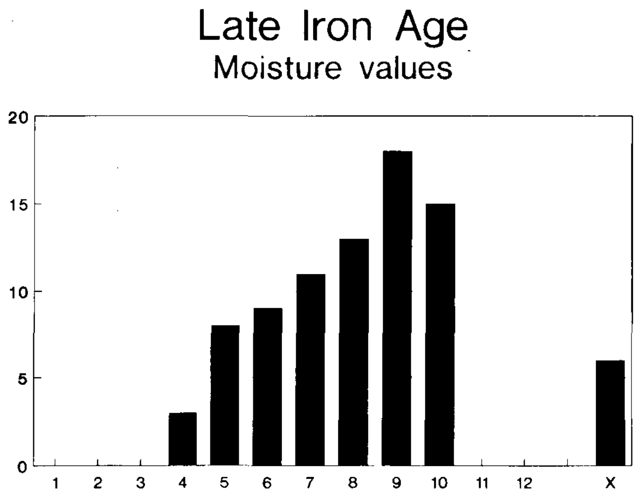
Table 30. **Presence and frequency of selected arable and meadow plants and their ratios for the sites studied.**

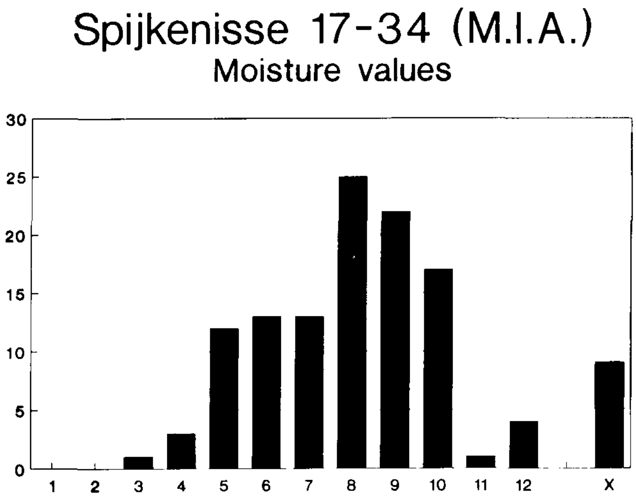
	Sp.17-30	Sp.17-35	Sp.17-34	Gv.17-55	Ab.17-22	Zl.16-15	Zl.17-27	Ro.08-52	Nh.09-89	Rock.10	Rock.2	Rock.1
number of samples:	9	8	19	3	1	1	2	8	26	6	12	5
dating:	E.I.A.	E./M.I.A.	M.I.A.	M.I.A.	L.I.A.	L.I.A.	L.I.A.	L.I.A.	R.P.	R.P.	R.P.	R.P.
Crop weeds												
Polygonum lapathifolium	—	—	—	—	1	1	2	6	4	2	6	4
Polygonum persicaria	—	2	4	—	—	—	—	—	3	—	—	—
Sonchus asper	—	2	7	2	1	1	2	5	2	4	9	5
Sonchus oleraceus/arvensis	—	1	1	1	—	—	—	3	2	4	8	4
Echinochloa crus-galli	—	2	3	3	—	—	2	—	—	1	—	—
Spergula arvensis	—	—	—	—	—	—	—	—	—	—	—	—
Euphorbia helioscopia	—	—	—	—	—	—	—	—	—	—	—	1
Chenopodium polyspermum	—	—	1	—	—	—	—	—	—	—	—	—
Erisymum cheiranthoides	—	1	—	1	—	—	—	—	—	—	—	2
Anagallis arvensis	—	—	—	1	—	—	—	—	—	—	—	—
Meadow plants												
Carex disticha	—	4	17	3	1	1	2	—	3	—	5	—
Hypericum quadrangulum	3	7	9	1	—	1	—	—	2	—	—	—
Lychnis flos-cuculi	5	7	14	3	1	1	1	4	2	2	—	—
Lythrum salicaria	7	8	15	2	—	1	2	5	19	1	1	1
Prunella vulgaris	—	1	2	2	—	—	2	—	2	2	—	—
Trifolium repens/arvensis	2	2	—	3	—	—	—	4	2	2	5	3
Leontodon autumnalis	—	—	1	—	—	—	—	—	—	4	5	2
Poa trivialis-type	6	7	17	3	—	1	2	7	4	3	8	5
Ranunculus repens-type	—	3	12	3	—	—	1	1	—	1	2	1
Agrostis spec.	8	7	10	3	1	—	2	7	13	4	6	5
Presence ratio	0.0	38.5	35.7	35.7	40.0	28.6	30.0	33.3	33.3	35.3	30.0	45.4
Frequency ratio	0.0	14.8	14.2	25.8	40.0	28.6	33.3	33.3	19.0	36.7	41.8	48.5

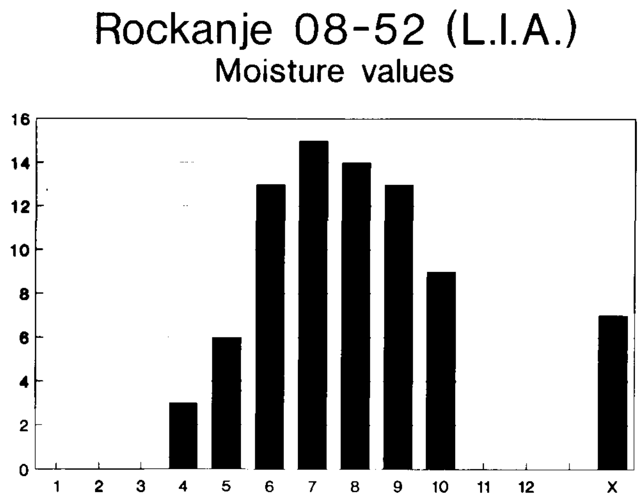

Spijkenisse 17-30 (E.I.A.)
Moisture values
0 2 4 6 8 10 12 14 16
1 2 3 4 5 6 7 8 9 10 11 12 X


Geervliet 17-55 (M.I.A.)
Moisture values
0 2 4 6 8 10 12 14 16
1 2 3 4 5 6 7 8 9 10 11 12 X


Spijkenisse 17-35 (E.\M.I.A.)
Moisture values
0 5 10 15 20 25 30
1 2 3 4 5 6 7 8 9 10 11 12 X


Late Iron Age
Moisture values
0 5 10 15 20
1 2 3 4 5 6 7 8 9 10 11 12 X


Spijkenisse 17-34 (M.I.A.)
Moisture values
0 5 10 15 20 25 30
1 2 3 4 5 6 7 8 9 10 11 12 X


Rockanje 08-52 (L.I.A.)
Moisture values
0 2 4 6 8 10 12 14 16
1 2 3 4 5 6 7 8 9 10 11 12 X

