Sowing the seed ? : human impact and plant subsistence in Dutch wetlands during the Late Mesolithic and Early and Middle Neolithic (5500-3400 cal BC)

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Appendix III. Archaeobotany of the Hazendonk, the Netherlands

III.1 Introduction

This appendix presents new archaeobotanical data of the Hazendonk (Alblasserwaard, The Netherlands, coordinates 116.780/430.460, see fig. III.1). The National Museum of Antiquities excavated the site during 1974-1976 under direction of L.P. Louwe Kooijmans. The excavation focussed on Holocene deposits containing discarded prehistoric remains (colluvia, clay deposits and refuse layers: fossil anthropogenic horizons) dating to the Early and Middle Neolithic. A series of preliminary publications discuss various aspects of the site (*e.g.* Van den Broeke 1983; Louwe Kooijmans 1974, 1987; Raemaekers 1999; Zeiler 1987, 1997). The excavation also included archaeobotanical research that has only partly been published (presented below).

The site is located on a late Pleistocene inland dune in the central part of the Rhine-Meuse river delta. The top of the dune is at *c.* 0.10 m +NAP. The Holocene geological history of the region reflects the indirect influence of the sea and lagoonal-deltaic sedimentation. A gradual rise of the ground water level resulted in the continuous accumulation of fluvial sediment and freshwater peat. As a result, the dune slopes became gradually covered by Holocene deposits. The outcropping surface decreased from 1.2 ha during phase Haz 1 (*c.* 4000 BC) towards 0.4 ha during phase Vlaardingen 2b (*c.* 2500 BC). An anastomosing network of river channels was active in the area during occupation, resulting in steady sedimentation conditions. A crevasse channel of this network was situated within a few hundred metres of the dune during *c.* 2900-2100 BC (*i.e.* also during phase Vlaardingen 2b). Other potentially inhabitable terrain in the exploitation area existed of other dunes, levees, channel belts and crevasse splays (see chapter 2).

The excavation strategy was based on test pits located at some fifteen metres apart all around the dune, halfway along the slope (see fig. III.2). The test pits with good research prospects were extended with additional squares. This resulted in five major units: A, B, C, D and E. The surface of the excavated area is approximately 900 m^2. The excavation revealed features and refuse layers on the slopes of the dune and in the surrounding Holocene deposits (clay and peat), corresponding with several Neolithic occupation phases. The features comprised postholes, pits, hearths, a path of branches stretching into the marsh and dated to phase VL 1a, and a palisade dating to phase VL 1b that probably enclosed *c.* 1000 m^2 (see Out 2008c, figure 14.2). Huts or house structures were not attested but this can be related to erosion of the top of the dune and to modern soil disturbance. The refuse layers revealed flint, stone, pottery, beads, bones of wild and domestic animals, human skeletal remains and botanical remains.

Material on the top and slope of the dune could not be assigned to a single phase, but refuse from the successive occupation phases was separated in distinct layers in the Holocene stratigraphy as a result of the gradual rise of the ground water level. The age of the dated layers is shown in table III.1 (see also figure 2.5). Hazendonk phases will here be abbreviated as Haz and Vlaardingen phases will be abbreviated as VL. The dating of the occupation phases is based on conventional ^{14}C dating and by reconstruction of the ground water level rise (see Verbruggen 1992), representing mean values. Single occupation phases may represent continuous occupation or intermittent use. This last option is especially relevant for phase VL 1a that includes all remains found between the Haz 3 and VL 1b layers and probably reflects multiple visits to the site.

Van Dijk *et al.* (1976) investigated the extension and thickness of the refuse layers by coring. The same principle is still used to investigate the presence and extent of sites in the Dutch regions with a comparable Holocene subsurface. The resulting estimates of the extent of the refuse layers are given in table III.1 and figure III.3. Distinct refuse layers are those of phase Haz 1, Haz 3 and VL 1b. The occurrence of phase Haz 2 was underestimated during excavation. All layers had a restricted spatial extent.

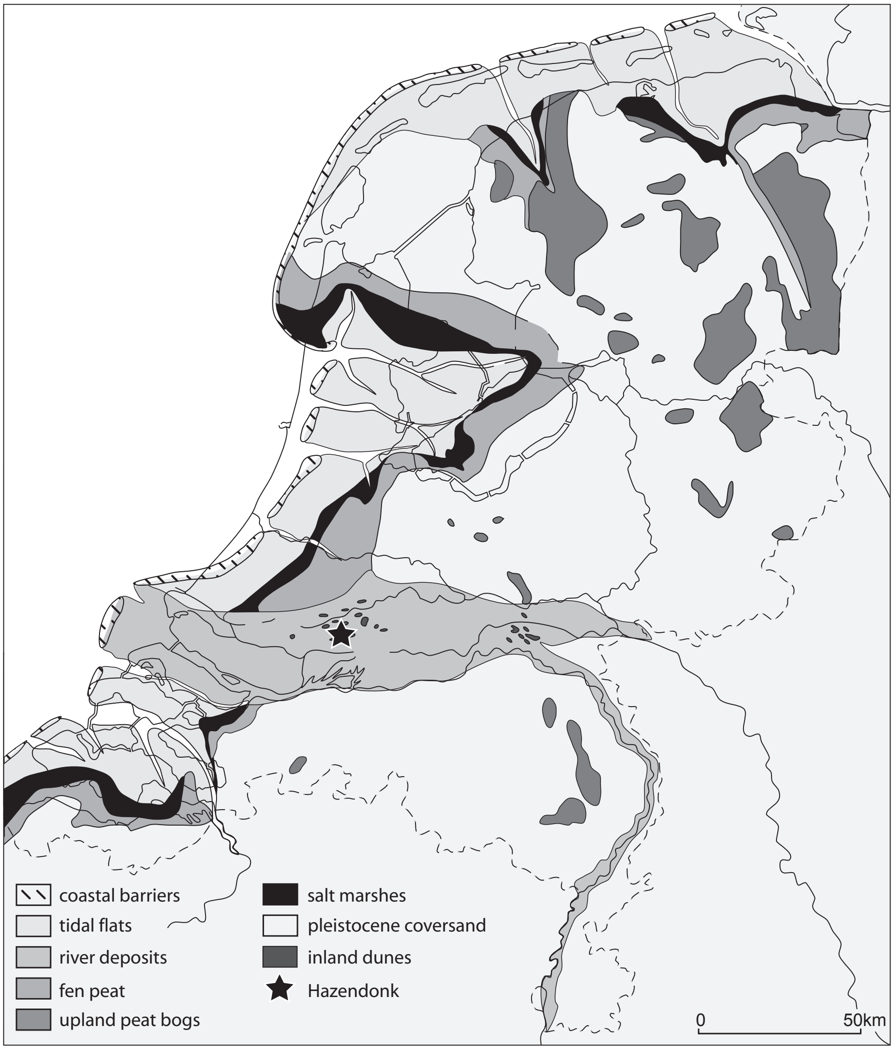


Figure III.I The Hazendonk, the Netherlands, location plotted on a palaeogeographical map (*c.* 4200 BC, NITG).

phase	age (yrs cal BC, 2σ)	surface (m^2)	attachment point (m -NAP)
Bell Beaker	1800		
Vlaardingen 2b	2570-2470		2.10
Vlaardingen 1b	3260-2960	760	2.55
Vlaardingen 1a	3500-3300		
Hazendonk 3	3670-3610	730	3.50
Hazendonk 2	3910-3790	300	3.80
Hazendonk 1	4020-3960	800	4.30

Table III.1 The Hazendonk, age, extent and the attachment point of the refuse layers in unit C (Raemaekers 1999 based on Verbruggen in prep.). The dates are reconstructed by conventional ^{14}C dating and by interpolation of ground water levels of other sites in the region (see Verbruggen 1992). The attachment point is the height where the peat is attached to the sand of the dune, influenced by the ground water table.

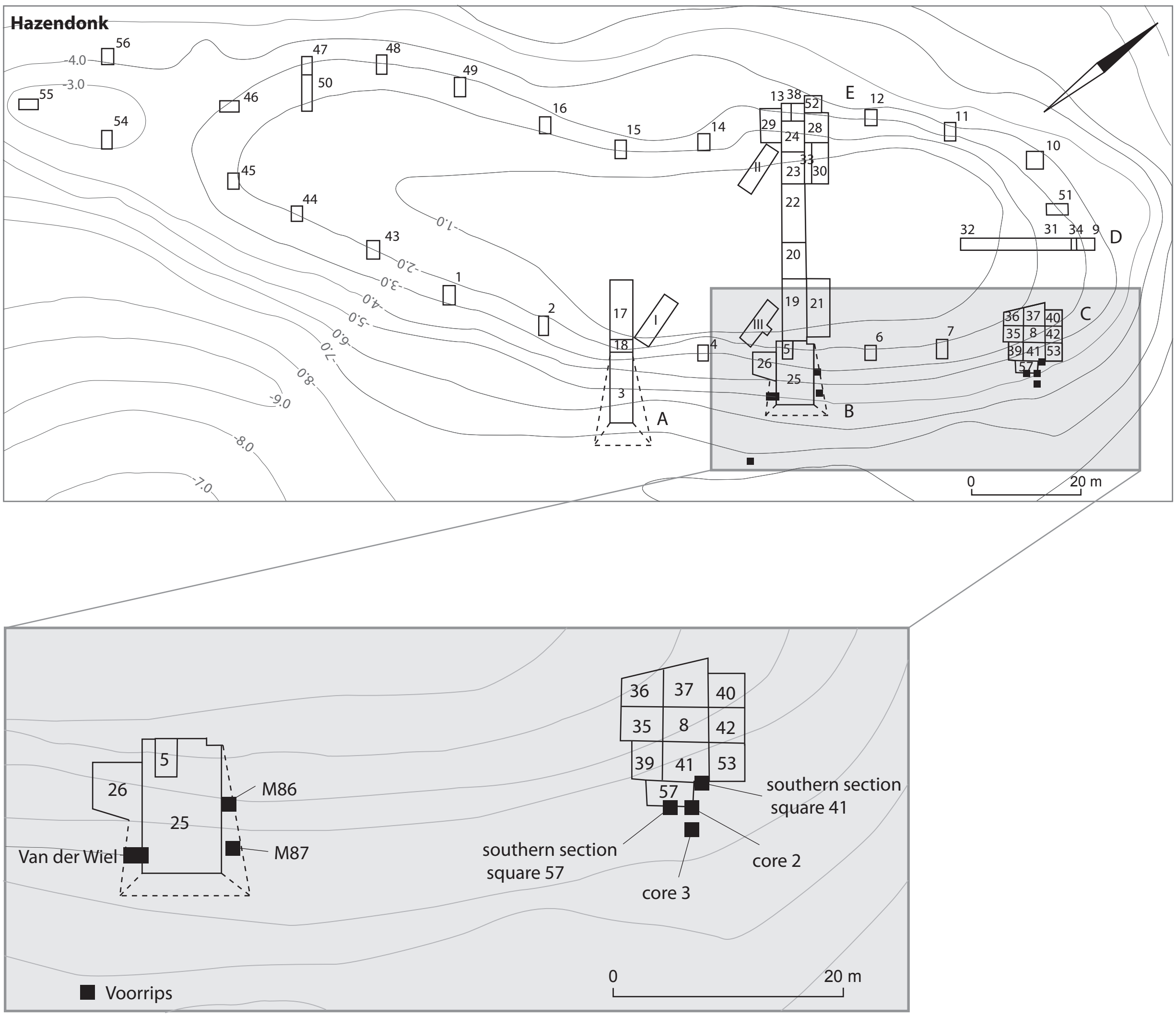
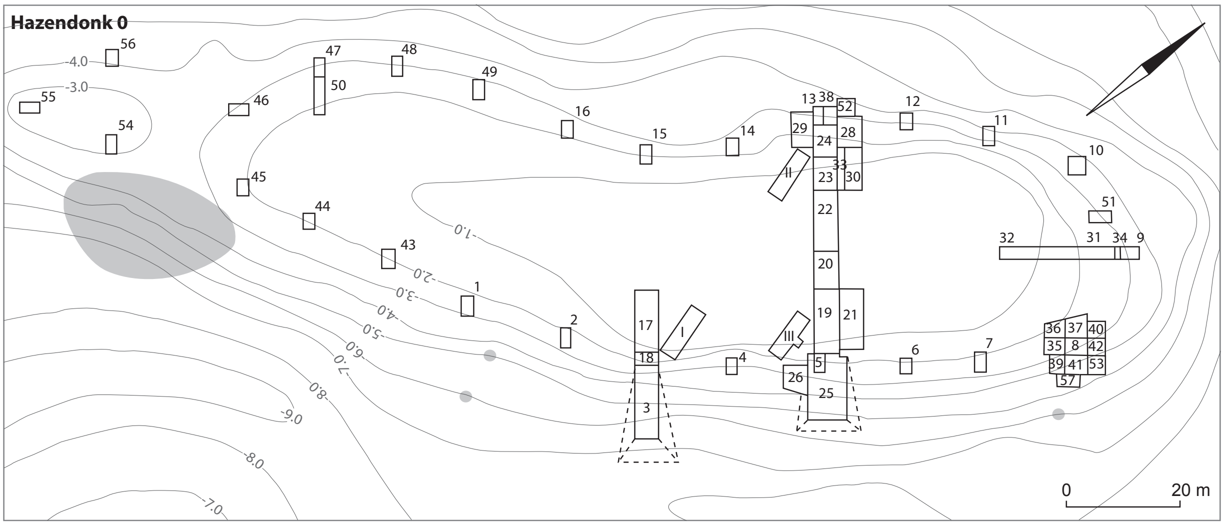


Figure III.2 The Hazendonk, the Pleistocene subsurface (m –NAP) and the plan of the excavation showing the location of the units (A-E), squares, cores and sample boxes (archives National Museum of Antiquities).



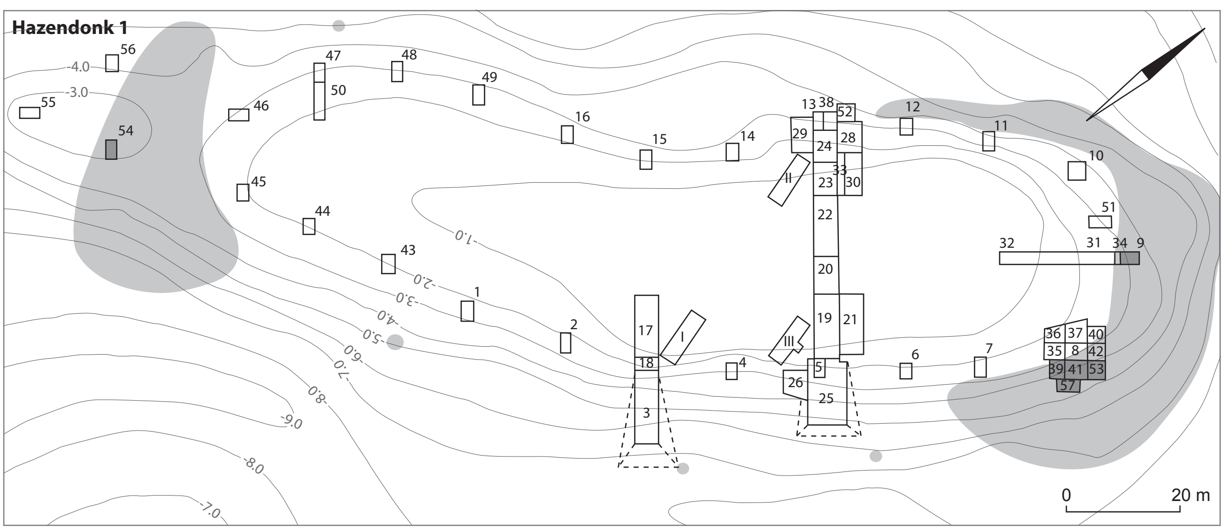


Figure III.3a The Hazendonk, the Pleistocene subsurface (m –NAP) and the interpretation of the distribution of refuse for the various occupation phases, based on finds of archaeological indicators obtained by coring and on the presence of datable pottery in the squares (after Van Dijk *et al*. 1976 and archives National Museum of Antiquities). The refuse layers are indicated in grey, while high densities of finds are indicated in dark grey.
Phases Haz 0 and 1.

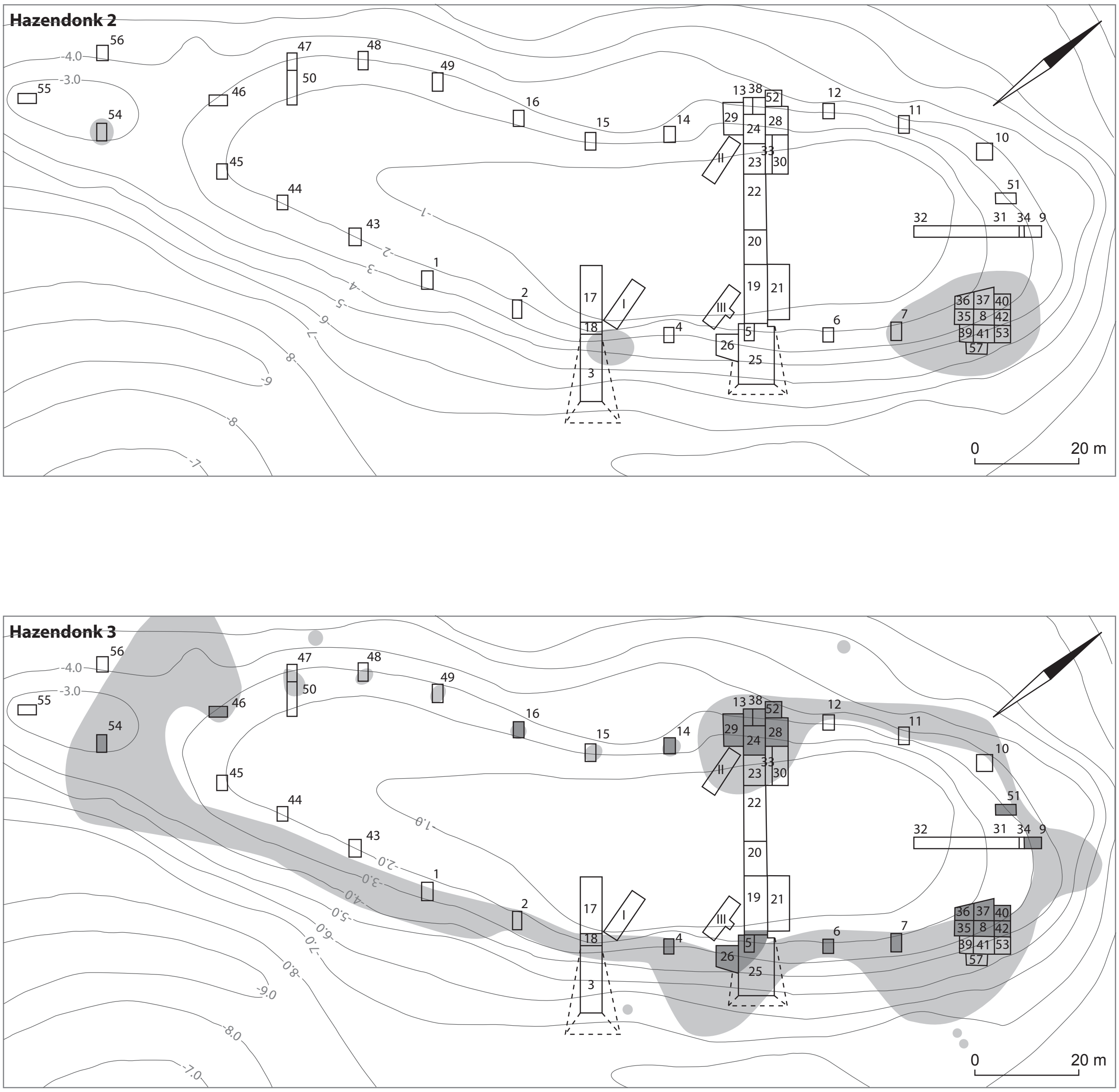
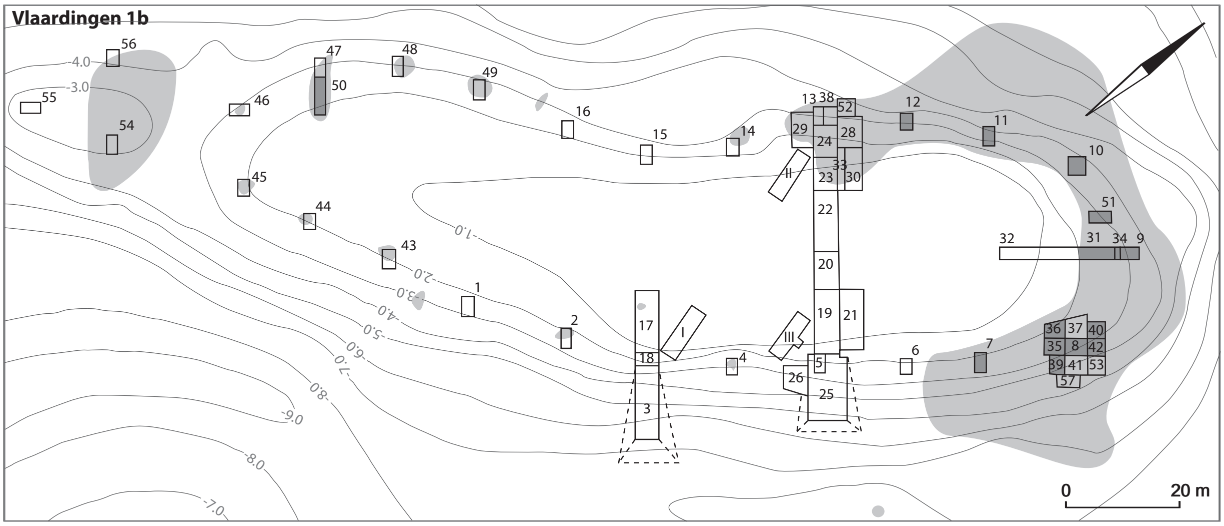


Figure III.3b The Hazendonk, the Pleistocene subsurface (m –NAP) and the interpretation of the distribution of refuse for the various occupation phases, based on finds of archaeological indicators obtained by coring and on the presence of datable pottery in the squares (after Van Dijk *et al*. 1976 and archives National Museum of Antiquities). The refuse layers are indicated in grey, while high densities of finds are indicated in dark grey.
Phases Haz 2 and 3.



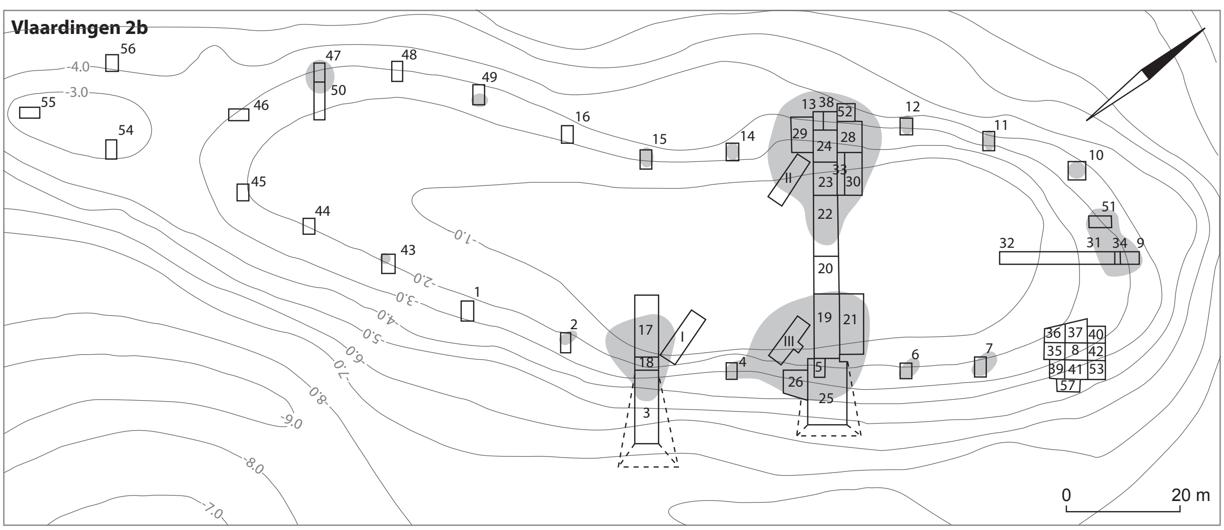


Figure III.3c The Hazendonk, the Pleistocene subsurface (m –NAP) and the interpretation of the distribution of refuse for the various occupation phases, based on finds of archaeological indicators obtained by coring and on the presence of datable pottery in the squares (after Van Dijk *et al*. 1976 and archives National Museum of Antiquities). The refuse layers are indicated in grey, while high densities of finds are indicated in dark grey.
Phases VL 1b and VL 2b.

Phase VL 1b is characterised by a trampling horizon stretching into the marsh over a distance of *c.* 20 metres. Unit C is the only unit where all occupation phases except for phase VL 2b were attested. In addition to the established phases, the prospection by coring suggested the presence of a phase Haz 0, which was earlier recognised in the pollen diagram of Voorrips (Louwe Kooijmans 1974). The estimated age of this phase is 4550-4495 BC (5700 BP; Van Dijk 1979, 40). Even earlier occupation dating to 6000-5650 BC may have occurred as well (6900 ± 100 BP, charcoal, Van der Woude 1983, 47). Archaeological remains of these early phases are not known since the water table did not allow excavation at the relevant depths.

The cultural interpretation of occupation at the Hazendonk has developed through time in correlation with the general understanding of the neolithisation process in the Dutch wetlands. The pottery found in layers 1 and 2 is nowadays considered as representing the southern group of the middle phase of the Swifterbant culture, the pottery found in layer Haz 3 as characteristic of the Hazendonk group, and the pottery found in the upper layers as characteristic of the successive phases of the Vlaardingen group and Bell Beaker culture. Some pottery of the phases Haz 2, Haz 3 and VL 1a shows influences of the Michelsberg culture (Louwe Kooijmans 2005, 258). During all phases, subsistence at the Hazendonk was based on a combination of hunting, fishing and some animal husbandry. Domestic animals present are dog, cattle, pig, and sheep/goat. Predominantly beaver and otter were hunted during all phases, and wild boar, red deer and roe deer additionally. Wild animals became more important during each following phase except for phase VL 2b (Zeiler 1997).

Detailed seasonality data are available from the zoological research (Zeiler 1997). These data give indications of occupation during all seasons for almost all phases. The site may represent a supportive special activity site that was occasionally occupied more permanently. Occupation on a year-round basis and the use of the site as a seasonal or permanent base camp may have been possible, but this cannot be demonstrated (Louwe Kooijmans 2007; Raemaekers 1999, 117).

Several archaeobotanical studies on the Hazendonk have already been published. Published pollen diagrams of the Hazendonk are diagrams of Voorrips (Louwe Kooijmans 1974), Van der Wiel (1982) and Van der Woude (1983). These diagrams are based on cores that are located on a distance of some metres up to km away from the dune. Furthermore, a selection of pollen curves was published (Louwe Kooijmans 1987), as well as a macroremains diagram from phase VL 1b (Bakels 1981, Out 2008c). A considerable quantity of data analysed in the years after excavation remained, however, to be published. All available results were reinterpreted in 2003-2007 (see also appendix IV).

The aim of this appendix is to reconstruct the natural vegetation and human impact on the dune and its surrounding slopes, and to reconstruct the plant subsistence. This will be investigated through the analysis of pollen, non-pollen palynomorphs and macroremains from on-site sampled cores and sections, and macroremains, wood, moss and molluscs from the excavation. All presented material is sampled at a short distance from the spot(s) where human activity took place, in contrast to most data published earlier. Research questions discussed are:

- What was the composition of the natural vegetation on the top and slopes of the dune?
- How did human occupation influence the natural vegetation?
- How do occupation intensity and distance influence the signal of human impact in the pollen diagrams?
- Which plants functioned as use plants, as food plants and as arable weeds?
- Did crop cultivation take place at the dune?
- Do the botanical remains give information on seasonality or site function?

III.2 Materials and methods

In the first place, A. Louwe Kooijmans-Bouhuijs collected samples from refuse layers with sample boxes and cores. This material was subjected to the analysis of pollen, non-pollen palynomorphs and macroremains in 1974-1981 in order to reconstruct the development of the vegetation and human impact before, during and after separate occupation phases. The analysed material comprises sample boxes from square 57, core 3, core 2, and sample boxes M86 and M87. The locations of the cores and sample boxes are shown in figures III.2, III.4 and III.5. It was not possible to sample a single continuous core that contained all refuse layers because not all occupation layers were present everywhere and because of natural irregularities in the sediment such as tree falls and large quantities of wood remains.

The southern section of square 57, unit C, was investigated to provide a detailed sequence of the phases Haz 1 up to and including Haz 3. It was sampled with two sample boxes (100 x 10 x 10 cm and 50 x 10 x 10 cm). The sample interval of this column was mainly 4 cm, while a part of the material was sampled every 2 cm. Core 3 (length *c.* 1 metre) was analysed to cover the phases Haz 0 and 1 in detail. It was sampled with a corer on a distance of 3.5 metres from unit C and was analysed every 4 cm. Core 2 (length 1 metre) was analysed to provide the sequence of the phases VL 1a and VL 1b. It was sampled with a corer just outside square 57, next to and above the location of the sample boxes of square 57, and was analysed every 4 cm. The top of the sample boxes of square 57 and the bottom of core 2 are stratigraphically correlated. M86 and M87, which both cover phase VL 1b, were collected from the eastern section of square 25, unit B with sample boxes (20 x 20 x 10 cm) and were analysed every 2 cm. The distance between M86 and M87 is *c.* 3 metres. Dating of the cores and sample boxes was primarily based on the age of the refuse layers, while additional ^{14}C dates were obtained from the section of square 57 and from M87.

The pollen samples, prepared according to the standard methods, had a size of 1 cm^3. A. Louwe Kooijmans-Bouhuijs identified the pollen using a magnification of 400 and 1000 times.[25] The pollen sum consists of 300 to 400 upland pollen grains, including dryland trees, shrubs, herbs, spore plants and crop plants. Data were analysed and converted into percentage diagrams with the software programs Tilia (2.0.b.4) and TGView (2.02) (Grimm1991-1993, 2004). The diagrams are divided into biostratigraphical zones, indicated with straight lines, which are based on changes in the diagrams and on comparison with the pollen diagram of Van der Wiel (1982). The zones are also applied in the diagrams of non-pollen palynomorphs and macroremains from the same sections and cores. Occupation phases, indicated with grey zones in the diagrams, were recognised by observations of the sediment during excavation, the presence of charcoal, sand and bone remains in the sediment of the sample box and changes in the curves of the analysed diagrams.

A. Louwe Kooijmans-Bouhuijs also analysed non-pollen palynomorphs (NPP's) of square 57, core 3 and core 2.[26] Data were analysed and converted into percentage diagrams, based on the pollen sum of the pollen diagrams. The NPP diagrams only include identified types. Each diagram nevertheless contains a curve of the total of NPP's that shows the total percentage of both identified and unidentified NPP's.

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25 Identification was based on literature (Beug 1963; Erdtman *et al.* 1961; Fægri and Iversen 1964; Grohne 1957; Nilsson and Praglowski 1963; Punt *et al.* 1976) and the reference collection of the Institute of Prehistory Leiden (now the Faculty of Archaeology, Leiden University). Revision resulted in removal of Araceae and *Cornus suecica*, lumping of *Populus cf. nigra* and *Populus cf. tremula*, lumping of *Sparganium emersum* and *Typha angustifolia* in *Sparganium emersum*-type, lumping of *Lotus corniculatus* and *L. uliginosus* in *Lotus*-type and changing Cerealia into Cerealia-type. The remaining old nomenclature is mainly left unchanged for optimal correspondence with the identification literature, although family names are given according to the modern standards (*e.g.* Brassicaceae instead of Cruciferae). Cerealia-type pollen grains were identified with a phase-contrast microscope, and their identification was based on the diameter and shape of the pollen grain, the characteristics of the pore and annulus, the thickness of the wall and the shape of the pollen grains. Large pollen grains of grasses (> 37 or 40 μm) that were identified as wild grasses are included in the curve of Poaceae.

26 Identification of NPP's was based on Van Geel (1978), Van Geel and Aptroot (2006), Van Geel *et al.* (1981), Van Geel *et al.* (2003), Pals *et al.* (1980), Prager *et al.* (2006) and Van der Wiel (1982). The identifications of *Spirogyra* sp., *Mougeotia* sp., *Zygnema*-type and *Pediastrum* sp. include various subgroups (including single species). These subgroups are not included separately in the diagrams since the restricted ecological information on modern species does not allow relating the identifications of subfossil subgroups to specific ecological conditions.

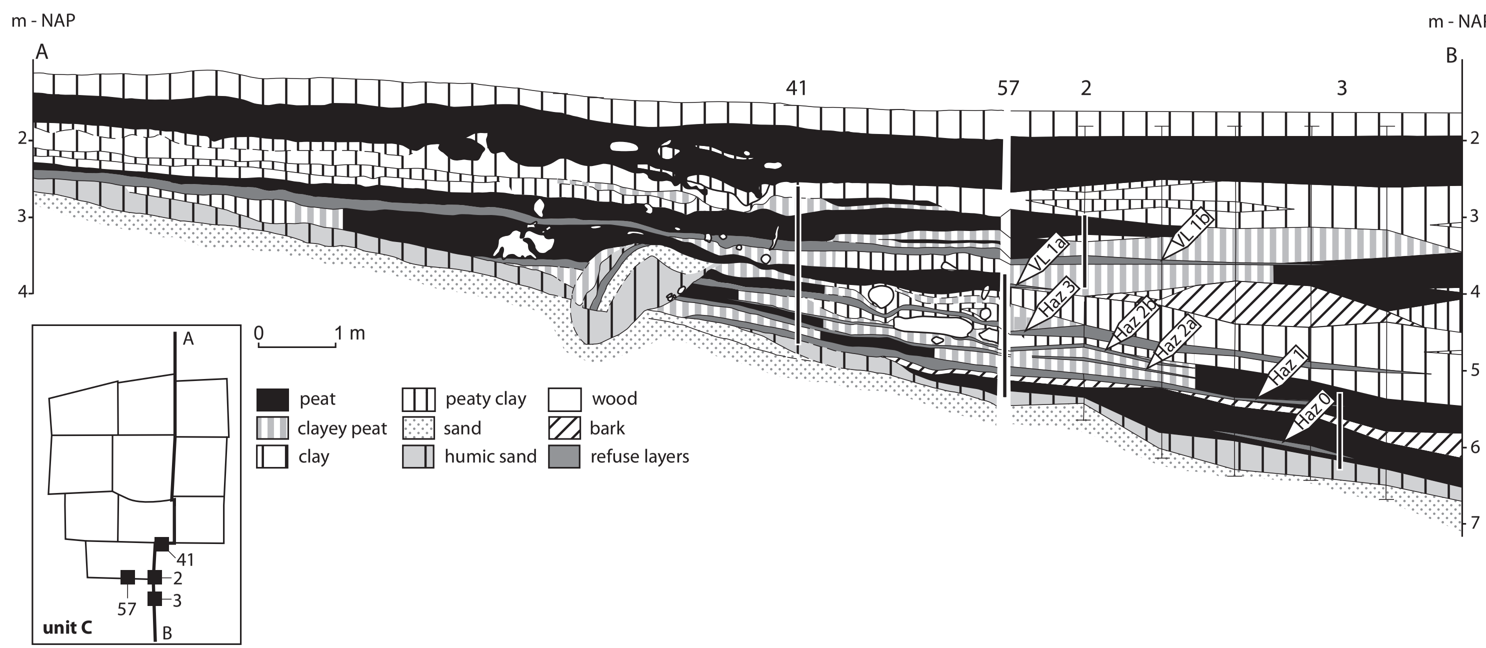


Figure III.4 The Hazendonk, north-south section across unit C and cored extension, showing the location of the sample boxes from the southern section of squares 41 and 57, and the location of cores 2 and 3 (archives National Museum of Antiquities).

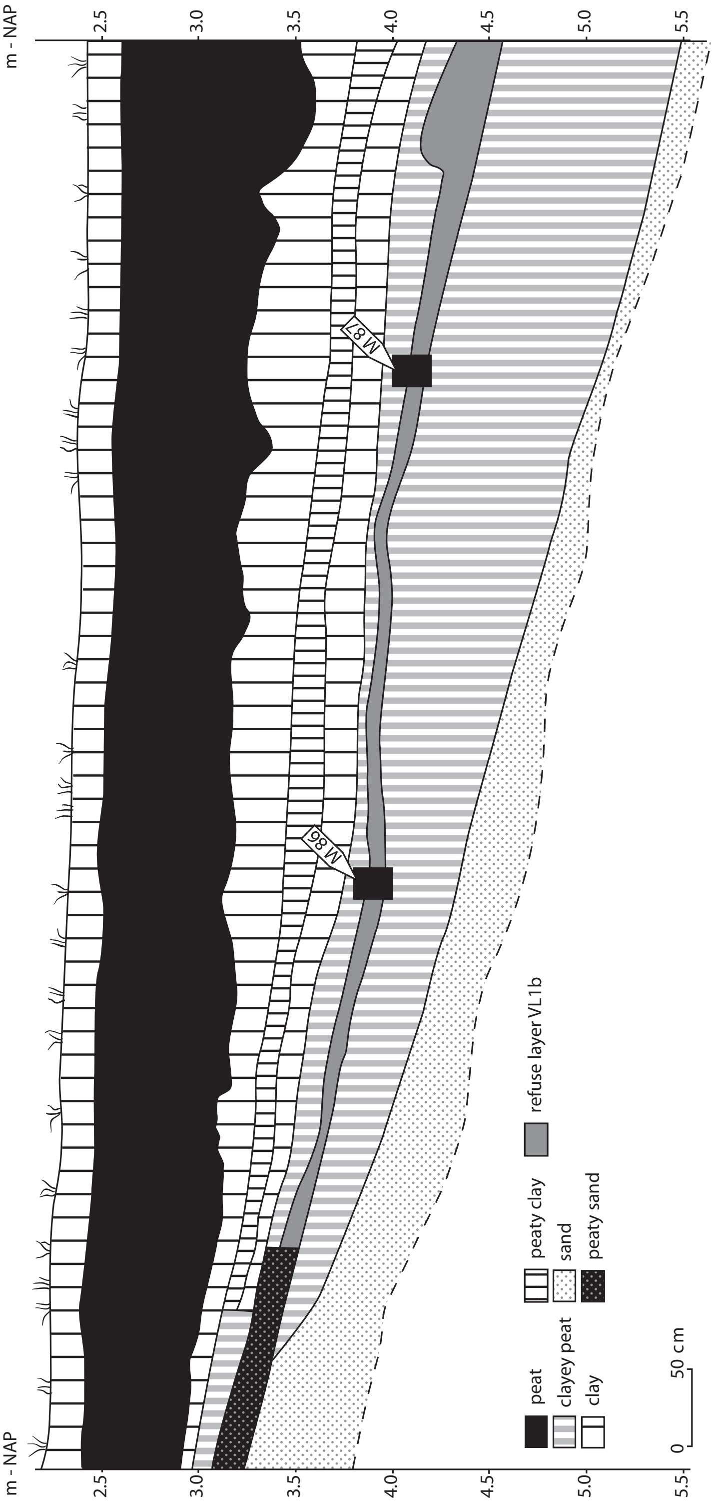


Figure III.5 The Hazendonk, unit B, eastern section of square 25, showing the location of the sample boxes M86 and M87 (archives National Museum of Antiquities).

W.J. Kuijper analysed the macroremains of the section samples and cores. The sample size of the samples of square 57 was 1 cm^3. The thickness of the samples of core 3 varied between 3-6 cm, and the thickness of the samples of core 2 was 5 cm, while the diameter of both cores was 4 cm. The results of the cores 2 and 3 were calculated for a standard volume of 12.5 cm^3. The volume of samples of M86 and M87 was 50 cm^3.

In addition to the macroremains of the sections and cores analysed for pollen and non-pollen palynomorphs, macroremains were also analysed from the southern section of square 41 in unit C, located 2 metres north of the southern section of square 57, *c.* 1 metre higher on the slope (see fig. III.2). This section yielded macroremains from the largest number of phases from a single sample location. The section was sampled with two sample boxes, each measuring 100 x 20 x 10 cm. The thickness of the samples of this section varied between 3 and 10 cm, while the volume of the samples varied between 350 and 1400 cm^3. The number of macroremains was calculated for a standard volume of 1000 cm^3. All macroremains samples from sections and cores were wet-sieved on a 0.25 mm sieve. Details on identification methods of the macroremains are discussed below. All data were turned into diagrams that show absolute values of macroremains.