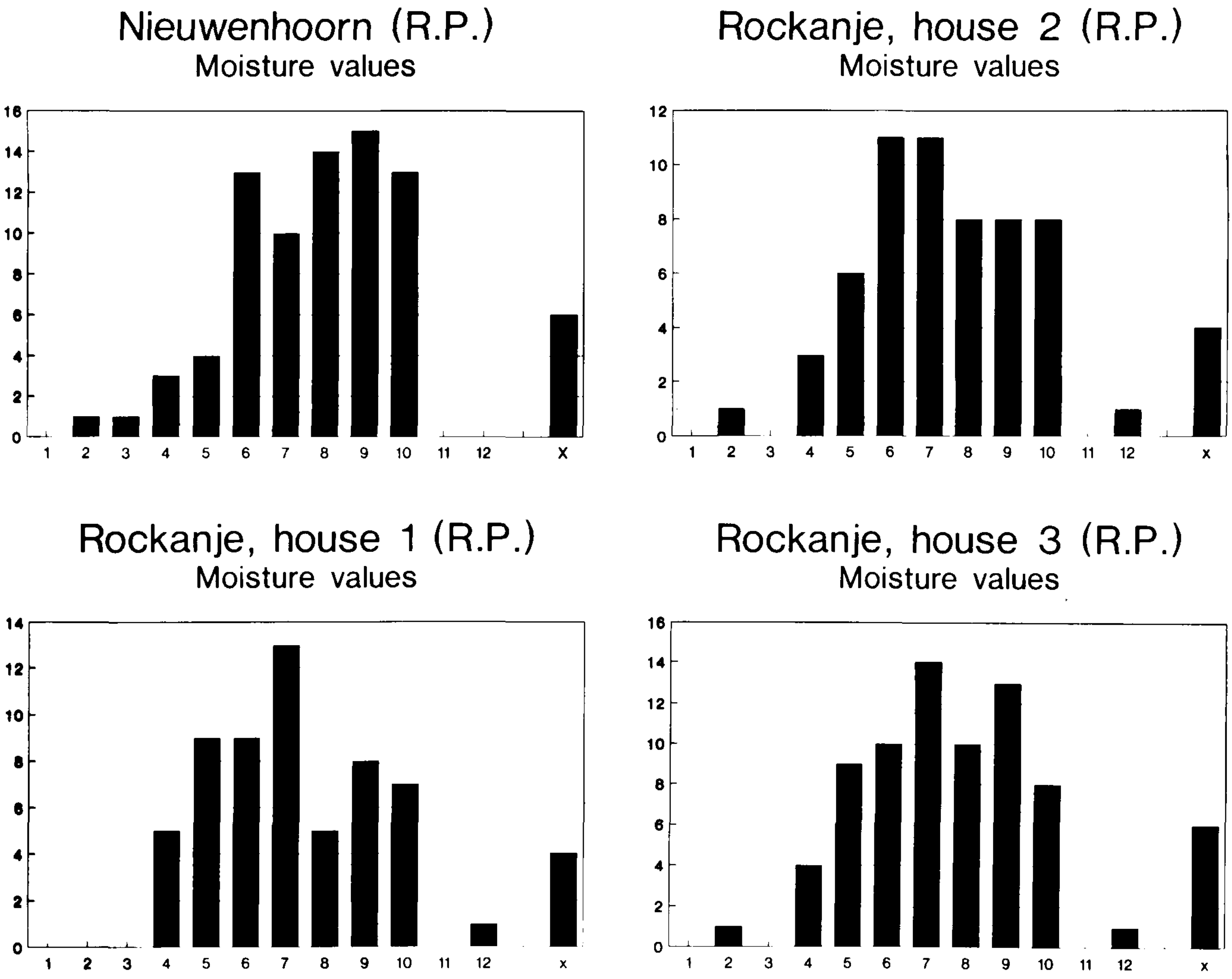


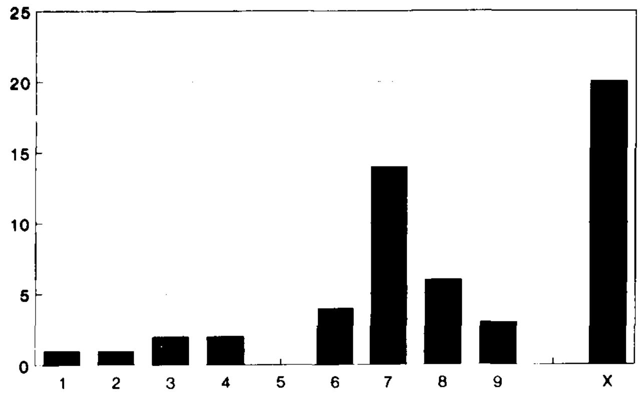
Fig. 55 Eco-diagrams for moisture. Late Iron Age = excluding Rockanje 08-52.

(1979) are an attempt to assign values to certain environmental parameters for individual species. The parameters dealt with by Ellenberg are Light, Moisture, pH, Nitrogen, Temperature and Continentality. For each parameter Ellenberg gave values between 1 and 9 (or to 12 for Moisture), in which 1 stands for a low and 9 for a high value of a parameter for the species concerned. X means an indifferent reaction of the species to a particular parameter. A species of dry, calcareous sand dunes for instance may score 1 for Moisture and 9 for pH, a plant averse to shade may score 9 for light. Willerding (1978) introduced the application of these "Ellenberg-values" for palaeo-botanical data.

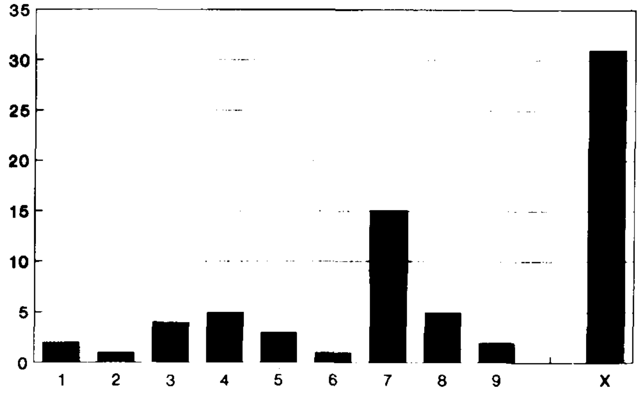
In this study, the list of species found on a particular site was used as a basis. With a DBase program, which was placed at my disposal by Drs. H. van Haaster (I.P.P.), it was possible to list the different Ellenberg-values of the species found on a site. Subsequently, the frequency of each value per parameter was established and presented as a bar diagram. These diagrams were called "palaeo-ethnobotanical eco-diagrams" by Willerding (1978).

The results obtained for the sites on Voorne-Putten will be discussed in the following. The results will be treated per eco-factor, since the results obtained per site proved to be comparable. The eco-factors of Temperature and Continentality will not be treated here, as these are only of interest in a comparison of sites that are hundreds of kilometres apart, at least in a flat country like the Netherlands.