In addition to macroremains from cores and sections, macroremains were collected during excavation in three ways. The first class of samples consists of visible concentrations of carbonised cereals of phase Haz 1, some of which were wet-sieved in the lab on a 0.25 mm sieve. The second class consists of a part of the residue that was collected in search of archaeological finds by sieving with mesh widths of 10, 5 and 1.5 mm. The botanical samples were primarily collected from the 1.5 mm sieve while a selection of finds of the other mesh widths was sometimes added. Some of these samples were only scanned on the presence of cereal grains resulting in the identification of relatively large macroremains only. Furthermore, the relation of these samples to the excavated volume is not documented and the density of macroremains could thus not be calculated. The third class consists of handpicked finds and finds collected from the coarser meshes (10 and 5 mm) of the field sieving procedure. The number of samples from phases Haz 2 and VL 2b is small and there are no samples of the Bell Beaker period because of limited occurrence of these horizons. Some samples could not be dated precisely by stratigraphy. The samples of phase VL 2b were divided in two activity periods, which is based on stratigraphy but which is not supported by ^{14}C dates that provide similar results for both periods.

W. J. Kuijper identified all macroremains between 1974 and 1981.[27] C.C. Bakels and R.T.J. Cappers revaluated all cereal remains in 2004. Seeds of *Elatine* sp. were identified up to species level in 2006 (see Brinkkemper *et al.* 2008). Names of plant species are according to Van der Meijden (1996). W.J. Kuijper also identified molluscs from macroremains samples. A. Touw identified moss remains that were found in the macroremains samples.

The macroremains are divided into ecological groups, based on the modern plant communities (Schaminée *et al.* 1995-1999) and on the interpretation of the vegetation. Table III.2 shows the distinguished ecological groups. This classification is only a method to analyse changes in the vegetation, since the distinction between some groups is not sharp and since some taxa are more or less characteristic of more than one plant community. The taxa of groups 4 and 5 in particular can occur in the same plant community as well as in other plant communities. Prehistoric plant communities are additionally not necessarily comparable with modern plant communities. Group 5, representing marsh taxa, also contains taxa of sedge vegetation and

27 Identification was based on literature (Aalto 1970; Bang 1973; Berggren 1969; Brouwer and Stählin 1975; Dickson 1970; Jessen 1955; Katz *et al.* 1965; Knörzer 1970, 1973; Kowal and Rudnicka-Sternowa 1969; Körber-Grohne 1964, 1967; Lange 1979; Langhe *et al.* 1978; Nilsson and Hjemquist 1967; d'Olivat and Pals 1974; Ooststroom and Reichgelt 1964; Villaret-von Rochow 1967; Van Zeist 1974) and the reference collection and literature of the Institute of Prehistory Leiden. A single find of *Alisma plantago-aquatica* was initially identified as *Damasonium alisma* (section square 41, 331-326 cm -NAP). This is presented as *A. plantago-aquatica* since the difference between the two species is not always clear and since it concerned only a single find (see also De Roller *et al.* 2002). The *Tilia* remains were identified as *Tilia platyphyllos* but presence of *T. cordata* could not be excluded. *Bromus secalinus*-type represents *B. arvensis*, *B. mollis* and *B. secalinus*. *Galeopsis bifida*-type represents *G. bifida*, *G. speciosa* and *G. tetrahit*. *Ranunculus aquatilis*-type represents *Ranunculus* section *Batrachium*. *Ranunculus repens*-type represents *R. acris/lingua/repens* but it probably concerns *R. repens* here. *Veronica beccabunga*-type represents *V. anagallis-aquatica*, *V. beccabunga* and *V. catenata*.

ecological groups
1) Taxa of woodland, woodland edges and shrubs of dry terrain.
2) Dryland ruderals and taxa that indicate recent disturbance of dry to slightly moist sediment.
3) Crop plants.
4) Wetland trees and shrubs.
5) Wetland herbs and spore plants of marsh and forb vegetation.
6) Wetland pioneers and wetland herbs that indicate disturbance.
7) Taxa indicative of open water.
8) Taxa that are not associated with specific ecologic conditions.
9) Varia, including archaeological remains, macroscopic plant remains such as bark, leaves and moss, animal remains and sand.

Table III.2 The Hazendonk, ecological groups that have been distinguished.

depth (m -NAP)	sediment
3.87-3.84	coarse peat
4.01-3.88	peaty clay with wood remains
4.02	fine-layered peat
4.30-4.03	layered peaty clay, wood remains from 4.15 m -NAP,
	darker layers at 4.17 and 4.11 m -NAP
4.38-4.31	sandy peat with charcoal, wood remains and bone remains: Hazendonk 3
4.42-4.39	peaty clay with roots
4.47-4.43	sandy peat with charcoal remains in the upper part, burned bone at 4.47 m -NAP
4.55-4.48	peaty clay, disturbed by a tree fall, some sand and charcoal in the lower part
4.62-4.56	fine peat with charcoal remains
4.67-4.63	black peat with sand and bone remains: Hazendonk 2b
4.69-4.68	clayey peat
4.72-4.70	peat with charcoal remains
4.85-4.73	clayey peat, Hazendonk 2a at 4.78 m -NAP
4.99-4.86	black peat with sand, charcoal, bone remains and a sherd: Hazendonk 1,
	bark remains at 4.97 to 4.95 m -NAP
5.03-5.00	transition
5.22-5.02	peat with wood remains
5.28-5.23	sandy peat
5.33-5.29	humic calcareous sand, Hazendonk 0 at 5.30 m -NAP

Table III.4 The Hazendonk, unit C, southern section of square 57, lithostratigraphy.

eutrophic/mesotrophic grasslands, since the number of taxa in these groups is low and since most of these taxa can also grow in the classes that are included marsh vegetation.

R.G. van den Berg identified wood remains from the excavation, and the results are based on an unpublished manuscript of his hand. Wood remains were retrieved from 14 squares that were mostly located around unit C, but also near units D and E and at the southwestern side of the dune. The data set consists of unworked wood, worked wood with an unknown function and artefacts with a known function. Most wood remains were collected individually and are described. There are furthermore three samples of an unknown volume that consists of several wood identifications on which additional information is absent. The assemblage of wood consists of trunks, branches and twigs, bark and roots. Bark and roots were not identified but are included in the group of indeterminate instead. Wood remains that were partly carbonised were not identified either, although there are a few exceptions. Further charcoal identifications are absent.

III.3 Results

III.3.1 Southern section of square 57 (Hazendonk 0, 1, 2a, 2b and 3)

Table III.3 (below) shows the radiocarbon dates from the section of square 57 (Lanting and Van der Plicht 2000). The results correspond with the dates of the refuse layers. Table III.4 (opposite page) shows the lithostratigraphy of the southern section of square 57. Figures III.6-8 show the results of pollen analysis, non-pollen palynomorphs and macroremains of the southern section of square 57. The recognised occupation phases are Hazendonk 0, 1, 2a, 2b, 3, and possibly Vlaardingen 1a.

sample	depth (m -NAP)	lab code	age (yrs BP)	age (yrs cal BC, 2σ)	dated material
Haz 29f	3.86-3.84	GrN-8243	4720 ± 70	3640 (95.4%) 3360	peat
Haz 29e	4.33-4.31	GrN-8350	4755 ± 35	3640 (81.7%) 3500	peat
				3430 (13.7%) 3380	
Haz 29d	4.45-4.43	GrN-8242	5080 ± 70	4040 (1.1%) 4020	peat
				4000 (94.3%) 3700	
Haz 29c	4.64-4.62	GrN-8349	4995 ± 35	3940 (22.7%) 3850	peat
				3820 (71.5%) 3690	
				3680 (1.2%) 3660	
Haz 29b	4.86-4.84	GrN-8241	5385 ± 45	4340 (61.8%) 4220	peat
				4210 (17.1%) 4150	
				4140 (16.5%) 4050	
Haz 29a	5.03-5.01	GrN-8240	5330 ± 35	4320 (2.0%) 4290	peat
				4260 (93.4%) 4040	

Table III.3 The Hazendonk, unit C, southern section of square 57, ^{14}C dates (Lanting and Van der Plicht 2000).

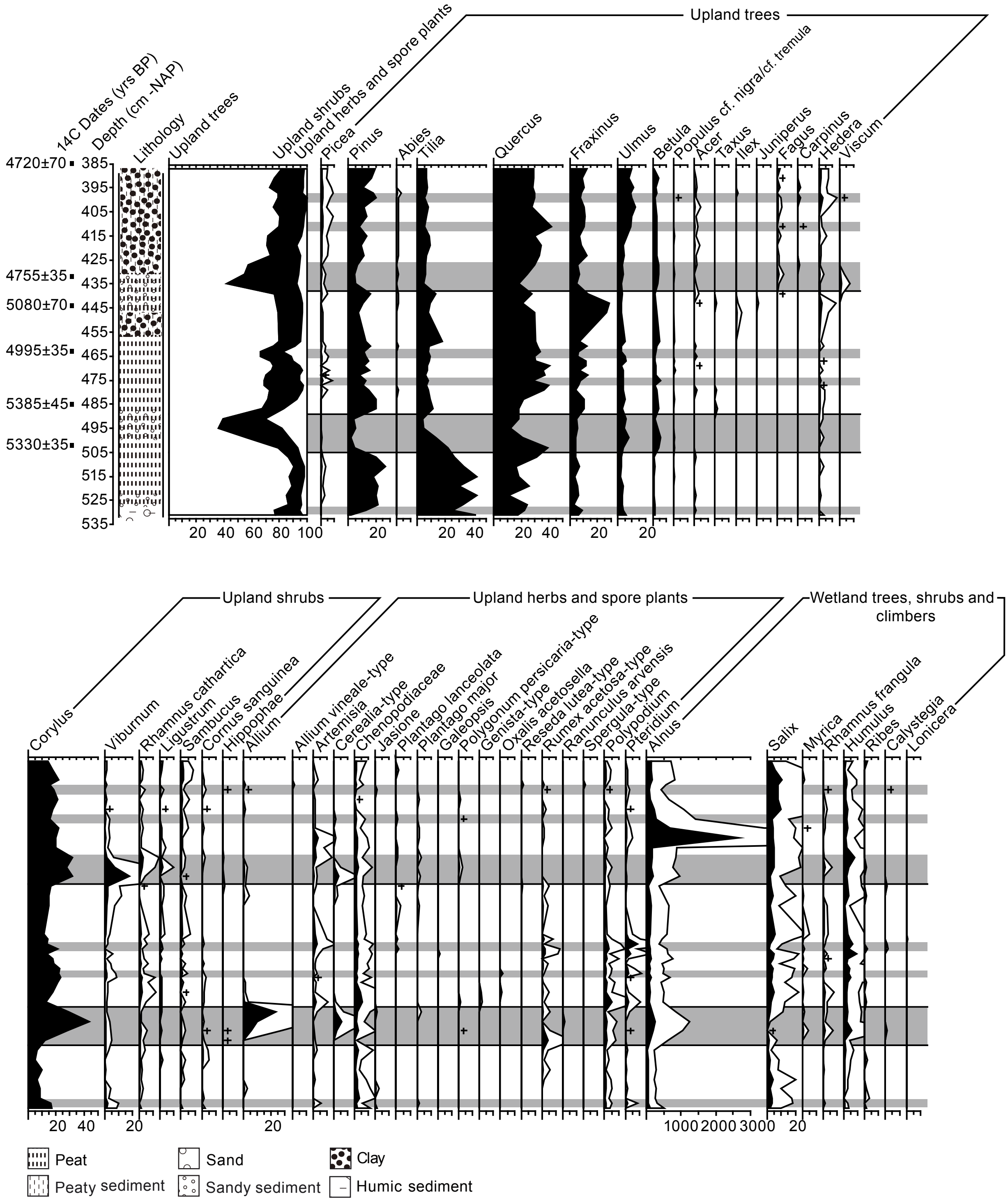


Figure III.6 part 1.

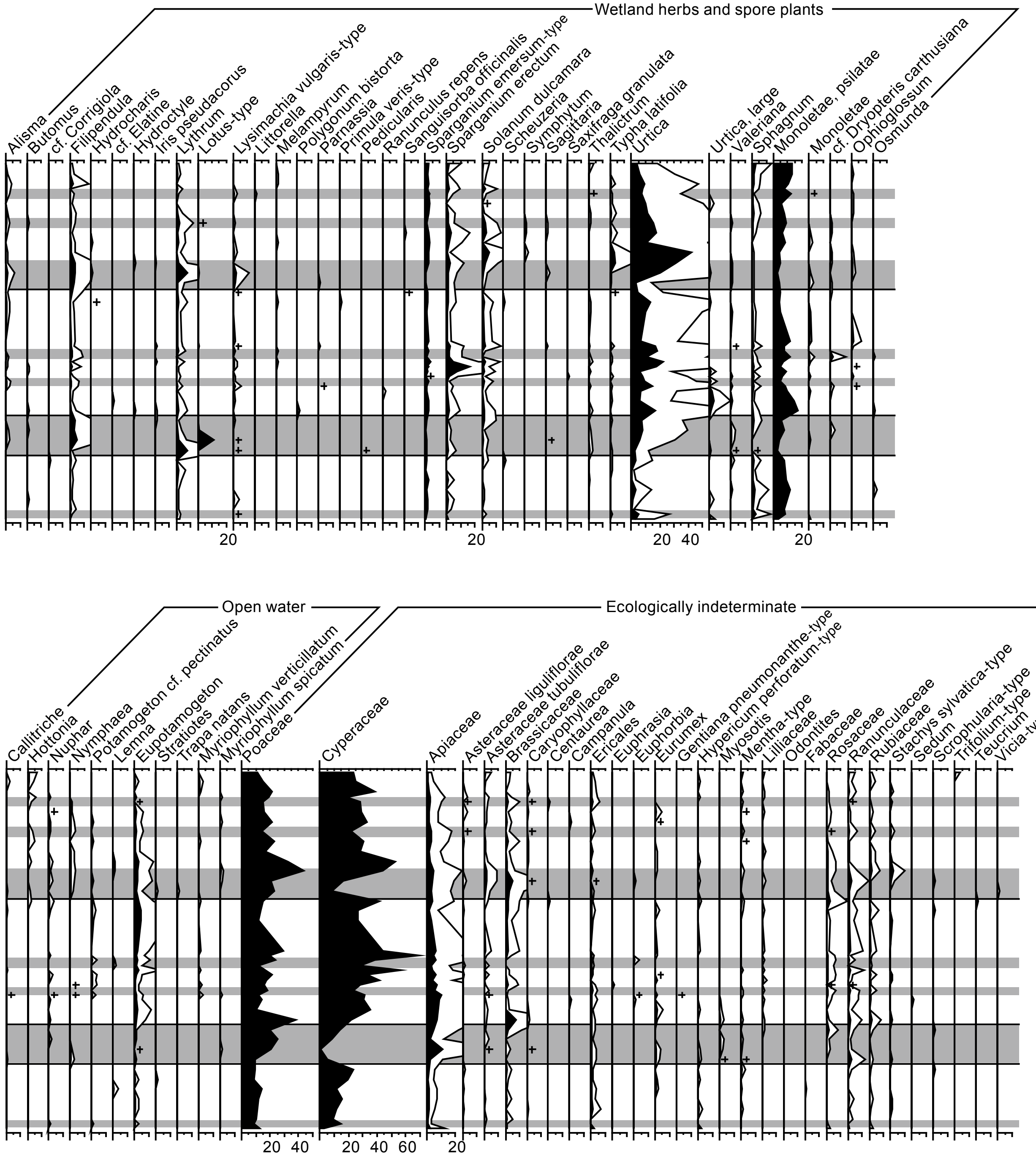


Figure III.6 part 2.

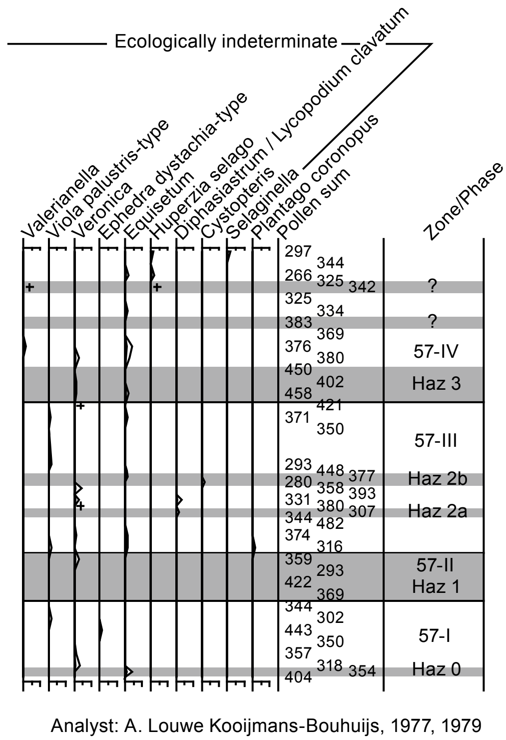


Figure III.6 part 3 The Hazendonk, unit C, southern section of square 57, pollen diagram based on an upland pollen sum, exaggeration 5 x.
Figure III.12 can be seen as a continuation.

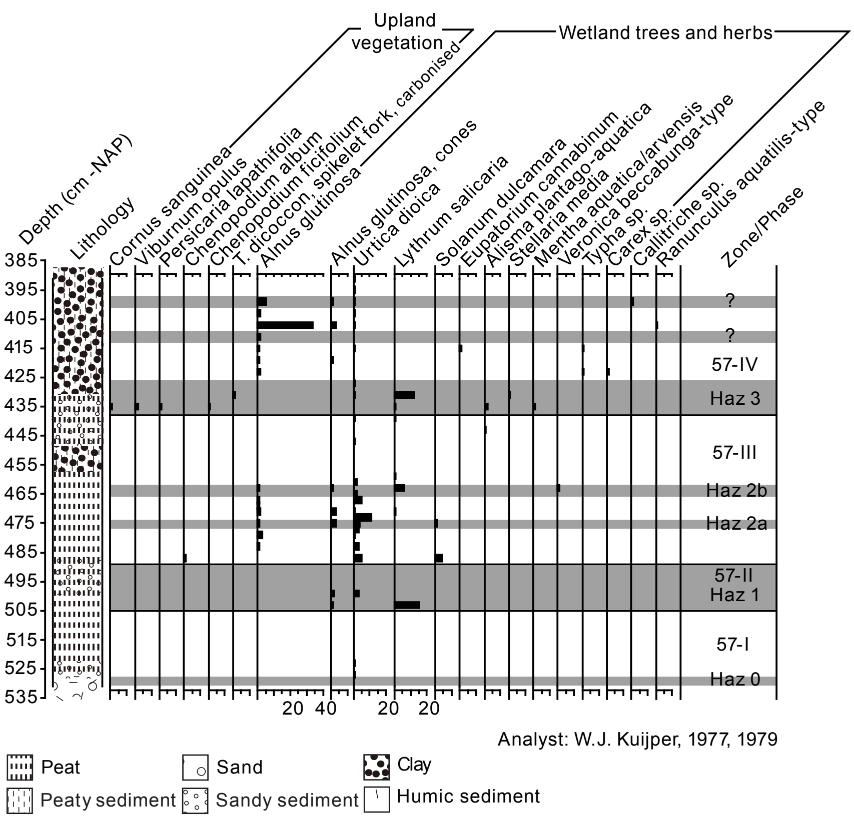
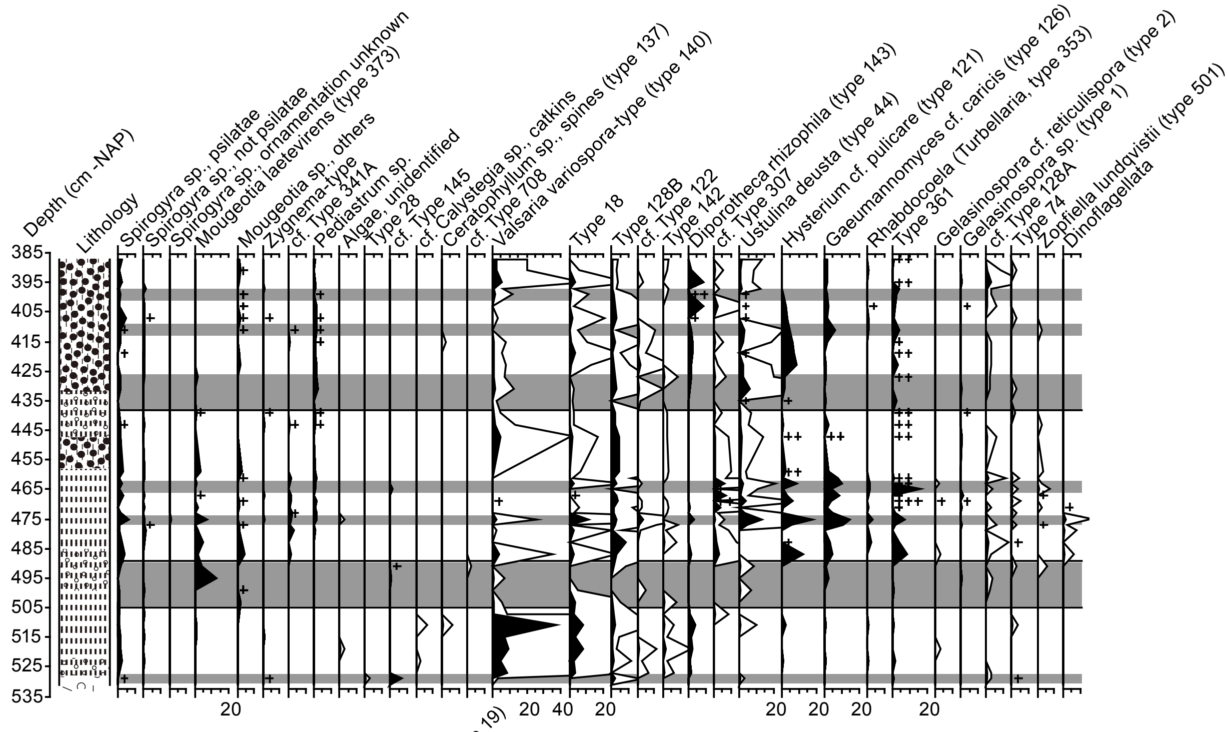


Figure III.7 The Hazendonk, unit C, southern section of square 57, macroremains diagram.
Figure III.13 can be seen as a continuation.



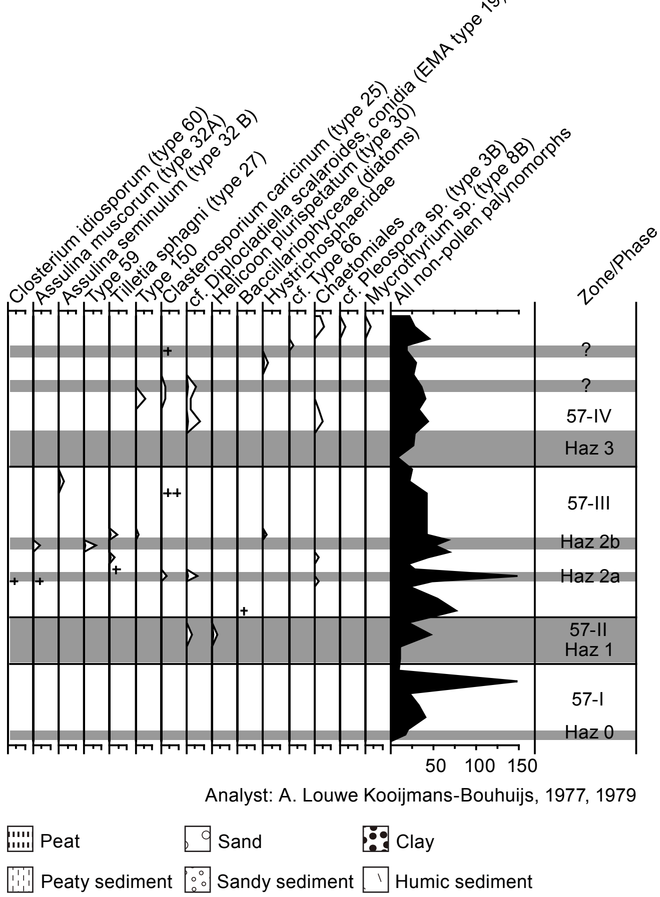


Figure III.8 The Hazendonk, unit C, southern section of square 57, non-pollen palynomorph diagram based on an upland pollen sum, exaggeration 10 x, + = few (1-10), ++ = some tens (10-49), +++ = many tens (50-99).
Figure III.14 can be seen as a continuation.

Zone 57-I (5.33 to 5.06 m -NAP) is based on high values of *Pinus* sp. and *Tilia* sp. and low values of *Corylus* sp. and *Betula* sp. Important taxa are *Tilia* sp., *Quercus* sp., *Corylus* sp., Poaceae, Cyperaceae and ferns (monoletae psilatae spores, possibly from *Thelypteris palustris*). *Tilia* sp. was certainly present in the local and extra-local vegetation, as indicated by the high percentage of pollen. *Pinus* sp. shows high values but was probably an element of the regional vegetation only, since local presence would result in much higher percentages of pine pollen and since macroremains and wood remains are not found at Hardinxveld-Giessendam Polderweg, Hardinxveld-Giessendam De Bruin and Brandwijk-Kerkhof. A variety of dryland shrubs was present in the (extra-) local vegetation, such as *Viburnum* sp., *Rhamnus cathartica*, *Sambucus* sp. and *Cornus sanguinea*. *Alnus* sp. was probably not present in the local vegetation yet, but grew nearby (see core 3). The variety of pollen of wetland herbs indicates that marsh vegetation was already present (for example *Urtica dioica*, ferns, *Sparganium emersum*-type and *Sphagnum* sp.), although the low curves indicate limited importance. Macroremains are relatively scarce in this zone. NPP's that dominate this zone are *Valsaria variospora*-type (type 140), type 18[28], type 128B and *Diporotheca rhizophila* (type 143). Type 128B, 140 and 143 indicate mesotrophic to eutrophic, moist to wet conditions (Van Geel *et al.* 2003[29]). The total number of NPP's shows a peak in the upper part of the zone. This peak corresponds with an increase in *Pinus* sp., *Fraxinus* sp. and *Betula* sp., and low values of *Quercus* sp. and *Corylus* sp., and may be related to changes in the water regime (see also core 3).

The base of zone 57-I shows a weak signal of phase Haz 0 (5.30 to 5.27 m -NAP). During this occupation phase, the pollen diagram shows a decrease in *Tilia* sp., relatively high values of *Quercus* sp., *Corylus* sp. and *Viburnum* sp. and small peaks in the curves of *Artemisia* sp., Chenopodiaceae (delayed), *Plantago major*, *Pteridium* sp., *Urtica* sp., Apiaceae and Rosaceae. The anthropogenic influence on the vegetation seems to be small. The diagram of square 57 possibly reflects only a part of phase Haz 0 since the same occupation phase is represented stronger in the pollen diagram of core 3. NPP's that show a slight increase during phase 0 are type 74, *cf.* type 145 (see also Van der Wiel 1982), *cf.* type 128A and *Ustulina deusta* (type 44, a parasite causing soft-rot of wood; Van Geel and Aptroot 2006). These types are not known as typical anthropogenic indicators.

Zone 57-II (5.05 to 4.90 m -NAP) is based on a decrease in *Pinus* sp. and *Tilia* sp. and temporarily peaks of *Quercus* sp. and *Corylus* sp. The zone reflects human impact during phase Haz 1, such as a decrease in *Tilia* sp., resulting in the increased presence, flowering and/or pollen transport of *Quercus* sp. and *Corylus* sp. These changes represent the composition of the very local vegetation since the peaks of *Quercus* sp. and *Corylus* sp. are not visible in core 3 that reflects the same period. The decrease in *Pinus* sp. is probably a statistical decrease, resulting from the increased pollen precipitation of *Quercus* sp. and *Corylus* sp. Dryland shrubs other than *Corylus* sp. do not show strong changes. The summary diagram shows a major increase in dryland herbs, corresponding with increasing values of Chenopodiaceae, *Allium* sp., *Cerealia*-type and the sporadic presence of other anthropogenic indicators. The openness of the vegetation may however be overrepresented. Firstly, the Cerealia-type pollen may represent pollen from plant waste since concentrations of cereals were present in square 57. Secondly, the peak of *Allium* sp. may represent shade-tolerant vegetation or waste of food preparation (see also chapter 9). The *Allium* pollen may represent *A. oleraceum A. schoenoprasum, Allium scorodoprasum*, *Allium ursinum* and/or *A. vineale*, some of which tolerate shaded conditions. All taxa other than *A. ursinum* are known from present-day inland dunes along rivers in the Netherlands (Eenkhoorn and Smit 1982; Weeda *et al.* 1991; Wolf *et al.* 2001). Overall, it can be concluded that the dryland vegetation became more open during phase Haz 1, but not as strong as the summary diagram suggests since the increase in dryland herbs is overrepresented. The signal of human activity in the wetland vegetation confirms that phase Haz 1 is

28 Type 18 is found on *Eriophorum vaginatum* (Van Geel 1976), a species characteristic of acid, mesotrophic soils. There are however no direct identifications of *E. vaginatum* and the species does not fit well in the vegetation at the Hazendonk, suggesting that the type may represent another type, may have other hosts or may be deposited after water transport.

29 See also Van Geel and Aptroot 2006; Van der Wiel 1982; Van der Woude 1983 for type 143.

not substantially different from later major phases. A small rise in the curve of *Alnus* sp. and *Humulus* sp. and increased values of Poaceae, *Urtica* sp., *Filipendula* sp., *Lythrum* sp., *Lotus*-type, and Apiaceae indicate the increased presence of open patches in the vegetation. The Cyperaceae clearly decrease. The macroremains diagram mainly indicates the local presence of wetland taxa including *Alnus glutinosa*, possibly representing alder carr. The NPP diagram shows that phase Haz 1 is characterised by a decrease in previously common types, a low number of identifications and an increase in certain types such as *Mougeotia laetevirens* (type 373), type 145, type 708, *Zopfiella lundqvistii* (type 501) and *cf. Diplocladiella scalaroides* (EMA type 19).[30] These types are again not known as typical anthropogenic indicators.

Zone 57-III (4.89 to 4.39 m -NAP) is based on an increase in *Pinus* sp., *Tilia* sp. and *Fraxinus* sp. and high values of *Quercus* sp. in the diagram. The first part of the zone directly after phase Haz 1 reflects the recovery of the vegetation after occupation, as shown by the curves of *Tilia* sp., *Quercus* sp., *Fraxinus* sp., *Corylus* sp. and *Alnus* sp. The increase of some of these taxa may partly be explained by the statistical effect of the decrease in *Corylus* sp. and *Allium* sp. after the end of phase Haz 1. *Tilia* sp. only partially recovers, which is related to the increasing water table and the resulting decrease in the surface of the local habitat. Chenopodiaceae, *Polypodium* sp., *Pteridium* sp., Poaceae, *Urtica* sp., monoletae psilatae fern spores and Brassicaceae show peak values at the end of occupation, suggesting that disturbed patches were overgrown with fern and forb vegetation before the final recovery of the vegetation. The macroremains diagram shows the local presence of *Alnus glutinosa* and *Urtica dioica* in the first half of this zone.

The sediment of the upper half of zone 57-III mainly consists of peaty clay (from 4.55 m -NAP onwards, see table III.4 for details). This part of the section is investigated in less detail since a tree fall prevented regular sampling. The presence of clay corresponds with a clear increase in *Fraxinus* sp., of which the local presence is confirmed by finds of macroremains in the section of square 41. Other changes contemporary with the increase in *Fraxinus* sp. are a decrease in *Pinus* sp., *Tilia* sp., *Quercus* sp., Poaceae and Cyperaceae, the presence of *Ilex* pollen, a slight increase in *Plantago lanceolata*, the start of the regular presence of *Plantago maior*, an increase in *Urtica* sp. and maximal values of *Eupotamogeton*. The NPP diagram shows a peak of *Valsaria variospora*-type and considerable values of some psilate *Spyrogira* sp., *Mougeotia* sp. and *M. laetevirens*. These changes in the pollen and NPP's are probably related to an increase in the water table and/or the increased flooding frequency, although the decrease in *Pinus* sp. and *Tilia* sp. probably represent a statistical result of the increase in *Fraxinus* sp. The presence of archaeological remains at this depth (see table III.4) may be the result of disturbance by a tree fall or other non-stratigraphical deposition since the pollen diagram does not show changes in curves similar to those that occur during the recognised occupation phases. The increased presence of the *Plantago* species can be related to the instability of the natural environment, caused by the treefall and flooding (*cf.* Groenman-Van Waateringe 1968; Louwe Kooijmans 1974, 139; Weeda *et al.* 1988, 252 and further).

Phases Haz 2a and 2b are present at 4.77 to 4.73 and 4.66 to 4.62 m -NAP. Both phases appear to be much shorter than phase Haz 1. *Quercus* sp. (phase Haz 2a), *Fraxinus* sp. (phase Haz 2b) and Cyperaceae decreased, while *Tilia* sp., *Corylus* sp. and Poaceae slightly increased. *Quercus* sp. may have been cleared. The unusual absence of a decrease in *Tilia* sp. may be related to the small scale of human impact and the dominance of *Quercus* sp. and *Fraxinus* sp. in the (very) local vegetation at the sample point. The curves of *Artemisia* sp., Chenopodiaceae, *Polypodium* sp., *Pteridium* sp. and *Urtica* sp. and the presence of *Plantago lanceolata* suggest that the effect of anthropogenic influence was stronger during phase Haz 2b phase than during phase Haz 2a. The NPP diagram shows increases in *Spirogyra* sp., *Mougeotia laetevirens* (type 373), *Ustulina deusta*-type (type 44), *Hysterium cf. pulicare* (type 121), *Gaeumannomyces cf. caricis* (type 126), type 361, *Clasterosporium caricinum* (type 25) and *cf. Diplocladiella scalaroides* (EMA type 19) amongst others. The total percentage of NPP's is especially large during phase Haz 2a for unknown reasons.

30 See also Van Geel and Aptroot 2006; De Klerk *et al.* 1997 and Barthelmes *et al.* 2006; Ellis and Ellis 1997.

Zone 57-IV (4.38 to 3.84 m -NAP) is based on a decrease in *Tilia* sp., the presence of *Fagus* and *Carpinus* pollen (transported by river water), an increase in *Ulmus* sp. and the relatively smooth curves of dryland trees. The regular presence of *Fagus* pollen is assumed to reflect the transition from the Atlantic to the Sub-Boreal, contemporaneous with the start of the Hazendonk 3 occupation (5080 ± 70 BP, 3670 BC (see table III.1); *cf.* Van der Wiel 1982). The changes in the pollen rain at the Hazendonk can be seen as a confirmation of the starting date of the Sub-Boreal date as suggested by Zagwijn (1986) for the Netherlands in general (5000 BP, 3850 BC). In contrast to some other regions in the Netherlands however, *Ulmus* sp. does not decrease (see also chapter 2.8).

Phase Haz 3 (4.37 to 4.27 m -NAP) is characterised by decreases in *Tilia* sp., *Quercus* sp. and *Fraxinus* sp. that are probably caused by human impact. Major increases in *Corylus* sp. and *Viburnum* sp. indicate the presence of open patches in the vegetation. The increase in these shrubs probably resulted in lower curves of *Pinus* sp. (despite continuous pollen rain). Other dryland taxa that increase are *Rhamnus cathartica*, *Ligustrum* sp. and *Viscum* sp. The latter could have grown on *Tilia* sp., *Malus* sp., *Sorbus* sp. (local presence not demonstrated), *Crataegus* sp. and *Populus* sp. (Westhoff *et al.* 1973). Similar to phase Haz 1, Cerealia-type pollen is present. Poaceae, *Filipendula* sp., *Lythrum* sp., Apiaceae, Brassicaceae and Asteraceae tubuliflorae slightly increase again, while the monoletae psilatae spores and Cyperaceae temporarily decrease. The macroremains diagram shows a large variety of taxa during phase Haz 3, representing both dryland and wetland taxa and also including a carbonised spikelet fork of *Triticum dicoccon*. The NPP diagram shows increased values of psilate *Spirogyra* sp., *Mougeotia laetevirens*-type (type 373) and *Ustulina deusta*-type (type 44).

After phase 3, almost all taxa recover to previous values. Some taxa initially increase at the end of occupation (*Artemisia* sp., Cyperaceae, Poaceae, *Urtica* sp. and *Solanum dulcamara*) to fall back to previous values afterwards, indicative of the gradual recovery of the vegetation. *Tilia* sp. is not able to return to previous values due to the combination of human impact and the rising water table. In the middle of the zone, *Alnus* sp. shows a sharp peak, and the macroremains diagram confirms the local presence of alder vegetation. In the upper part of the zone, *Ulmus* sp. and *Salix* sp. gradually increase, indicating a raise of the water table and possibly more dynamic water activity.

At 4.11 and 3.99 m -NAP, there are minor changes in the vegetation that might reflect an anthropogenic signal, such as a decrease in *Tilia* sp., *Fraxinus* sp., *Corylus* sp. and Cyperaceae, and (small) increases in *Quercus* sp., *Hedera* sp., *Pteridium* sp., *Lythrum* sp., Apiaceae, Brassicaceae and Caryophyllaceae. These changes correspond with earlier signals of human impact. The anthropogenic signal at 4.12 m -NAP furthermore corresponds with the presence of darker sediment. *Gaeumannomyces cf. caricis*, type 361, *Zopfiella lundqvistii* and *Clastorsporium caricinum* show small peaks at these spectra. All these taxa showed peaks during one or more of the previous occupation phases, also supporting that it concerns occupation phases. These changes are apparently all related to phase VL 1a, which represents all occupation between phases Haz 3 and VL 1b. The macroremains diagram shows a peak of *Alnus* macroremains after the presumed phase at 4.11 m -NAP, possibly indicating the recovery of alder vegetation.

III.3.2 Core 3, near unit C (Hazendonk 0 and Hazendonk 1)

Table III.5 shows the lithostratigraphy of core 3. A sample in the lower part of the core consisting of reworked peat was not analysed. The upper 10 cm of the core were not analysed because the sediment consisted of clay. Figures III.9-11 show the results of pollen analysis, non-pollen palynomorphs and macroremains of core 3. Recognised occupation phases are Hazendonk 0 and Hazendonk 1. The core corresponds with the lower part of the section of square 57.

Zone 3-I (6.13 to 5.98 m -NAP) is characterised by relatively high values of *Tilia* sp. and low values of *Quercus* sp. and dryland herbs. The percentage of *Fraxinus* sp. is higher than in the diagram of square 57. The pollen diagram and the macroremains diagram both show a combination of dryland and wetland taxa.

depth (m -NAP)	sediment
5.21-5.16	clay
5.55-5.22	coarse peat with wood remains, Hazendonk 1 at 5.40 to 5.31 m -NAP
5.86-5.56	coarse peat, sometimes sandy, wood remains at 5.79 to 5.78 m -NAP
5.87	sand, Hazendonk 0 at 5.90 to 5.80 m -NAP
5.93-5.88	coarse peat
6.01-5.94	sandy peat
6.11-6.02	peaty sand, reworked peat at 6.11 to 6.06 m -NAP
6.16-6.12	humic sand

Table III.5 The Hazendonk, unit C, core 3, lithostratigraphy.

The macroremains diagram indicates the local presence of *Alnus glutinosa* and *Cornus sanguinea*. The NPP diagram shows high values of *Tilletia sphagni*, (type 27), *Ustulina deusta*-type (type 44), *Valsaria variospora*-type (type 140) and *Diporotheca rhizophila* (type 143), which corresponds with the section of square 57, except for the presence of *T. sphagni*. The macroremains diagram indicates the presence of charcoal and bone remains in the sediment of zone 3-I, but this waste was not interpreted as a refuse layer during excavation, which is confirmed by the absence of clear human impact in the diagrams.

The transition to zone 3-II (5.97 to 5.53 m -NAP) is based on a decrease in *Tilia* sp., an increase in *Quercus* sp. and an increase in Apiaceae. *Fraxinus* sp. shows a peak during the increase in *Quercus* sp. The zone starts with phase Haz 0 (5.94 to 5.82 m -NAP). In the pollen diagram, *Fraxinus* sp. and *Tilia* sp. decrease during this phase, while *Corylus* sp., *Viburnum* sp., Chenopodiaceae, *Rumex acetosa*-type, *Allium* sp., *Alnus* sp., *Urtica* sp., *Solanum dulcamara* and *Mentha*-type show increased values. The decrease in *Tilia* sp. indicates that human impact occurred somewhat higher on the slope than at the sample point, since *Tilia* sp. was not the main taxon at the sample point. The macroremains diagram only shows minor changes that can be related to occupation, such as the presence of charcoal, the presence of *Viburnum* sp. and a decrease in *Cornus sanguinea*. Carbonised macroremains were not found in this core. The NPP diagram shows small peaks of *Valsaria valsariospora*-type (type 140), type 18, type 361 indicative of erosion of sand, fragments of wood vessels (type 114), *Actinopeltis* sp. (type 8C), Cladocera and *Pleospora* sp. (type 3B).