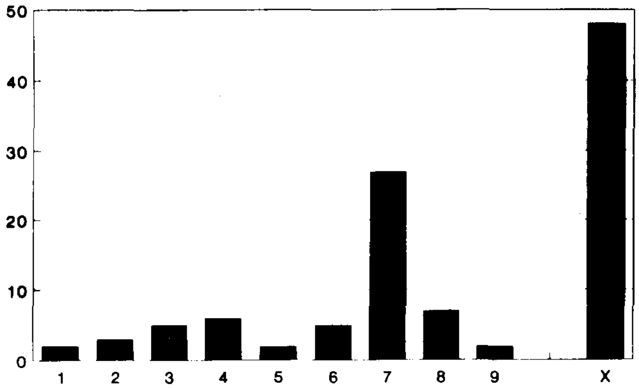
Spijkenisse 17-30 (E.I.A.)
Acidity values



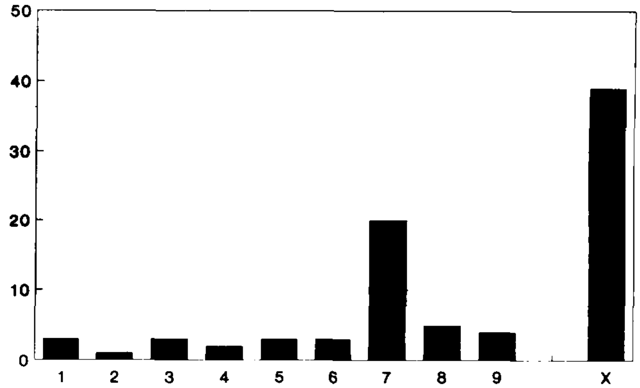
Geervliet 17-55 (M.I.A.)
Acidity values



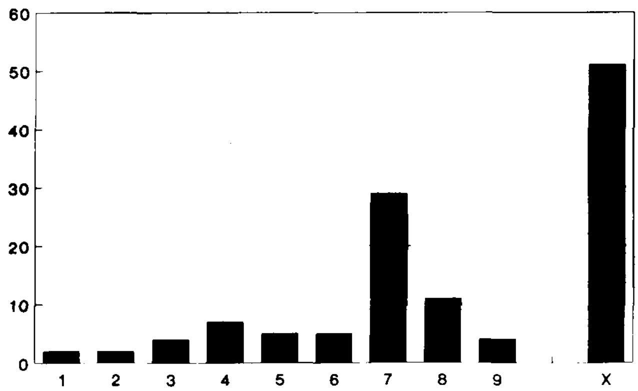
Spijkenisse 17-35 (E.\M.I.A.)
Acidity values



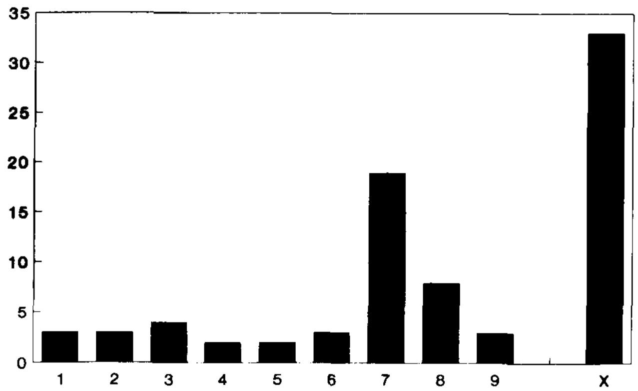
Late Iron Age
Acidity values



Spijkenisse 17-34 (M.I.A.)
Acidity values



Rockanje 08-52 (L.I.A.)
Acidity values



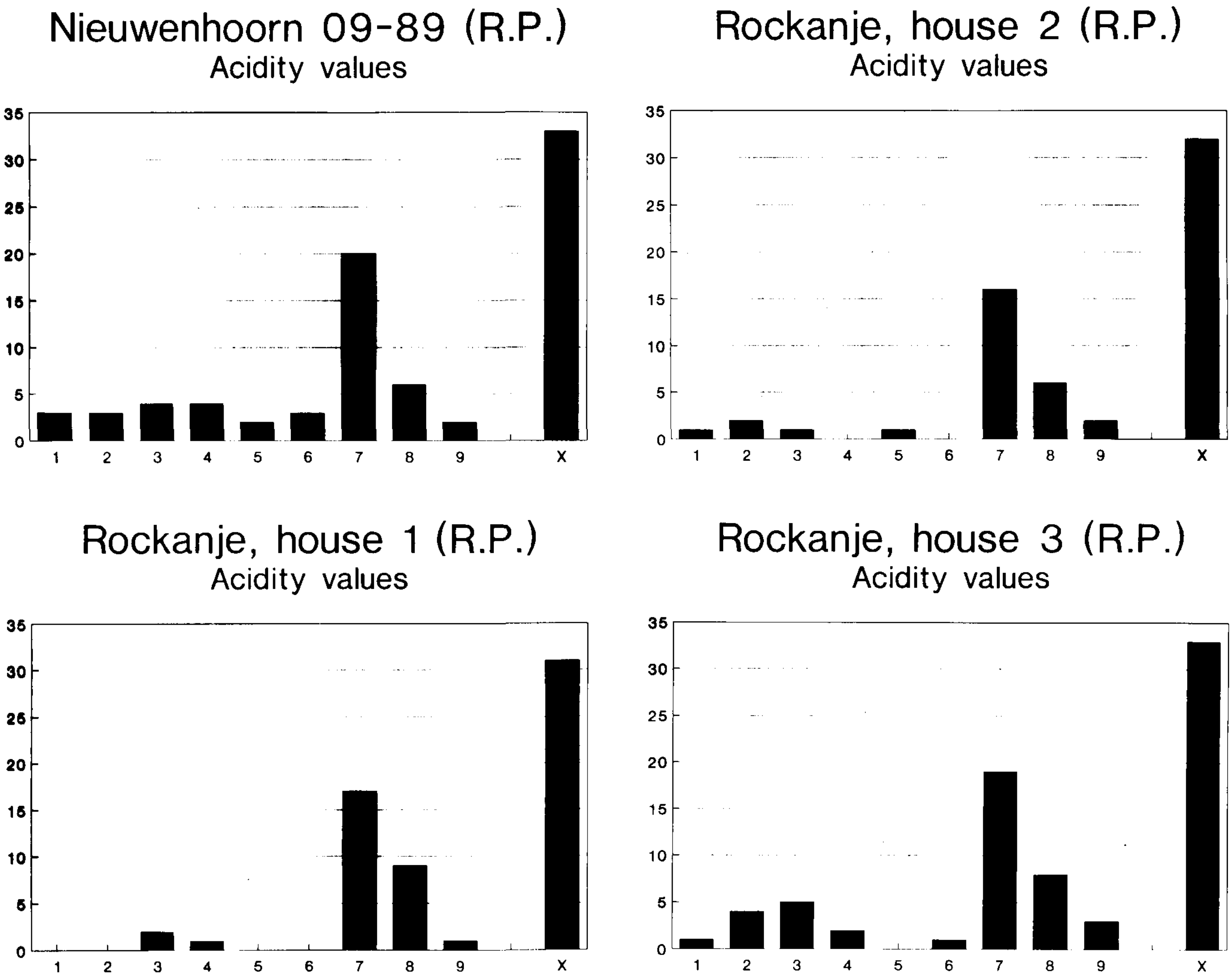


Fig. 56 Eco-diagrams for pH. Late Iron Age = excluding Rockanje 08-52.