In the following part of zone 3-II, *Tilia* sp. partly recovers and remained present in the extra-local vegetation. A variety of dryland shrubs was present, indicating somewhat open vegetation. The pollen and macroremains indicate the presence of alder carr. The NPP diagram shows the presence of algae and types that are indicative of moist to wet conditions and regular flooding. *Gaeumannomyces cf. caricis* (type 126) and *Clasterosporium caricinum* (type 25) indicate the common occurrence of sedges (Van Geel 1976, Van der Wiel 1982), which is confirmed by the macroremains diagram.

In the upper part of zone 3-II the curve of *Quercus* sp. shows relatively low values, which is probably related to the water table, since the pollen diagram shows a slight increase in the percentage of water plants, increased values of *Pinus* sp., and relatively high values of Cyperaceae, type 140, type 143 and the total percentage of NPP's. The peak in the NPP curve can also be observed in the diagram of square 57. The low values of *Quercus* sp. could also be explained by anthropogenic influence since bone remains are present at this level, but the diagrams do not support this by evidence of human impact.

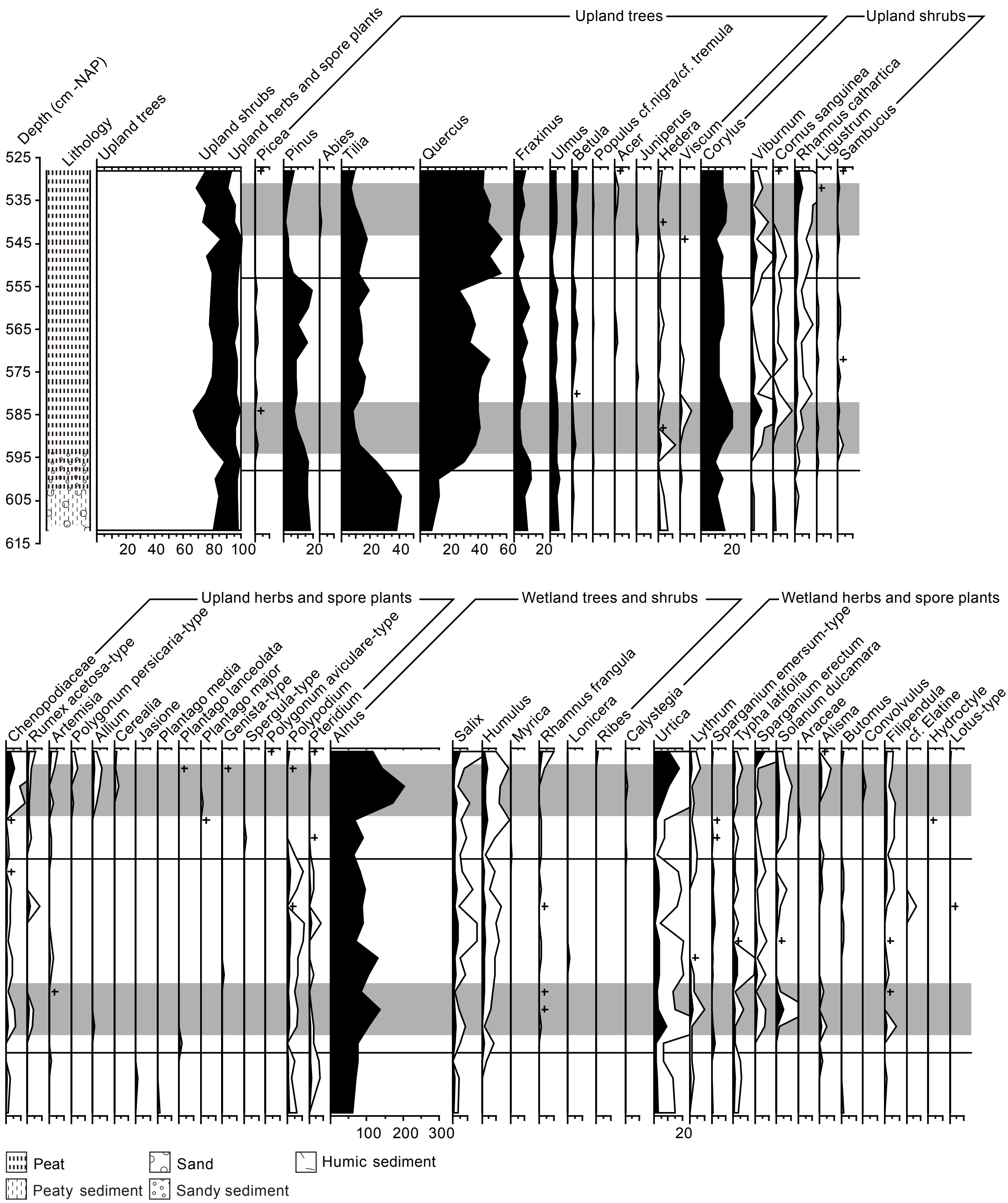


Figure III.9 part 1.

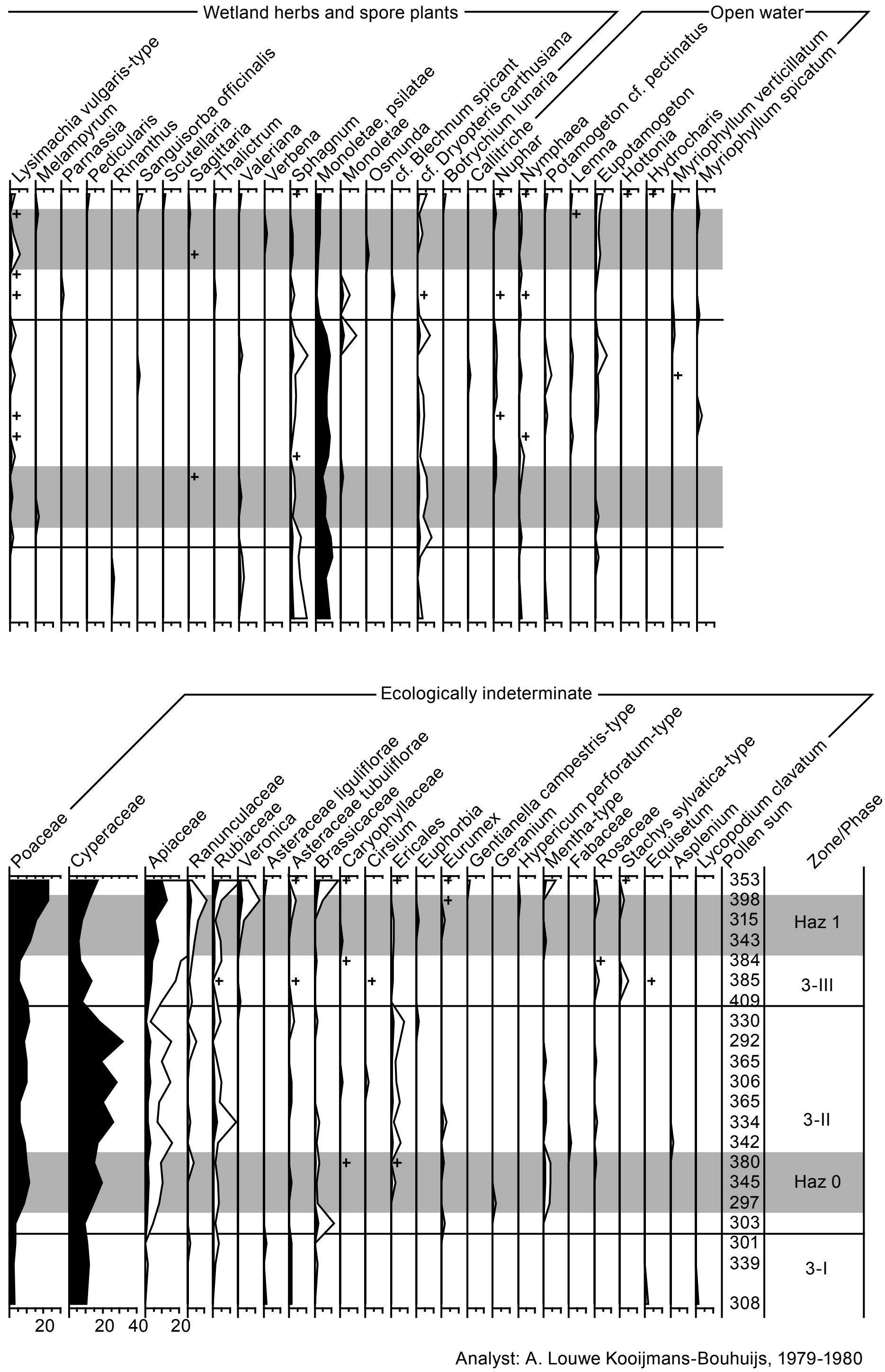


Figure III.9 The Hazendonk, unit C, core 3, pollen diagram based on an upland pollen sum, exaggeration 5 x, part 2.

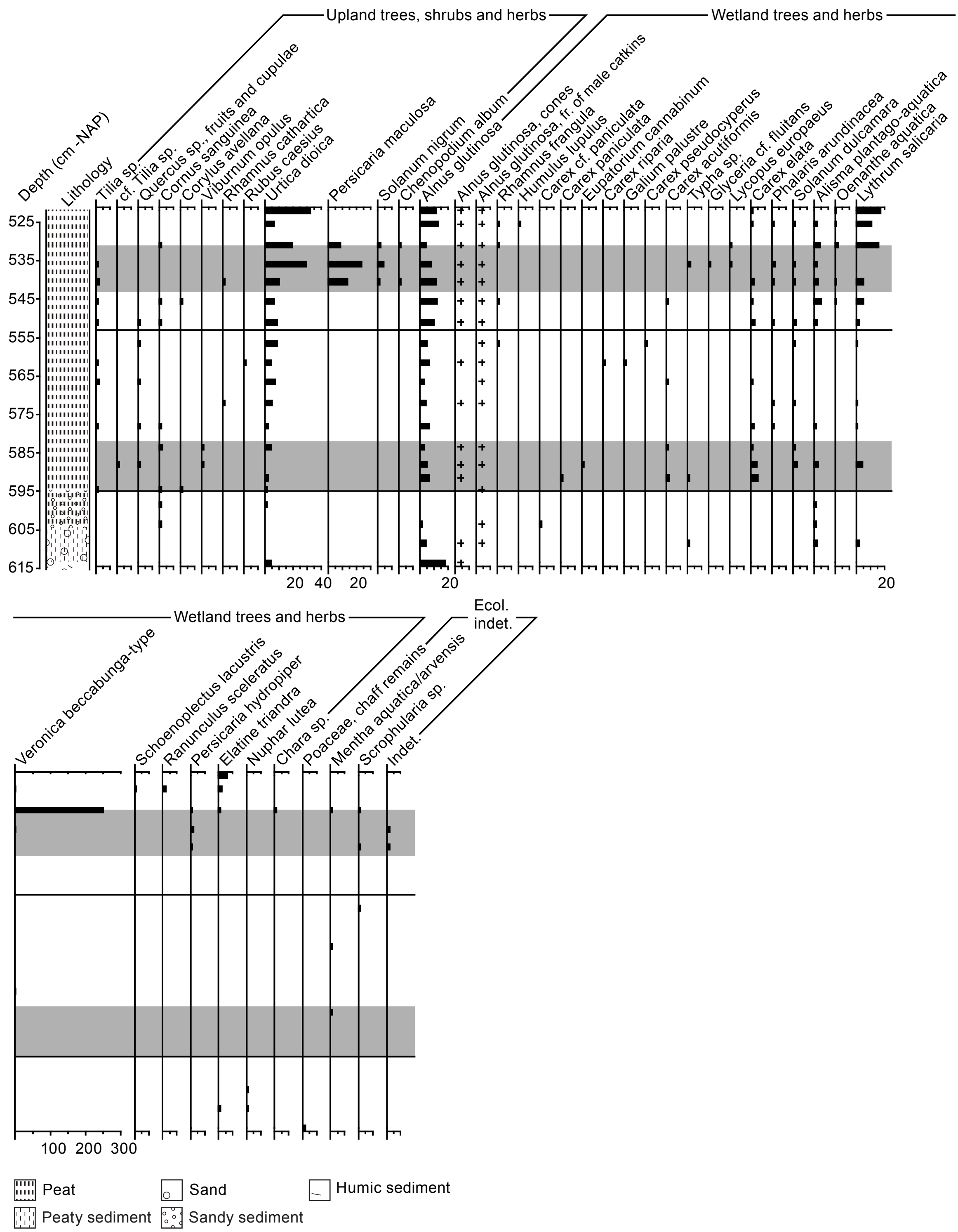


Figure III.10 part 1.

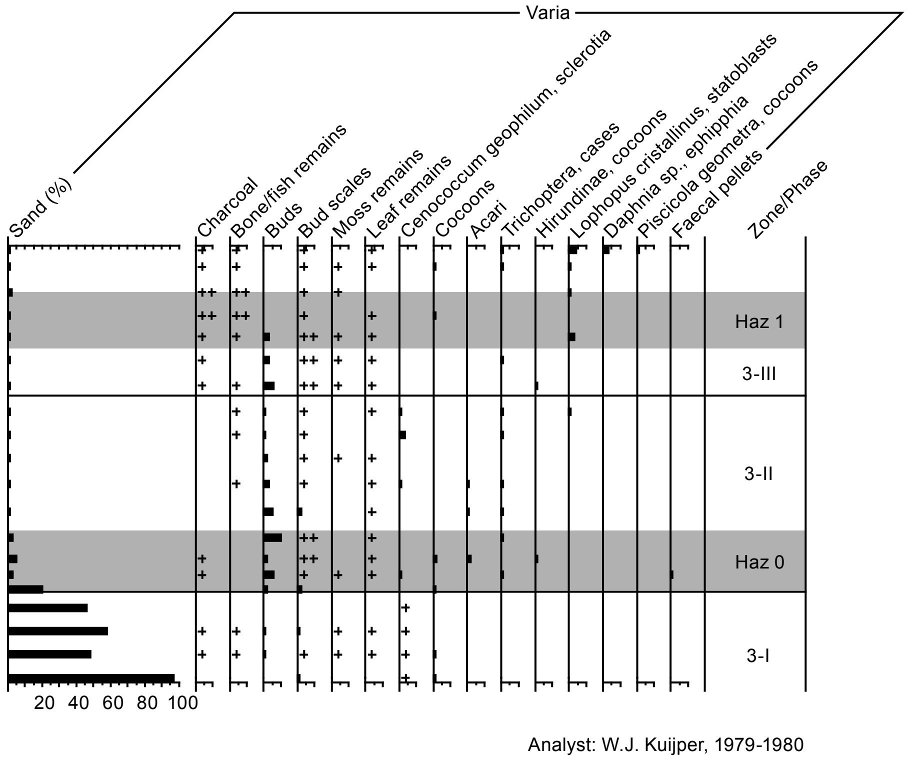
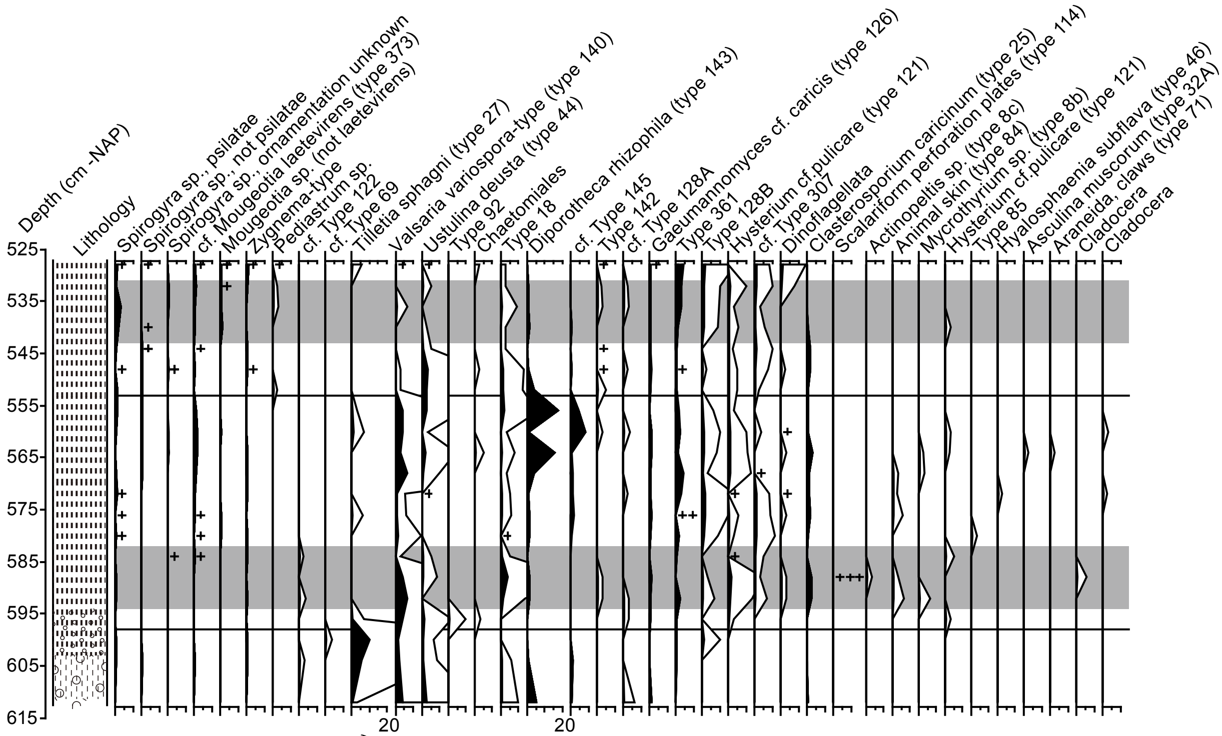


Figure III.10 The Hazendonk, unit C, core 3, macroremains diagram, + = few (1-10), ++ = some tens (10-49), part 2.



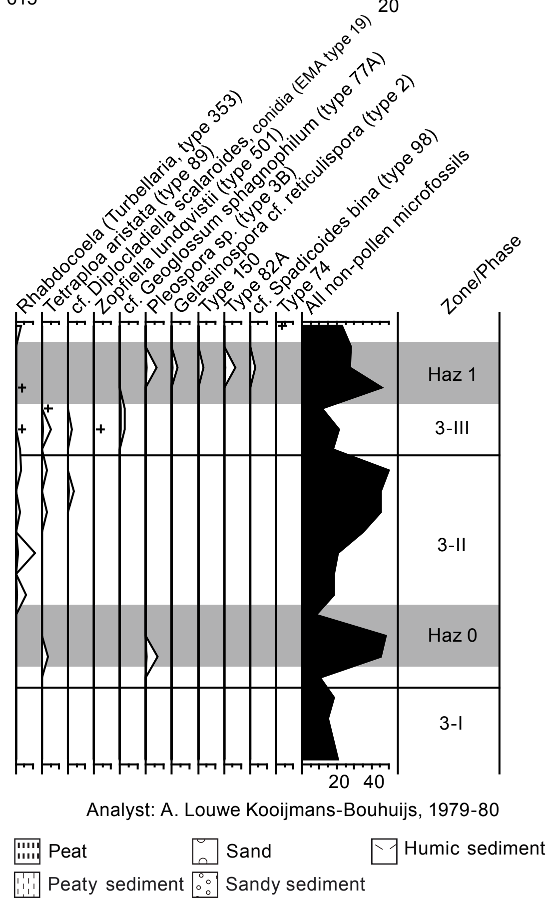


Figure III.11 The Hazendonk, unit C, core 3, non-pollen palynomorph diagram based on an upland pollen sum, exaggeration 10 x, + = few (1-10), ++ = some tens (10-49), +++ = many tens (50-99).

The transition to the third zone of core 3 is based on an increase in *Quercus* sp., a decrease in Cyperaceae and monoletae psilatae fern spores, and an increase in Apiaceae. The increase in *Quercus* sp. probably represents a lowered water table since there is a decrease in water plant pollen and since the NPP diagram shows a recovery of types that peaked at the end of the previous zone. *Valsaria valsariospora*-type (type 140) shows decreased values compared with the earlier zones.