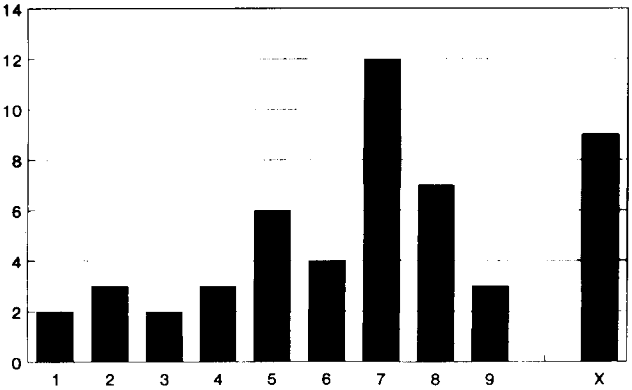
4.9.1 Moisture values

The moisture values 10, 11 and 12 indicate aquatic environments. As figure 55 illustrates, all Iron Age sites on Voorne-Putten show an eco-diagram with a maximum frequency at a Moisture value of 8, which means that the plants found as botanical macroremains are indicative of damp to wet environments. The Late Iron Age samples from the banks of ditches even show a maximum Moisture value of 9. The Roman site near Nieuwenhoorn shows two maxima, one at a value of 9 and a smaller one at 6. The other sites on Voorne show less extreme moisture conditions in comparison to the sites on Putten, with maxima around a value of 7, which is still damp. Willerding (1980) observed that on sites in central Germany the Moisture values generally lie round a value of 5, which is clearly drier than on the present sites.

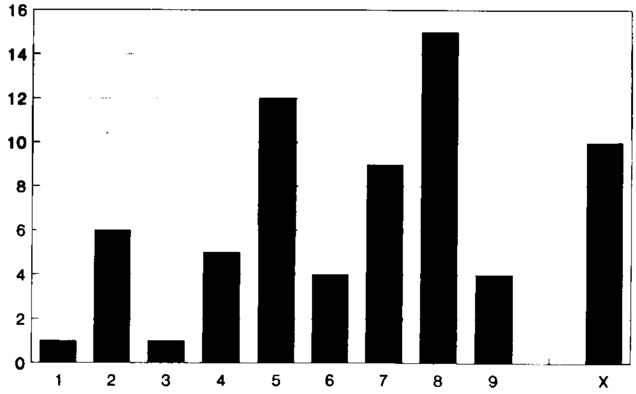
4.9.2 pH Values

All sites show a distinct maximum at a pH indicator value of 7, which indicates slightly acid to slightly alkaline conditions (see *fig. 56*). The fact that Nieuwenhoorn and Rockanje 08-52 were founded on a raised bog does not have an appreciable influence. For the German sites, Willerding found pH indicator values ranging from 2 to 7 or even 9, which he interpreted as evidence that the arable fields were located on different soil types. The fact that crop weeds play a subordinate role among the botanical macroremains in the

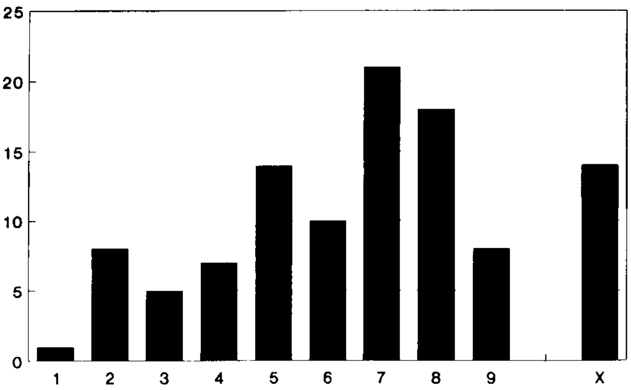
Spijkenisse 17-30 (E.I.A.)
Nitrogen values



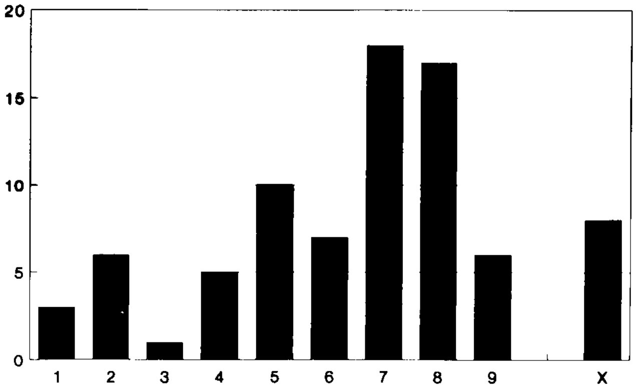
Geervliet 17-55 (M.I.A.)
Nitrogen values



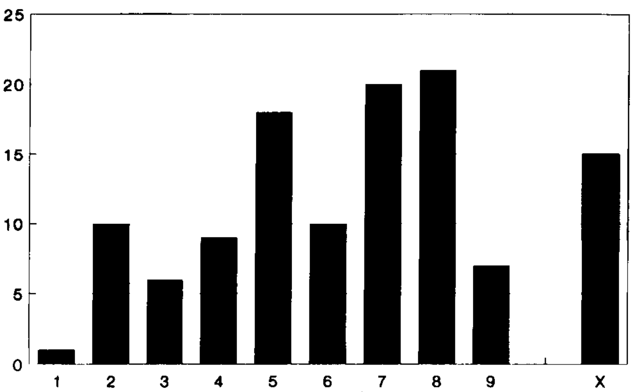
Spijkenisse 17-35 (E.\M.I.A.)
Nitrogen values



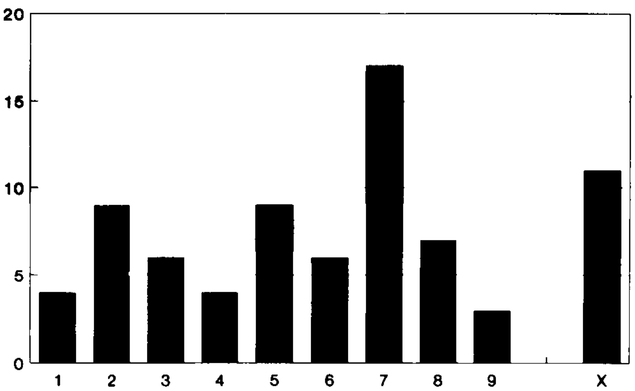
Late Iron Age
Nitrogen values



Spijkenisse 17-34 (M.I.A.)
Nitrogen values



Rockanje 08-52 (L.I.A.)
Nitrogen values



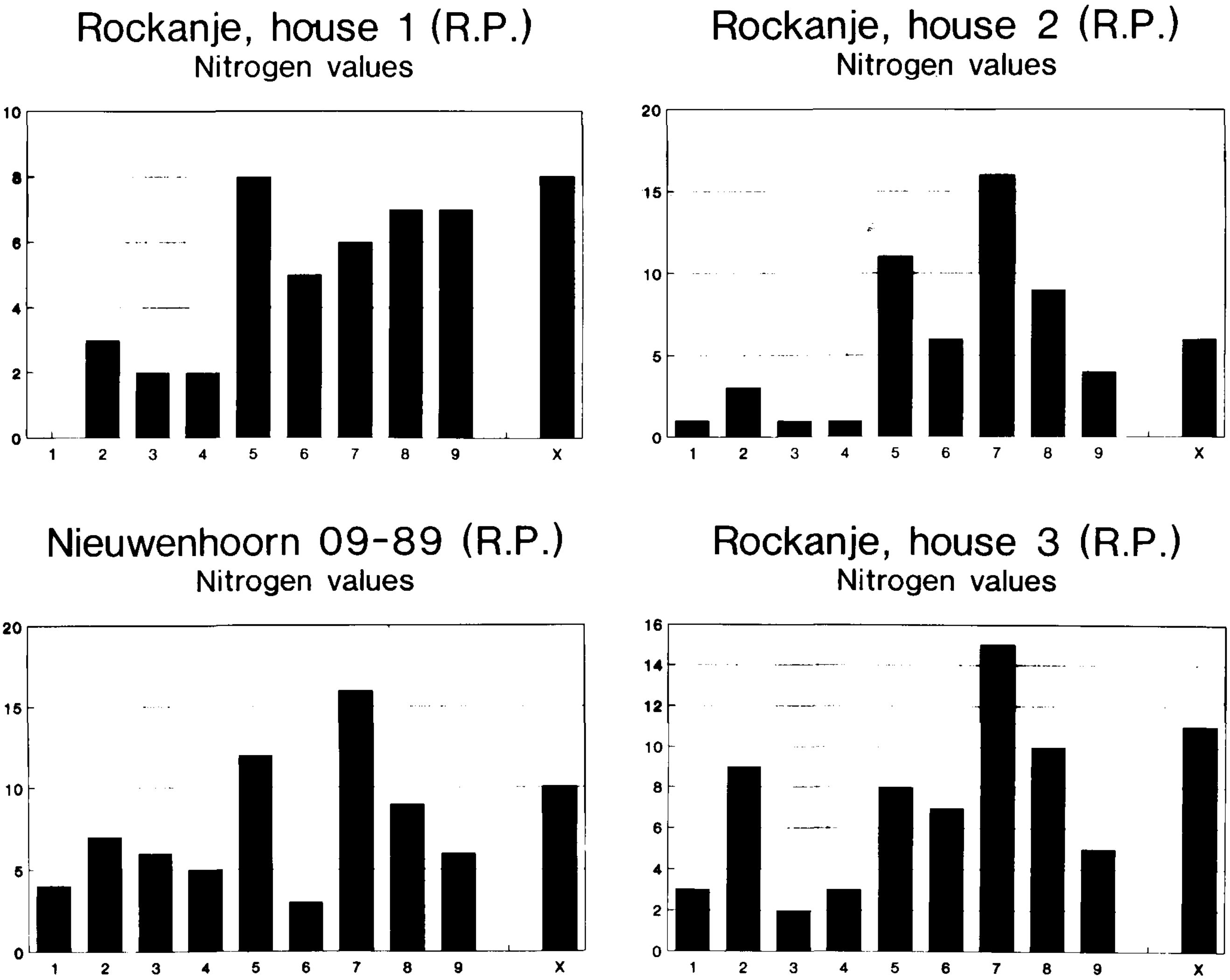


Fig. 57 Eco-diagrams for nitrogen. Late Iron Age = excluding Rockanje 08-52.

present study invalidate a similar conclusion for Voorne-Putten.

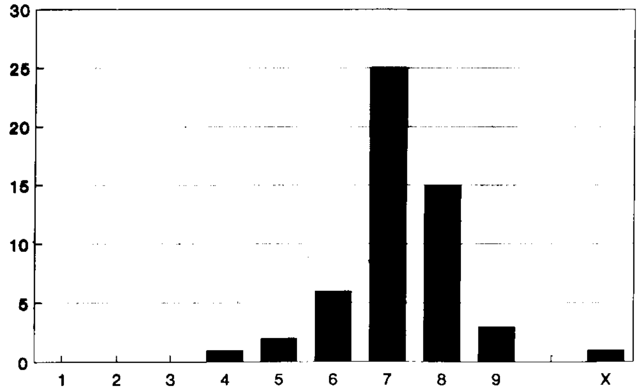
4.9.3 NITROGEN VALUES

All eco-diagrams for Nitrogen show maxima around the values 7 and 8, which indicates the presence of Nitrogen-rich soils around the settlements (see *fig. 57*). Two of the sites were founded on raised bogs, viz. Rockanje 08-52 and Nieuwenhoorn 09-89. None the less, the plants characteristic of Nitrogen-poor vegetations that occur on raised bogs do not predominate on these sites, although the lower Nitrogen values are slightly better represented. Willerding (1980) also found predominating Nitrogen values of 7 to 9 on German sites. He concluded that Nitrogen-deficiency (on the arable fields) was apparently rare. Van Zeist (1983) found equally high Nitrogen values for Iron Age Noordbarge. He suggested the possibility of fertilising the fields with dung to account for these high values, but also stated that the plants might equally well have come from refuse dumps around the settlements. The greater part of the species that play a role on the sites on Voorne-Putten has not come from arable fields, and thus do not allow statements about arable fields exclusively.

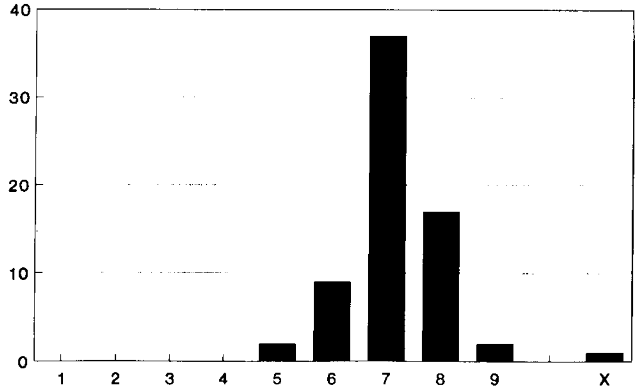
4.9.4 LIGHT VALUES

The Ellenberg-values discussed above show a striking resemblance between the various sites, but the Light values are in this respect even more uniform. As figure 58 shows, do all