The anthropogenic signal of phase Haz 1 is clearly visible in the pollen diagram at 5.43 to 5.31 m -NAP, characterised by a slight decrease in *Tilia* sp., *Quercus* sp. and Cyperaceae, and the presence and/or peaks of *Rhamnus cathartica*, Cerealia-type, Chenopodiaceae, *Plantago lanceolata*, *P. major*, *Polygonum persicaria*-type, Poaceae, *Urtica* sp., Ranunculaceae, Apiaceae, *Veronica* sp. and others (see diagram). *Alnus* sp. shows a peak but decreases afterwards. The decrease in *Alnus* sp. in the macroremains diagram indicates that it only concerns increased representation of the taxon in the pollen diagram due to decreased pollen rain of dryland pollen. The pollen diagram shows the recovery of the vegetation after occupation characterised by an increase in *Pinus* sp. and Cyperaceae and a decrease in *Alnus* sp., but some taxa suggest that occupation continued to the upper part of the diagram (*Quercus* sp. and various dryland herbs indicative of human impact). The macroremains diagram indicates that occupation resulted in a decrease in *Quercus* sp. and *Cornus sanguinea*, and an increase in *Urtica dioica*, *Persicaria maculosa*, *Solanum nigrum*, *Chenopodium album* and *Persicaria hydropiper*. *Lythrum salicaria* and *Veronica beccabunga*-type show maximal values after occupation. The NPP diagram shows small peaks of psilate *Spirogyra* sp., type 361, *Pleospora* sp. (type 3B), *Gelasinospora cf. reticulispora* (type 2), type 150, type 82A and *cf. Spadicoides bina* (type 98) during occupation. Type 361 and type 2 that is related to the presence of charcoal can both be related to human occupation (Van Geel 1978; Van Geel *et al.* 1981), while the other types are not known as anthropogenic indicators.

III.3.3 Core 2, near unit C (Vlaardingen 1a and Vlaardingen 1b)

Table III.6 shows the lithostratigraphy of core 2. Figures III.12-14 show the results of pollen analysis, non-pollen palynomorphs and macroremains of core 2. Recognised occupation phases are VL 1a and VL 1b. The core represents a continuation of the section of square 57. The dryland vegetation is quite constant during the whole diagram. *Quercus* sp., *Fraxinus* sp., *Ulmus* sp. and *Corylus* sp. dominate the diagram, while remains of the shrubs *Viburnum* sp., *Rhamnus cathartica*, *Ligustrum* sp. and *Sambucus* sp. are regularly present as well. The presence of *Fagus* sp. supports that the diagram represents the Sub-Boreal.

In zone 2-I (3.94 to 3.72 m -NAP), the percentages of *Pinus* sp. and Cyperaceae are relatively high compared with the following zone, which may indicate relatively wet conditions. The macroremains diagram suggests the presence of alder carr, but is poor in macroremains in this zone. Important NPP's are *Valsaria variospora*-type (type 140), *Diporotheca rhizophila*-type (type 143) and *Apiosordaria verruculosa* (type 169). Type 169 indicates the presence of decaying plant material, possibly in the form of dung (Van Geel and Aptroot 2006).

depth (m -NAP)	sediment
3.03-2.94	coarse peat with many wood remains and clay particles
3.26-3.04	clayey peat with coarse plant remains
3.28-3.27	wood remains
3.63-3.29	peat with fine plant remains, Vlaardingen 1b at 3.39 to 3.28 m -NAP
3.65-3.64	wood remains
3.94-3.66	peat with coarse plant and wood remains, Vlaardingen 1a at 3.88 to 3.80 m -NAP

Table III.6 The Hazendonk, unit C, core 2, lithostratigraphy.

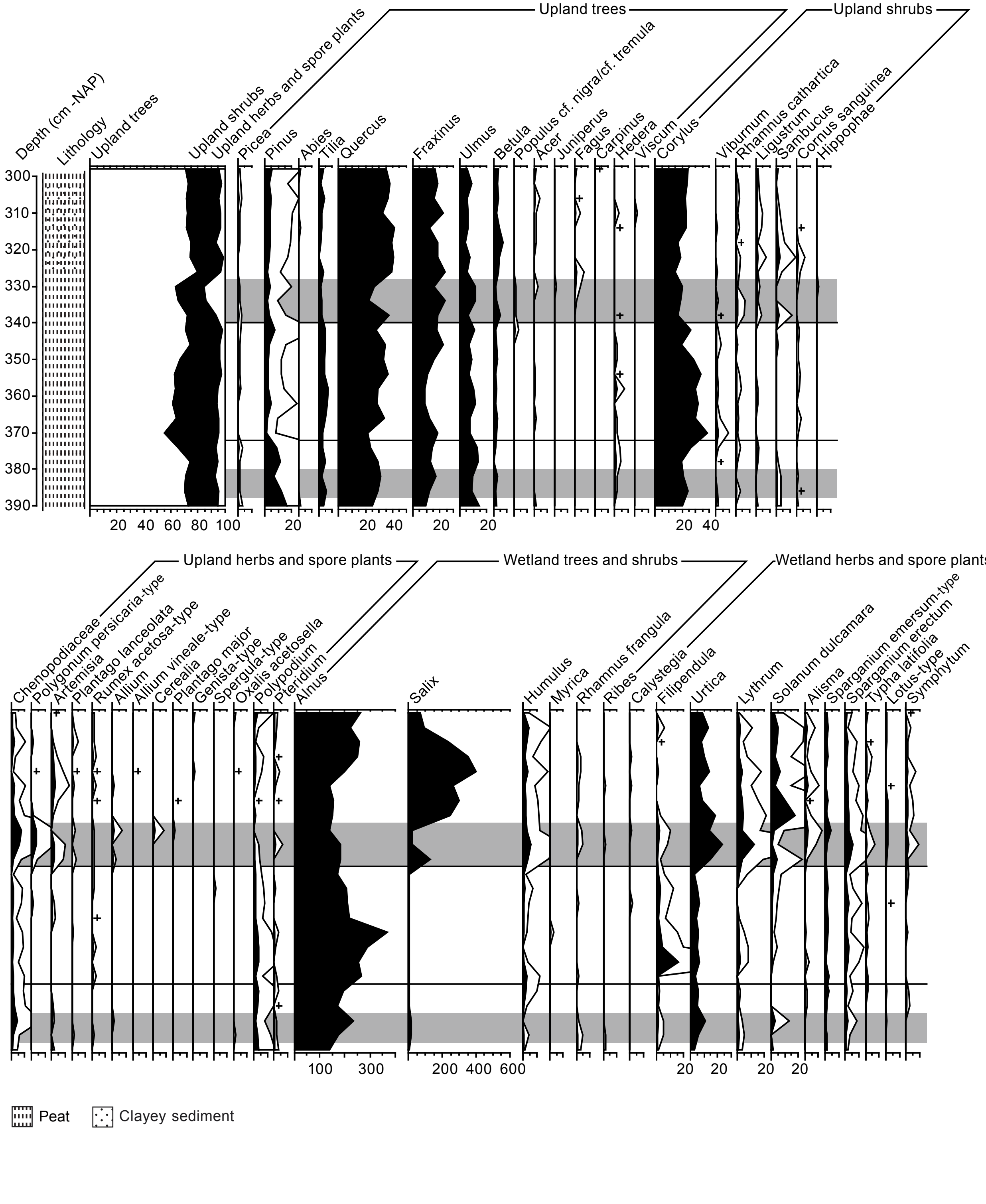


Figure III.12 part 1.

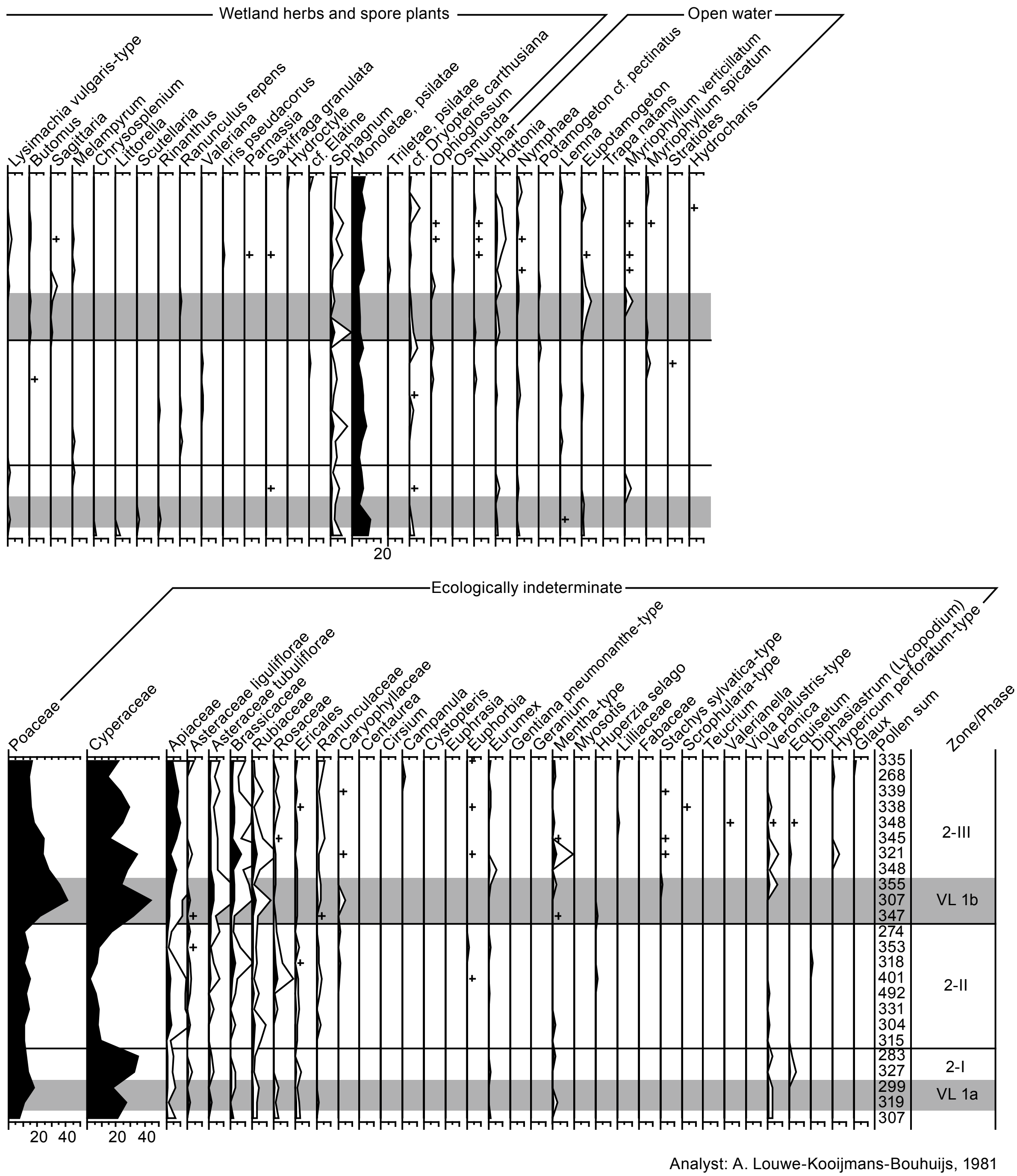


Figure III.12 part 2 The Hazendonk, unit C, core 2, pollen diagram based on an upland pollen sum, exaggeration 5 x. This figure can be seen as the continuation of figure III.6.

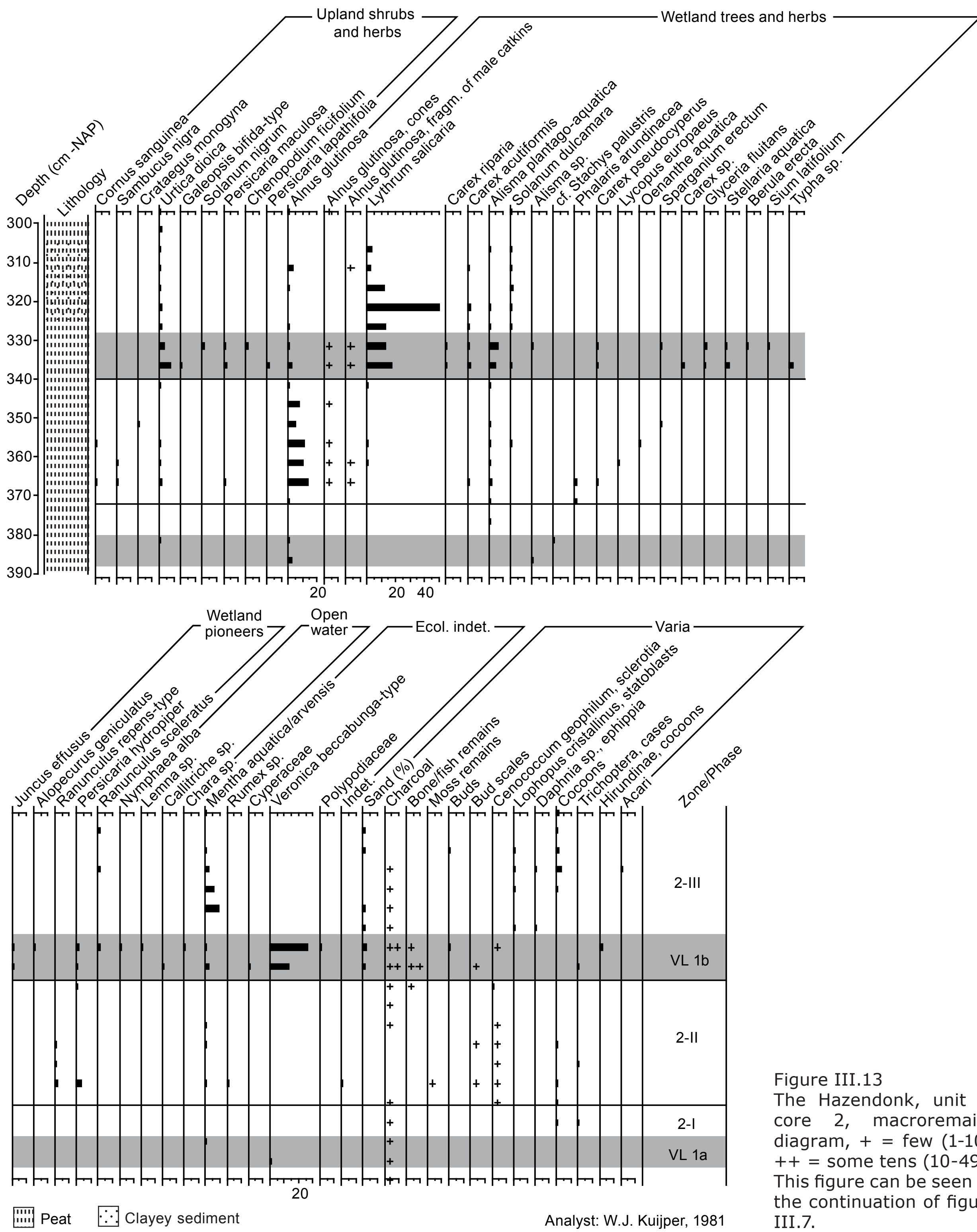


Figure III.13
The Hazendonk, unit C, core 2, macroremains diagram, + = few (1-10), ++ = some tens (10-49). This figure can be seen as the continuation of figure III.7.

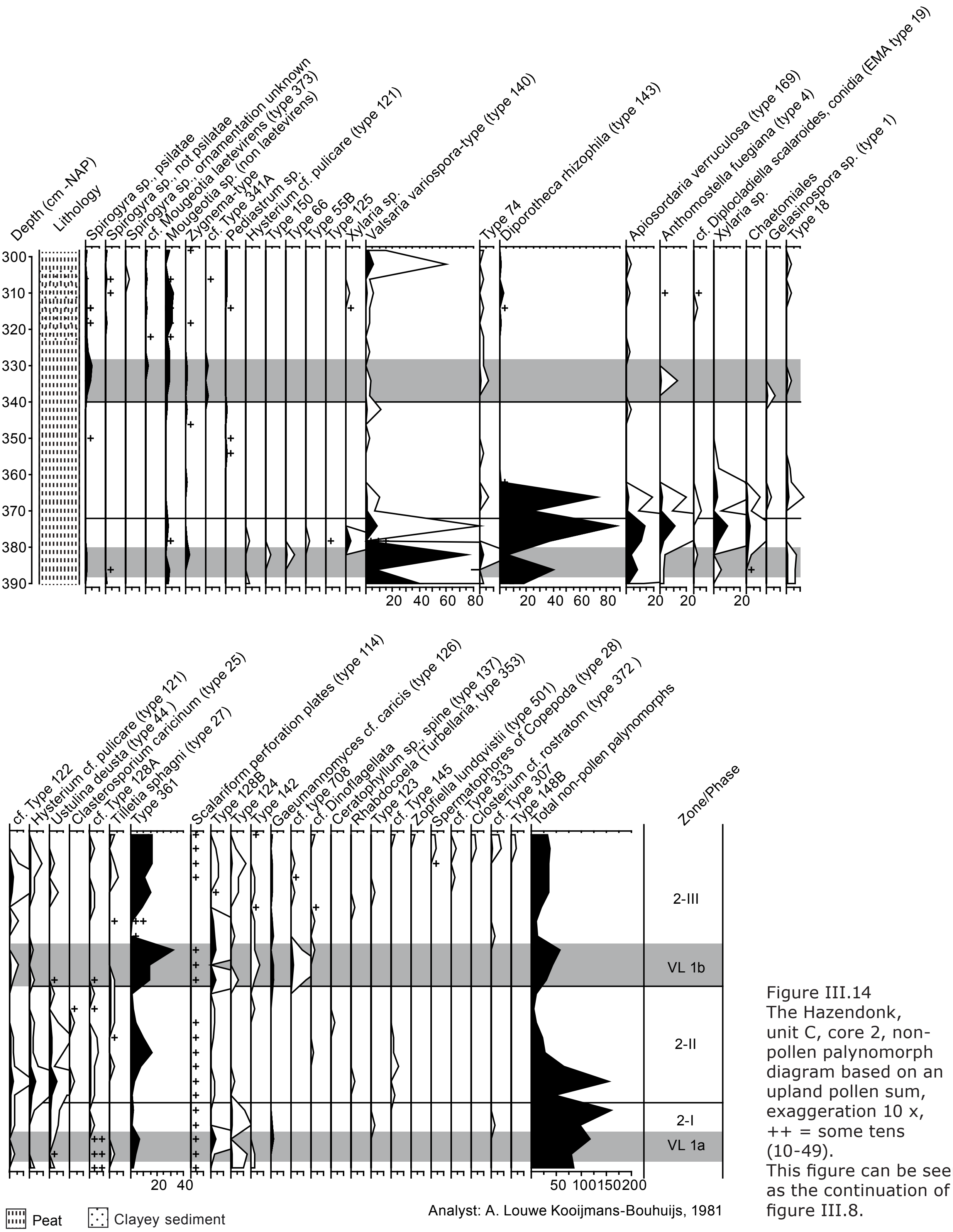


Figure III.14
The Hazendonk, unit C, core 2, non-pollen palynomorph diagram based on an upland pollen sum, exaggeration 10 x, ++ = some tens (10-49).
This figure can be seen as the continuation of figure III.8.

Phase VL 1a (3.88 to 3.80 m -NAP) is characterised by a very weak anthropogenic signal: a small decrease in *Tilia* sp. and *Corylus* sp., a small rise of *Quercus* sp. and *Fraxinus* sp., the presence of Chenopodiaceae, *Artemisia* sp., *Plantago lanceolata*, *Rumex acetosa*-type and *Allium* sp., a peak of Poaceae, *Alnus* sp., and *Urtica* sp., and a decrease in Cyperaceae and monoletae psilatae fern spores. The occupation is not characterised by a major change in the ratio of arboreal and non-arboreal dryland pollen, indicating that deforestation at the south-eastern side of the dune was very restricted. Most of the macroremains found in zone 2-I are found within the occupation horizon. NPP's that show an increase during occupation are psilate *Spirogyra* sp., *Zygnema*-type, type 150, type 66, type 74, type 361 and type 128B. Only type 361 is known as an indicator of anthropogenic influence (Van Geel *et al.* 1981), although type 150 was also present during phase Haz 1 in core 3 of this study. The limited impact of anthropogenic influence on the vegetation during this occupation period corresponds with the limited number of archaeological finds and the limited possibility of distinguishing this occupation phase during excavation.