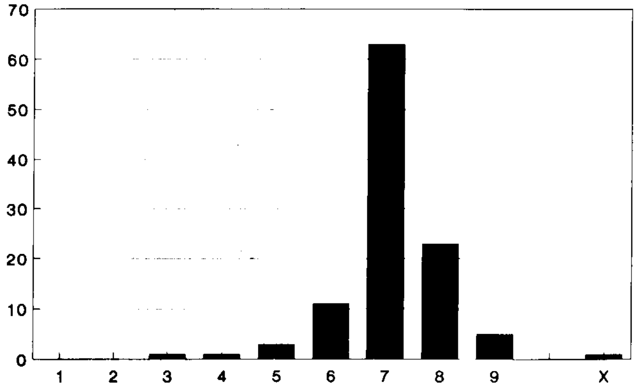
Spijkenisse 17-30 (E.I.A.)
Light values



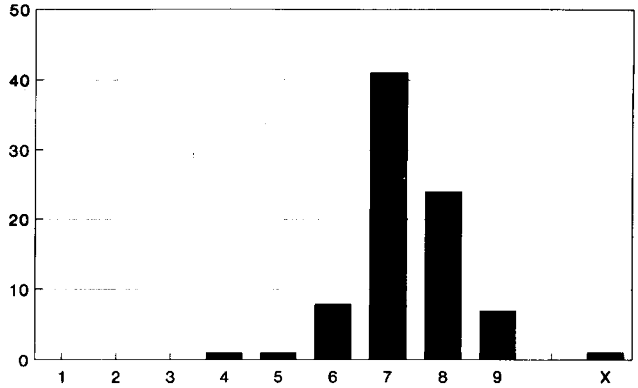
Geervliet 17-55 (M.I.A.)
Light values



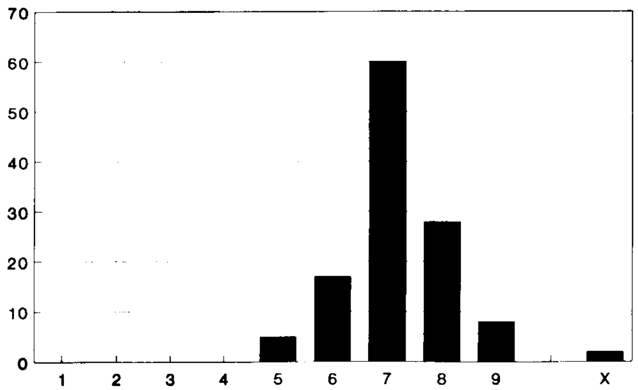
Spijkenisse 17-35 (E.\M.I.A.)
Light values



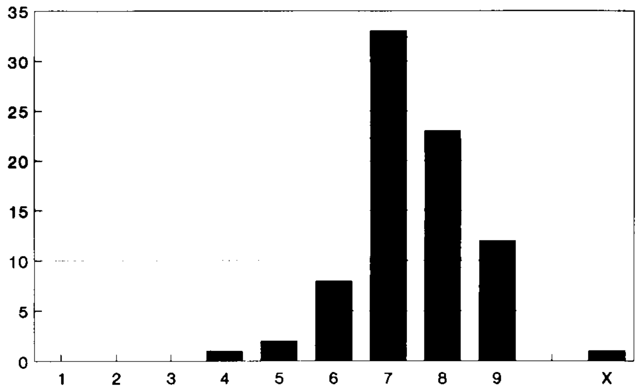
Late Iron Age
Light values



Spijkenisse 17-34 (M.I.A.)
Light values



Rockanje 08-52 (L.I.A.)
Light values



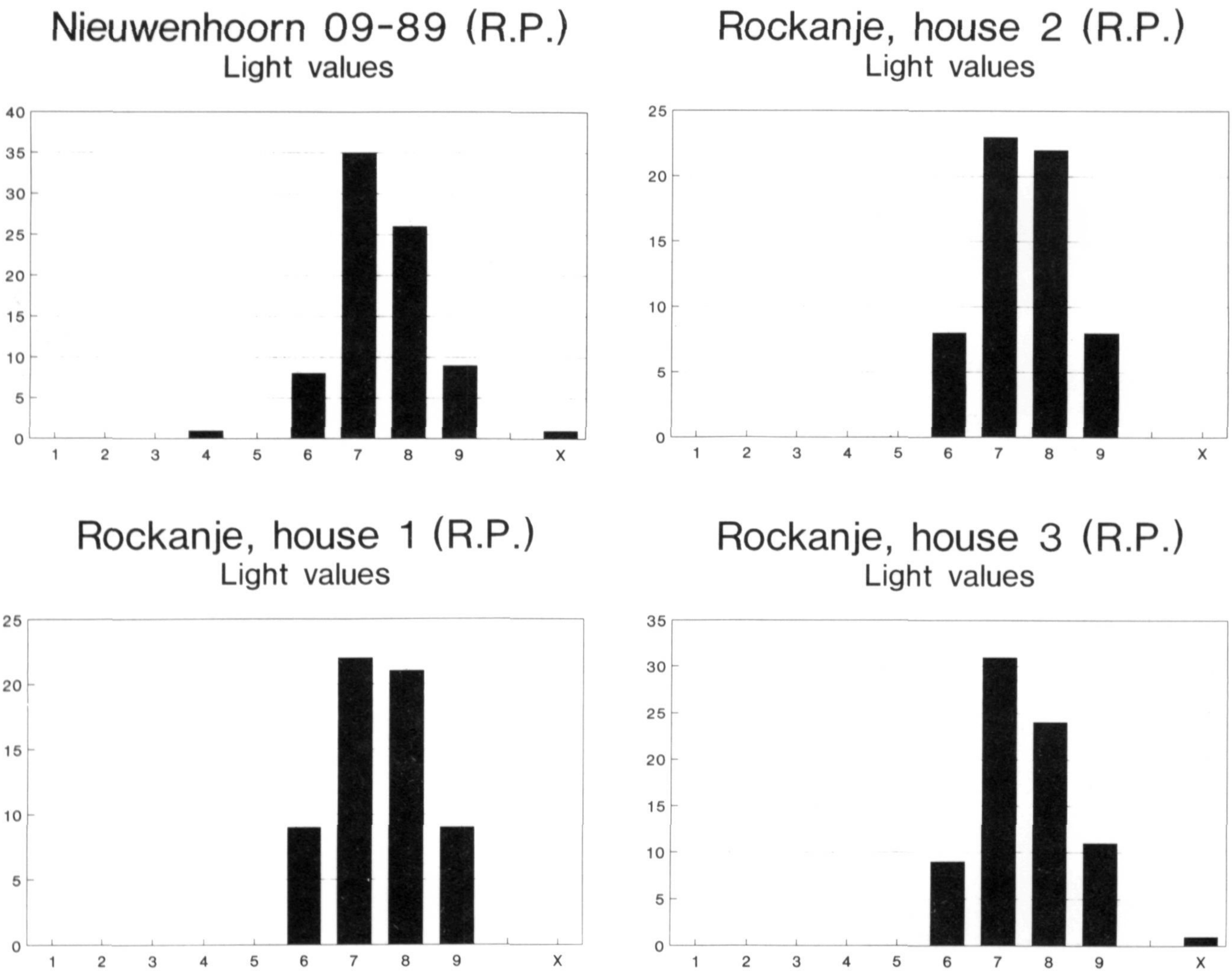


Fig. 58 Eco-diagrams for light. Late Iron Age = excluding Rockanje 08-52.

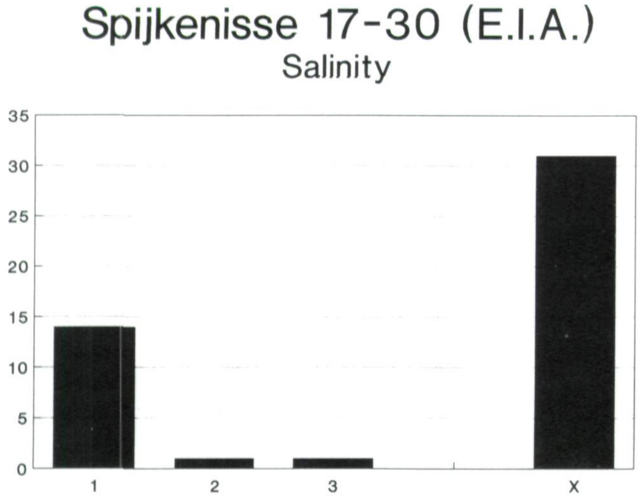
diagrams show a maximum Light value of 7, which indicates an open environment, devoid of tree cover on any appreciable scale. The open landscape that already appeared from the pollen analysis is thus clearly supported by the macroremains.

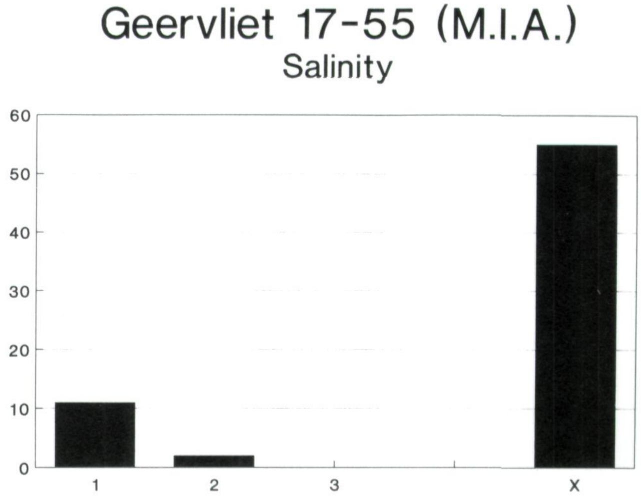
For Germany, Willerding (1980) found that the most common Light values are 5 and 6, indicating more closed types of vegetation than on Voorne-Putten.

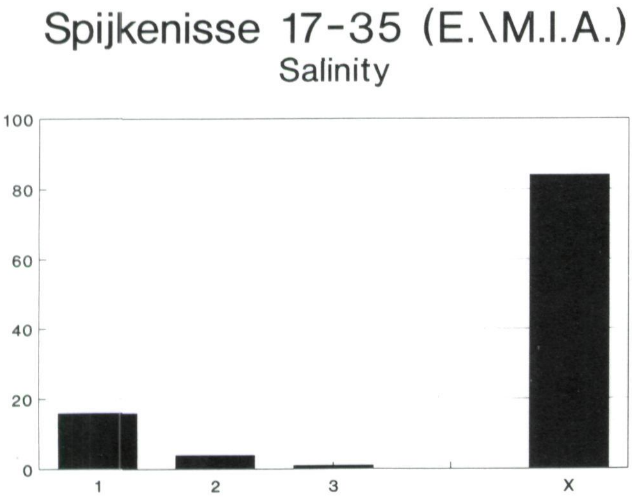
4.9.5 Salinity

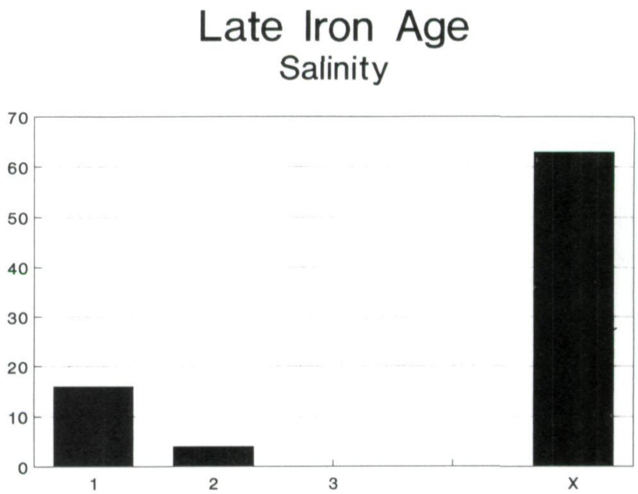
Ellenberg did not publish as detailed a scale for Salinity as he did for the other eco-factors. A value of 3 indicates that the species is an obligatory halophyte, a value of 2 represents "facultative" (optional) halophytes and a value of 1 indicates species from freshwater environments that tolerate some salinity. No indication means no salt tolerance. The salinity diagrams can be compared to the halophyte/glycophyte ratios discussed in paragraph 4.8.3.

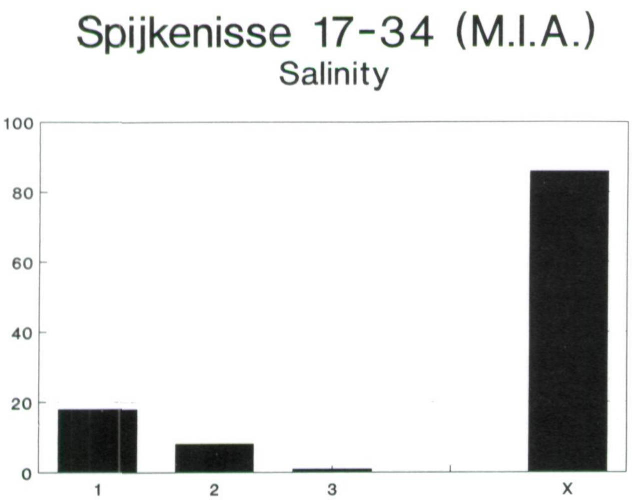
The salinity diagrams referring to the sites on Putten differ considerably from their counterparts on Voorne; Nieuwenhoorn is more or less intermediate (see *fig. 59*). This also applies to the halophyte/glycophyte ratios. The results produced by these different approaches are quite comparable. The fact that of all eco-factors, salinity shows the greatest inter-site differences, indicates that this is the parameter with the greatest influence on the differentiation of the plant cover on Voorne-Putten. Therefore, salinity is also the