The transition to zone 2-II (3.71 to 3.40 m -NAP) is based on a decrease in *Pinus* sp. and Cyperaceae, and an increase in *Corylus* sp. and *Alnus* sp. *Alnus* sp. replaced sedge vegetation as indicated by the pollen and macroremains diagram. The macroremains diagram shows (extra-) local presence of *Cornus sanguinea*, *Sambucus nigra* and *Crataegus monogyna*, which were probably part of the alder vegetation as well. The herbaceous undergrowth of the alder vegetation probably consisted of *Filipendula ulmaria*, *Sparganium* sp. (pollen), *Urtica dioica*, *Alisma plantago-aquatica*, *Ranunculus repens*-type and *Mentha aquatica* (macroremains). There are no clear indications of human impact in this zone despite fluctuations in some NPP curves (including type 361). In this zone, the macroremains diagram shows strong similarity with the middle part of the diagram of section 41 (after phase Haz 3) where *Alnus* sp., *Cornus* sp., *Sambucus* sp. and *R. repens*-type show peaks as well.

The transition to zone 2-III (3.39 to 2.94 m -NAP) is based on a slight increase in *Betula* sp., a decrease in *Corylus* sp. and an increase in Poaceae, Cyperaceae, *Salix* sp. and wetland herbs. The zone starts with occupation phase VL 1b (3.39 to 3.28 m -NAP). The pollen diagram shows a decrease in *Tilia* sp., *Quercus* sp. and *Corylus* sp., the presence or peaks of Chenopodiaceae, *Polygonum persicaria*-type, *Artemisia* sp., *Allium* sp., *Plantago lanceolata*, Cerealia-type, Poaceae, Cyperaceae, *Urtica* sp., *Lythrum* sp., *Alisma* sp., *Solanum dulcamara*, *Sparganium erectum*, Asteraceae tubuliflorae and Brassicaceae. The percentage of herbs shows a major peak in the summary diagram. The macroremains diagram shows the presence of sand, charcoal and bone remains, a decrease in *Alnus* sp. and increased values of *Urtica dioica*, *Lythrum salicaria*, *Alisma plantago-aquatica*, *Persicaria hydropiper* and *Veronica beccabunga*-type. The increase in both dryland and wetland herbs indicates relatively open conditions, disturbance and the increased presence of nutrients. The NPP diagram shows increased values of psilate *Spirogyra* sp., a major peak of type 361, small peaks of *Gelasinospora* sp. (type 1, related to the presence of charcoal), type 128B and type 708, and an increase in the total NPP percentage. Types 1 and 361 can be related to human impact.

After occupation, the dryland vegetation recovered, while *Urtica dioica*, *Solanum dulcamara*, Brassicaceae, Rubiaceae, *Mentha*-type, *Veronica* sp. (pollen) and *Lythrum salicaria* (seeds) show temporary peaks, representing an intermediate state of recovery of the natural vegetation. In the wetland vegetation, *Salix* sp. partly replaced *Alnus* sp., as indicated by a major peak of *Salix* sp. The high percentages of *Salix* sp. indicate local dominance (*cf.* Waller *et al.* 2005), and indicate more dynamic fluvial conditions. The percentage and diversity of water plants does not show major changes, but *Hottonia* sp. and *Myriophyllum verticillatum* are present more frequently. The presence of anthropogenic indicators in the pollen diagram, the presence of charcoal and the high values of type 361 in the NPP diagram in the middle part of zone 2-III suggest continued occupation, but this is probably related to erosion due to colluviation and/or water activity. The macroremains diagram indicates that woodland of dry terrain was no longer present in the local vegetation.

III.3.4 M86, eastern section of square 25, unit B (Vlaardingen 1b)

Table III.7 shows the lithostratigraphy of M86. Figures III.15 and III.16 show the results of the pollen and macroremains analysis of M86, which correspond to the period before, during and after phase VL 1b (3.70 to 3.58 m -NAP). The macroremains diagram was partially published earlier (Bakels 1981; Out 2008c). The local vegetation probably consisted of alder carr with *Viburnum opulus* and *Cornus sanguinea*. Well-represented herbs are *Veronica beccabunga*-type, *Juncus effusus* and *Urtica dioica*. Human impact resulted in a decrease in *Quercus* sp., *Fraxinus* sp., *Alnus glutinosa*, *V. beccabunga*-type, *J. effusus*, *U. dioica* and *Plantago lanceolata*, and to a strong increase in dryland anthropogenic indicators (*cf.* Behre 1981) including Cerealia-type, *Chenopodium album*, *Solanum nigrum* and *Stellaria media*. The diagram also shows a moderate increase in ferns, grasses, sedges and wetland taxa, including *Sparganium* sp., *Filipendula ulmaria*, *Symphytum* sp., *Ranunculus sceleratus* and *Rorippa amphibia*. Together these changes indicate the disturbance of the oak vegetation and of the alder carr, the increased presence of open patches and eutrophication that was probably caused by the dumping of waste. The macroremains do not contain crop plants or carbonised food plants. The only carbonised finds are two fruits of *Mentha aquatica/arvensis* (sample depth unknown[31]). Poaceae and Cyperaceae show a strong increase at the end of occupation, which was probably the result of the recovery of the vegetation as well as the rising ground water level. After occupation, *Quercus* sp. recovered, certain shrubs increase (*Rhamnus cathartica*, *Ligustrum* sp. and *Sambucus* sp.) and the dryland herbs decreased or disappeared, indicating the recovery of the vegetation. In the wetland vegetation, *Alnus* sp., *Salix* sp., *Lythrum salicaria* and *Mentha aquatica/arvensis* increased strongly, and *Sparganium erectum*, *Solanum dulcamara* and Rubiaceae increased as well, while Poaceae and Cyperaceae gradually decreased. The changes of these wetland taxa can be explained by the increase in the water level, as indicated by the presence of clay, and may possibly also represent the development of secondary vegetation as part of the recovery of the natural vegetation.

depth (m -NAP)	sediment
3.59-3.56	slightly clayey peat with pottery fragments
3.62-3.60	peat with charcoal remains
3.65-3.63	very sandy peat
3.67-3.66	sandy peat
3.70-3.68	very sandy peat
3.75-3.71	peat; charcoal remains at 3.73 to 3.72 m -NAP

Table III.7 The Hazendonk, unit B, eastern section of square 25, M86, lithostrigraphy.

31 The macroremains were found in the material that was left over after preparation of the pollen samples.

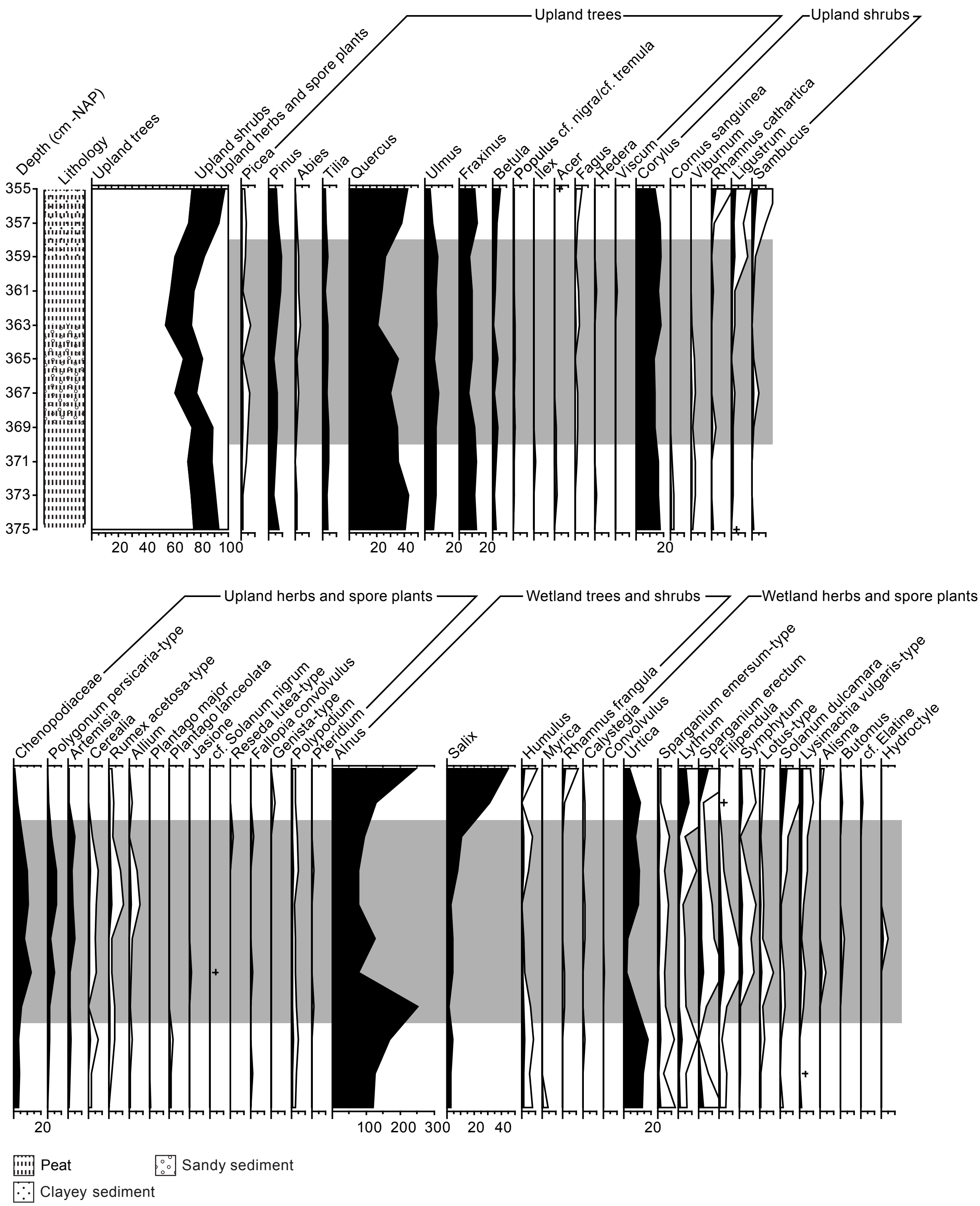
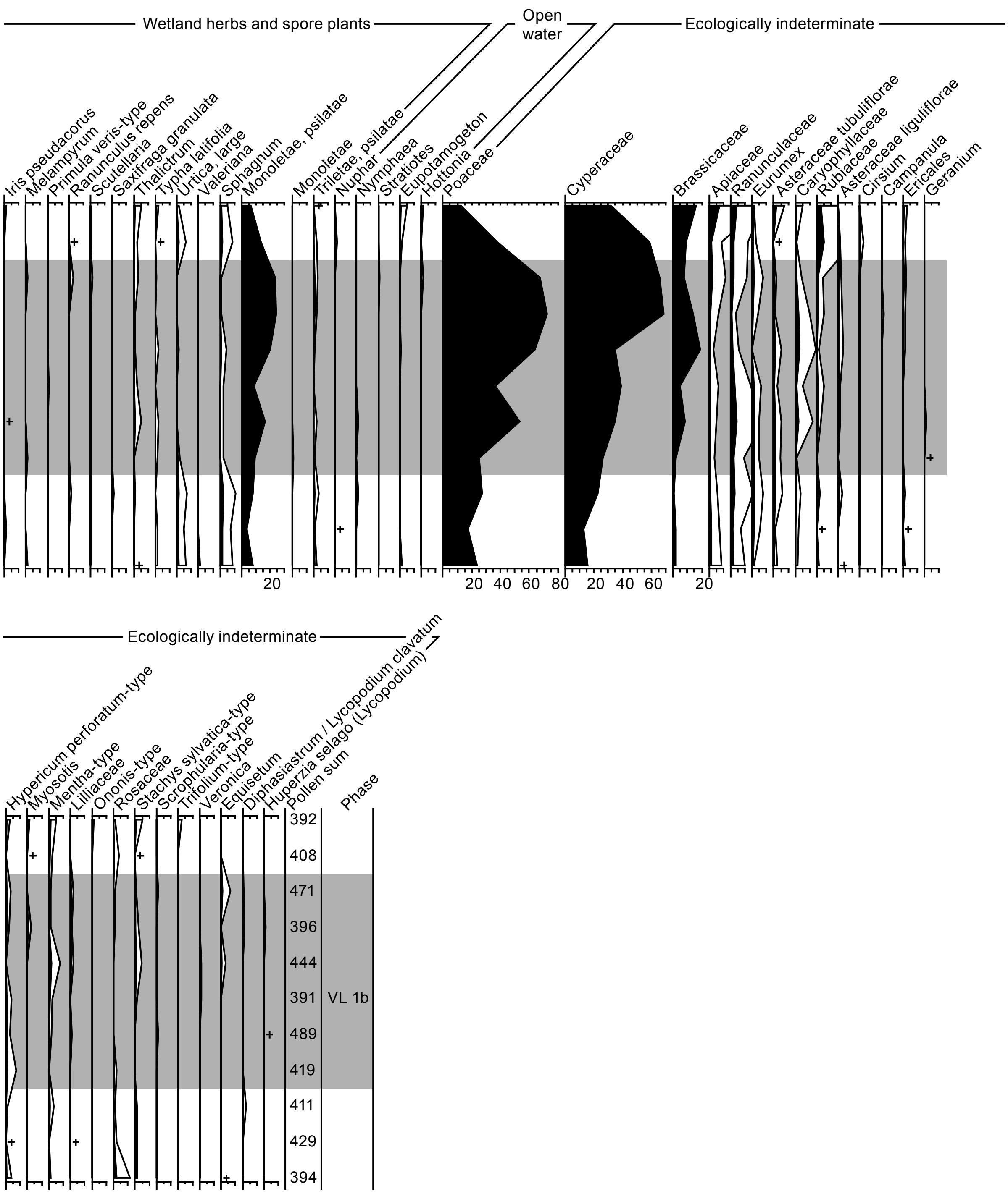


Figure III.15 part 1.



Analyst: A. Louwe Kooijmans-Bouhuijs, 1974-1980

Figure III.15 The Hazendonk, unit B, eastern section square 25, M86, pollen diagram based on an upland pollen sum, exaggeration 5 x, part 2.

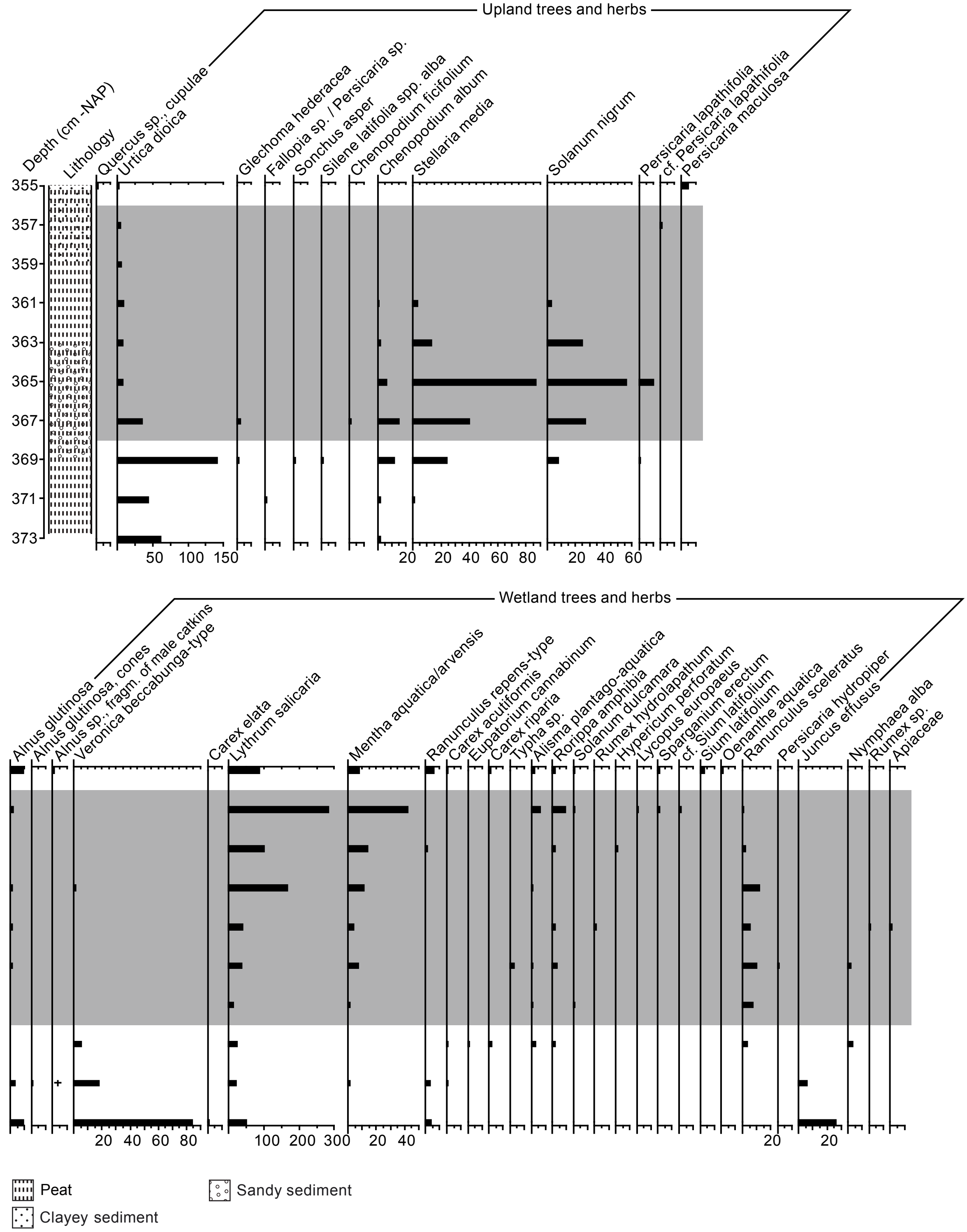


Figure III.16 part 1.

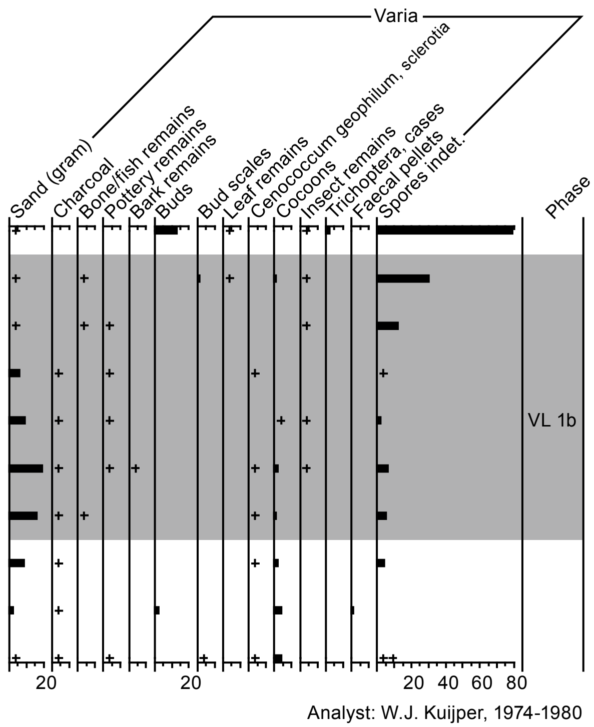


Figure III.16
The Hazendonk, unit B, eastern section square 25, M86, macroremains diagram, + = few (1-10), part 2.

III.3.5 M87, EASTERN SECTION OF SQUARE 25, UNIT B (VLAARDINGEN 1B)

Table III.8 shows the radiocarbon dates from M87 (Lanting and Van der Plicht 2000). The results correspond with the other dates of the refuse layer but do not add additional information because of the broad ranges. Table III.9 shows the lithostratigraphy of M87. Figures III.17 and III.18 show the results of the pollen and macroremains analysis of section M87, which correspond to the period before, during and after phase VL 1b (3.91 to 3.81 m -NAP). M87 is located *c.* 3 metres lower on the slope of the dune than M86 but is highly comparable with M86.