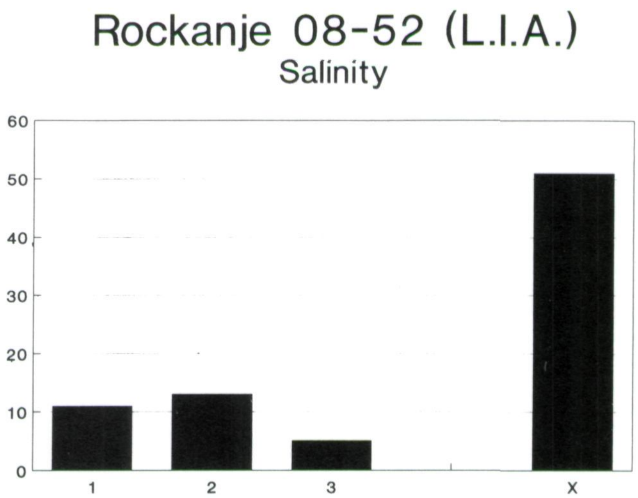

Spijkenisse 17-30 (E.I.A.)
Salinity
35
30
25
20
15
10
5
0
1
2
3
X


Geervliet 17-55 (M.I.A.)
Salinity
60
50
40
30
20
10
0
1
2
3
X


Spijkenisse 17-35 (E.\M.I.A.)
Salinity
100
80
60
40
20
0
1
2
3
X


Late Iron Age
Salinity
70
60
50
40
30
20
10
0
1
2
3
X


Spijkenisse 17-34 (M.I.A.)
Salinity
100
80
60
40
20
0
1
2
3
X


Rockanje 08-52 (L.I.A.)
Salinity
60
50
40
30
20
10
0
1
2
3
X

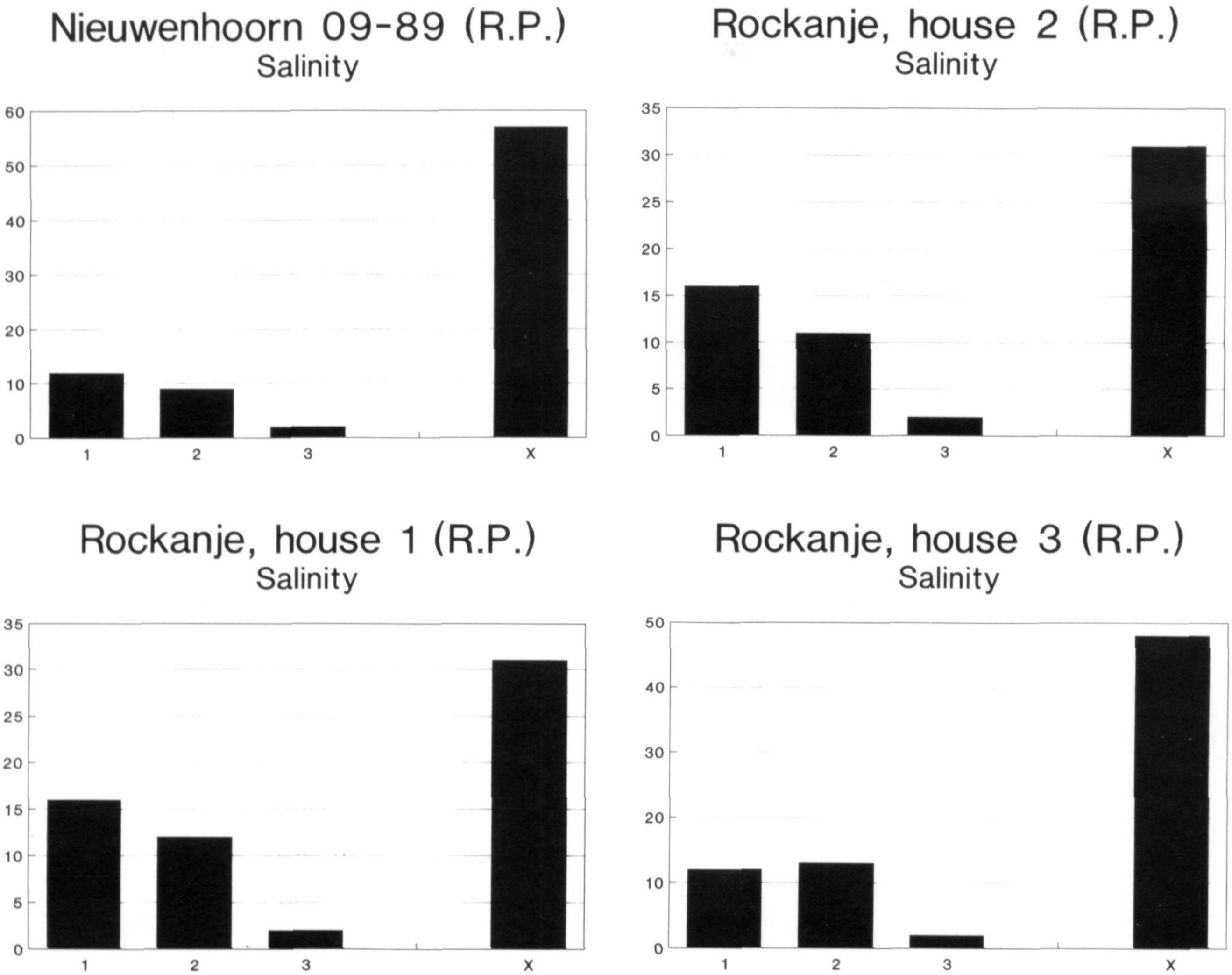


Fig. 59 Eco-diagrams for salinity. Late Iron Age = excluding Rockanje 08-52.

dominant factor producing the separation of the sites in the cluster analyses discussed in paragraph 4.7.

4.10 Summary

The study of botanical macroremains comprised 105 samples from twelve different sites. The samples were preserved under waterlogged conditions so that the major part of the material is uncarbonized. The samples are all judgement samples; a random sampling strategy was not applied.

The analyses demonstrated four-row hulled barley to be the most common cereal in all sites with the exception of the Early Iron Age site of Spijkenisse 17-30. On that site emmer wheat and broomcorn millet were found. The latter species only occurs on this site. Emmer wheat is regularly found in all Iron Age sites while it is remarkably less common in the Roman Period.

Linseed and gold of pleasure are the two most important crops cultivated for oil-rich seeds during the Iron Age. Again, Spijkenisse 17-30 forms an exception in that it lacks both species, and rapeseed was found in this site instead. Whether this was a cultivated crop or whether the seeds were gathered cannot be assessed. Crops with oil-rich seeds are much less represented in the native Roman settlements. The remaining crop plant found, Celtic bean, only occurs in the Roman site of Nieuwenhoorn.

Manna grass was gathered for consumption in the Middle Iron Age site of Spijkenisse 17-34. It will have been used as a source of carbohydrates during a shortage of cereals. Other deliberately gathered species occur only very rarely.

The crop weeds found in all sites belong exclusively to weeds of summercrops (Chenopodietea). Remarkable is the absence of the elsewhere often commonly occurring species *Chenopodium album*.

By means of cluster analyses on the basis of waterlogged remains it became clear that in general the sites were separated. Each cluster mainly comprised of samples from one single site. The inter-site variability is considerably larger than the intra-site variation. The judgement samples appeared useful in a comparison between the sites. Sub-clusters sometimes revealed a grouping according to contexts within sites. Therefore, as many different context types as possible should be studied in order to be able to assess the variation within a site.

The analyses of macroremains confirm several conclusions which were drawn on the basis of pollen analysis. The Early and Middle Iron Age settlements around the Bernisse were founded in a fen peat environment dominated by reed. Trees were absent in the surroundings of the sites. The Late Iron Age settlement near Rockanje and the Roman one near Nieuwenhoorn were built on a raised bog. The common occurrence of bog myrtle demonstrates that these bogs were subjected to oxidation and mineralisation, most probably due to natural drainage of the peat.

A cluster analysis exclusively on the basis of the waterlogged and carbonized crop plant remains, still revealed some groups of samples from one site, but the separation was less clear than in all waterlogged remains together. Cluster analyses based on the crop weeds and on the carbonized plant remains failed to discriminate between the sites. Apparently the natural vegetation around the sites produced the greatest inter-site variation in the botanical macroremains.

The groups formed on basis of cluster analyses of taxa could not be interpreted in view of plant communities. Apparently the samples contain plants from very different origins and became mixed on the site.

Through the ecology of the individual species (autecological approach), it could be demonstrated that salinity is the ecological key-factor determining the occurrence of plants around the settlements.

The share of crop weeds is much lower in the Early Iron Age settlements than in the later sites. Plants of meadows and pastures, in contrast, are more important in the Early Iron Age sites. The native Roman settlement near Nieuwenhoorn had a high share of meadow and pasture plants as well.