The local vegetation probably consisted of alder carr. The quantity of sand and archaeological refuse is smaller in M87 than in M86, indicating that M87 is located further away from human activity. At the start of occupation, *Quercus* sp. decreased and *Fraxinus* sp. showed a peak. *Ulmus* sp. was probably more common near M87 than at M86, since the percentage is higher in M87. Chenopodiaceae, *Artemisia* sp., Cerealia-type and *Solanum nigrum* clearly indicate the period of occupation, although the dryland herb signal is weaker than in M86. In the wetland vegetation, *Alnus* sp. decreased while Poaceae, Cyperaceae, *Urtica dioica*, *Lythrum salicaria* increased strongly. After occupation *Quercus* sp. and *Betula* sp. increased, certain dryland shrubs increased (*Rhamnus cathartica*, *Ligustrum* sp. and *Sambucus* sp.), and herbs that showed high percentages during occupation show a decrease. In the wetland vegetation, *Alnus* sp., *Salix* sp. and various herbs such as *Sparganium erectum*, *Lysimachia vulgaris*-type, Apiaceae, Brassicaceae, Ranunculaceae and Rubiaceae increased after occupation, correlated with the sedimentation of clay. The changes may possibly also represent the development of secondary vegetation as part of recovery of the natural vegetation.

Although systematically counted data are absent, some information on non-pollen palynomorphs from M86 and M87 is available. M86 and M87 contained the NPP's *Mougeotia* sp., *Spirogyra* sp., *Zygnema*-type, *Diporotheca rhizphila* (type 143), type 150, *Zopfiella lundqvistii* (type 501) and Hystrichosphaeridae. *Mougeotia* sp., *Spirogyra* sp. and *Zygnema*-type indicate shallow, stagnant, mesotrophic to eutrophic freshwater. Hystrichosphaeridae are indicative of marine influence, although the other available sources demonstrate that this was negligible. Due to the absence of data it is not possible to investigate the reaction of the NPP taxa observed in M86 and M87 to human impact.

sample	depth (m -NAP)	lab code	age (yrs BP)	age (yrs cal BC, 2σ)	dated material
Haz 28c	3.82	GrN-8239	4220 ± 60	2930 (95.4%) 2610	peat
Haz 28b	3.87-3.86	GrN-9198	4050 ± 120	2900 (95.4%) 2200	peat
Haz 28a	3.93	GrN-9197	4390 ± 170	3550 (95.4%) 2550	peat

Table III.8 The Hazendonk, unit B, eastern section of square 25, M87, ^{14}C dates (Lanting and Van der Plicht 2000).

depth (m -NAP)	sediment
3.83-3.78	clayey peat
3.89-3.84	peaty sand with charcoal remains and a bone fragment
3.91-3.90	sandy peat
3.97-3.92	peat with Phragmites remains

Table III.9 The Hazendonk, unit B, eastern section of square 25, M87, lithostratigraphy.

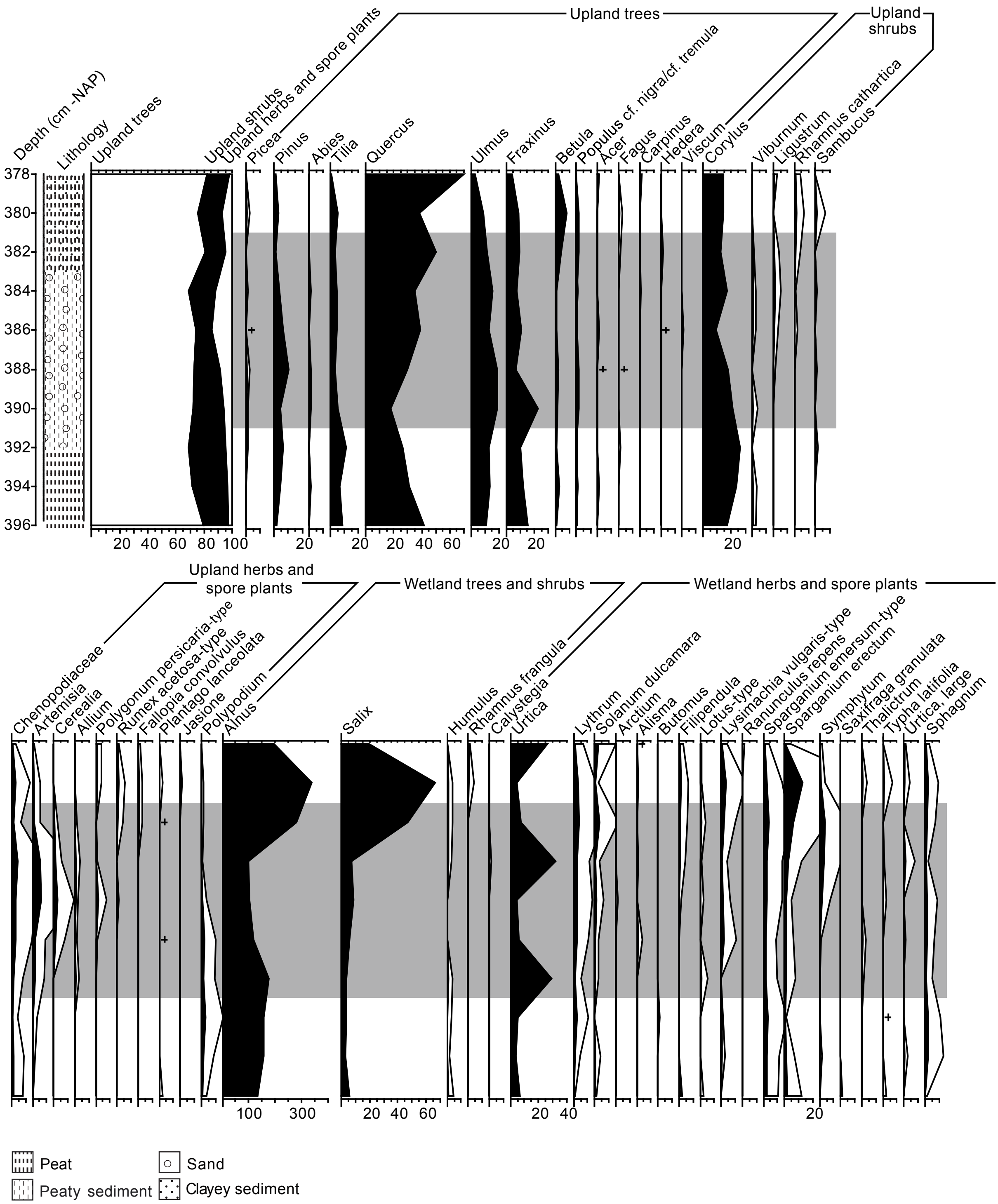


Figure III.17 part 1.

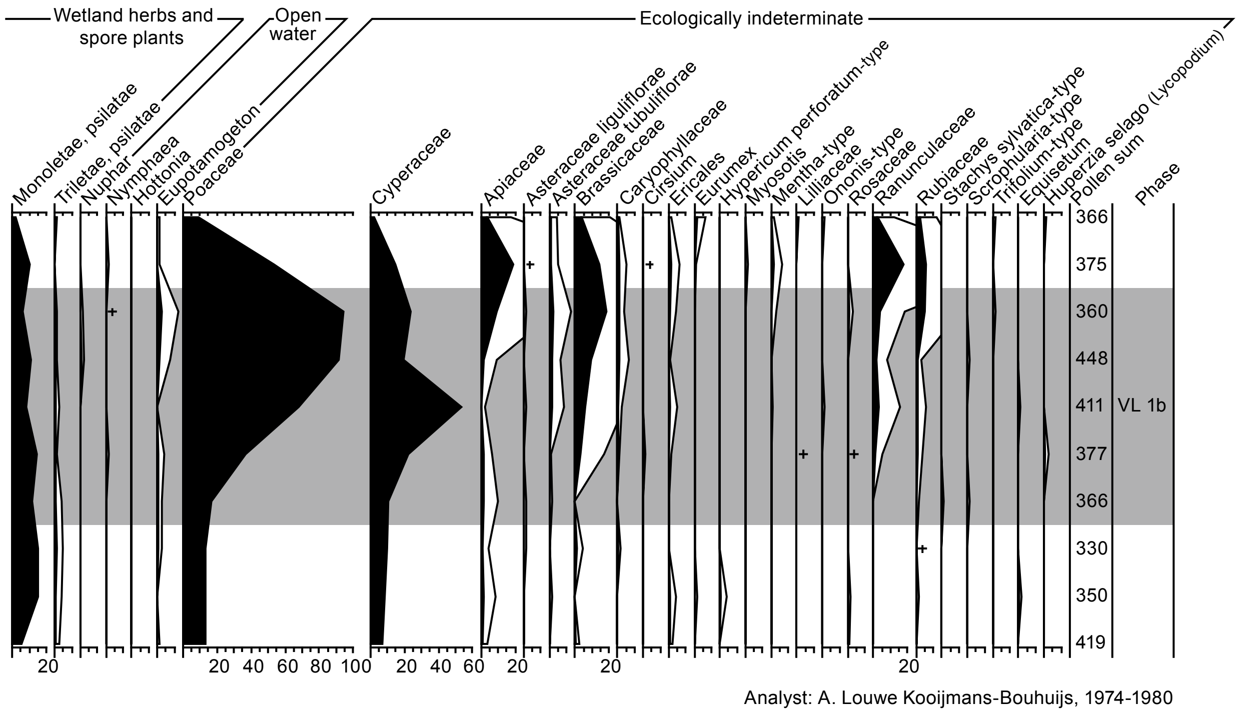
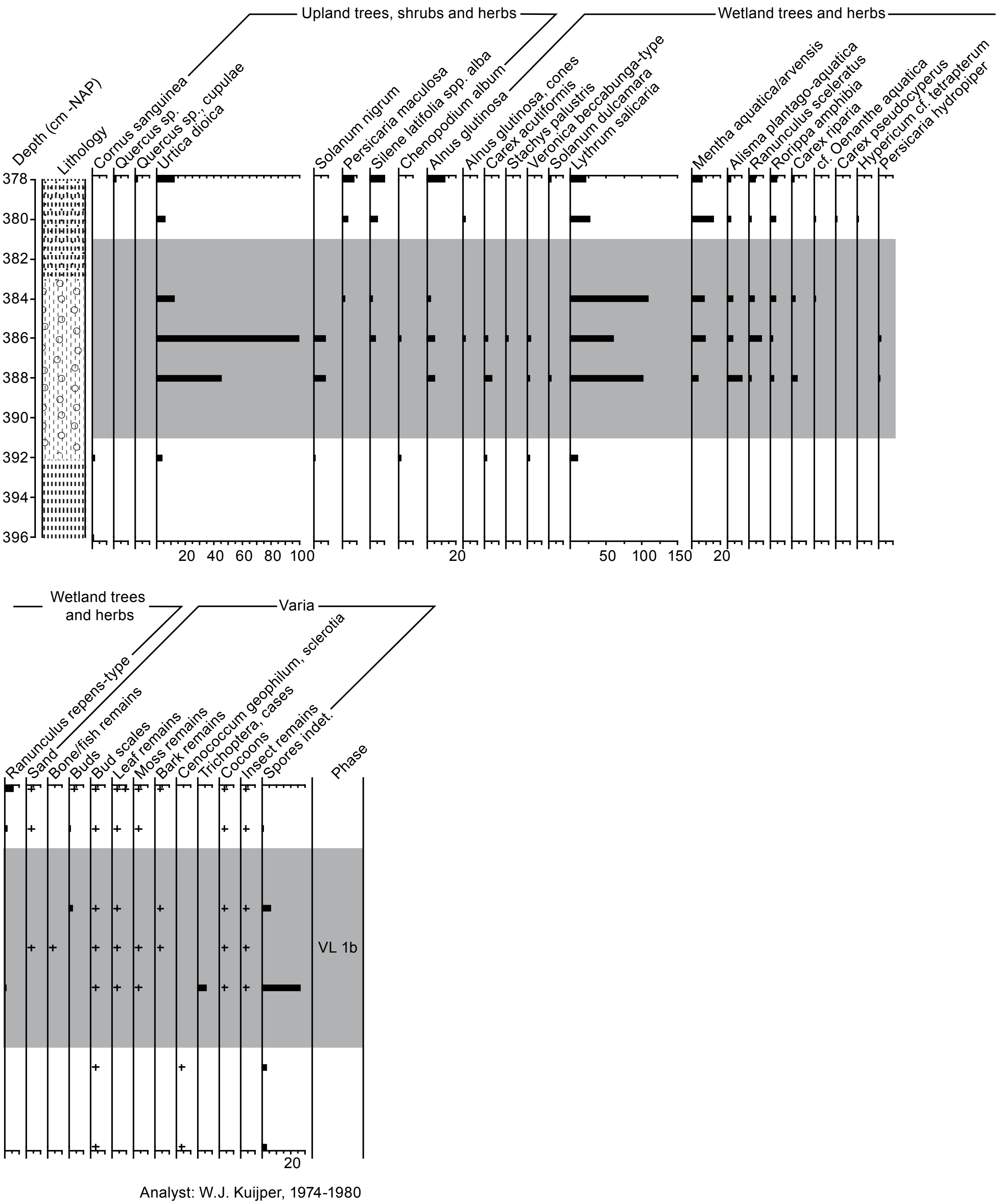


Figure III.17 The Hazendonk, unit B, eastern section square 25, M87, pollen diagram based on an upland pollen diagram, exaggeration 5 x, part 2.



Peat
Sand
Peaty sediment
Clayey sediment

Figure III.18 The Hazendonk, unit B, eastern section square 25, M87, macroremains diagram, + = few (1-10), ++ = some tens (10-49).

III.3.6 Southern section of square 41, unit C (Hazendonk 1, Hazendonk 2, Hazendonk 3 and Vlaardingen 1b)

Table III.10 shows the lithostrigraphy of the southern section of square 41 (unit C). Figure III.19 shows the corresponding macroremains diagram. The diagram generally shows the change from dryland vegetation towards wetland vegetation. In the lower part of the diagram, the variety of dryland taxa is relatively large, and woodland of dry terrain may have been present in the extra-local vegetation. Herbs indicative of moist conditions are additionally present in the extra-local vegetation as well, such as *Valeriana officinalis* and *Solanum dulcamara*. In the middle part of the diagram from phase Haz 2 onwards, alder carr develops with an undergrowth of *Urtica dioica*, *Typha* sp. (*T. angustifolia/latifolia*), *Solanum dulcamara*, *Carex acutiformis*, *Lythrum salicaria*, *Scrophularia* sp. and other marsh plants. After 3.60 m -NAP (between phases Haz 3 and VL 1b), alder shows maximal values, *Cornus sanguinea* and S*ambucus nigra* show peaks, and *Persicaria maculosa*, *Phalaris arundinacea* and *Ranunculus repens*-type show high values. Both *Persicaria maculosa* and *Ranunculus repens* may indicate trampling or water activity, resulting in the presence of condensed substrate. Alder vegetation was replaced by marsh vegetation at the time of phase VL 1b. The sediment of the upper part of the diagram (after phase VL 1b) consists of clay poor in macroremains. Reed vegetation may possibly have been present since reed fruits seldom remain preserved. The development of the vegetation represents a reversed succession, controlled by an increase in the water level and increasing instability of the water level.

depth (m -NAP)	sediment
2.63-2.60	clay
2.75-2.64	very clayey peat
3.00-2.76	clayey peat
3.10-3.01	peat
3.16-3.11	clayey peat
3.20-3.17	peat
3.40-3.21	peat: Vlaardingen 1b
3.50-3.41	peaty clay
3.60-3.51	peat
3.75-3.61	peaty clay
3.85-3.76	peat (brown)
3.88-3.86	peat (dark brown): Hazendonk 3 ?
3.97-3.89	sandy peat: Hazendonk 3
4.13-3.98	peaty clay
4.20-4.14	slightly sandy peat: Hazendonk 2b
4.25-4.21	peat rich in clay
4.31-4.26	sandy peat: Hazendonk 2a
4.40-4.32	sandy peaty with clay
4.50-4.41	sandy peat: Hazendonk 1
4.60-4.51	humic sand

Table III.10 The Hazendonk, unit C, southern section of square 41, lithostratigraphy.

The distinction of phases Haz 1, 2a and 2b is difficult since sand, charcoal, and bone remains are more or less continuously present in the lower part of the diagram, which may be related to vertical transport and colluviation processes (*cf.* Amkreutz *et al.* 2008). The precise start and end of these occupation phases cannot be detected in this diagram. The horizon of phase Haz 1 is based on the presence of carbonised remains. Distinction of phase Haz 2a is based on a high value of bone remains and a peak of *Urtica dioica* and *Chenopodium album*. The high values of *Urtica dioica* correspond with the macroremains diagram of square 57 during this phase. Distinction of phase Haz 2b is based on peak values of taxa that occur before and after the recognised occupation.

The Haz 1 horizon is characterised by a relatively large number of carbonised cereal remains, corresponding with the presence of concentrations of cereals during the Hazendonk 1 phase in squares 57 and 39. The variety of carbonised taxa (see diagram) is maximal compared with other cores and sections, which may be related to the nearby presence of a dry surface where human activity could have taken place. During later phases, the distance to the dry surface gradually increased.

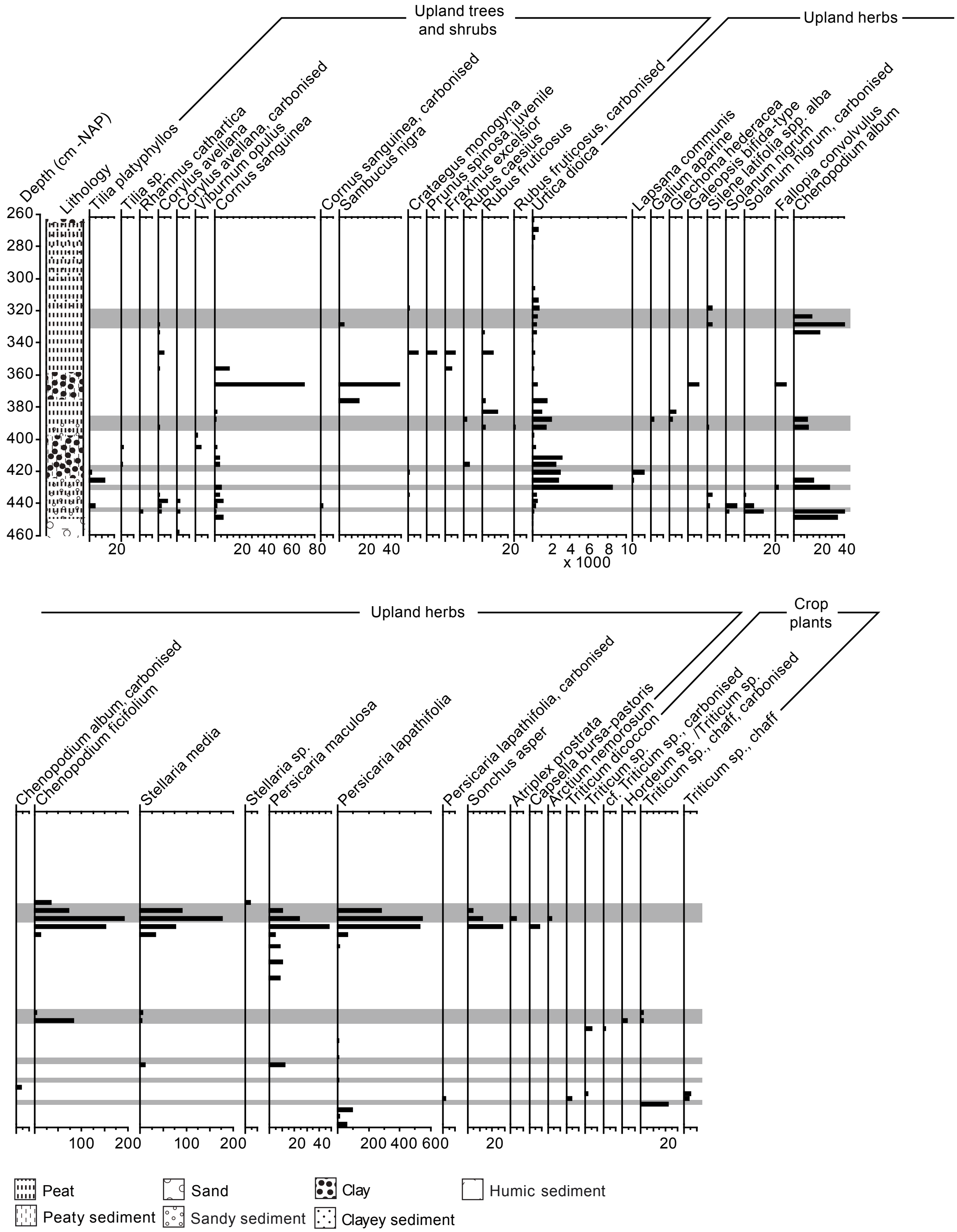


Figure III.19 part 1.

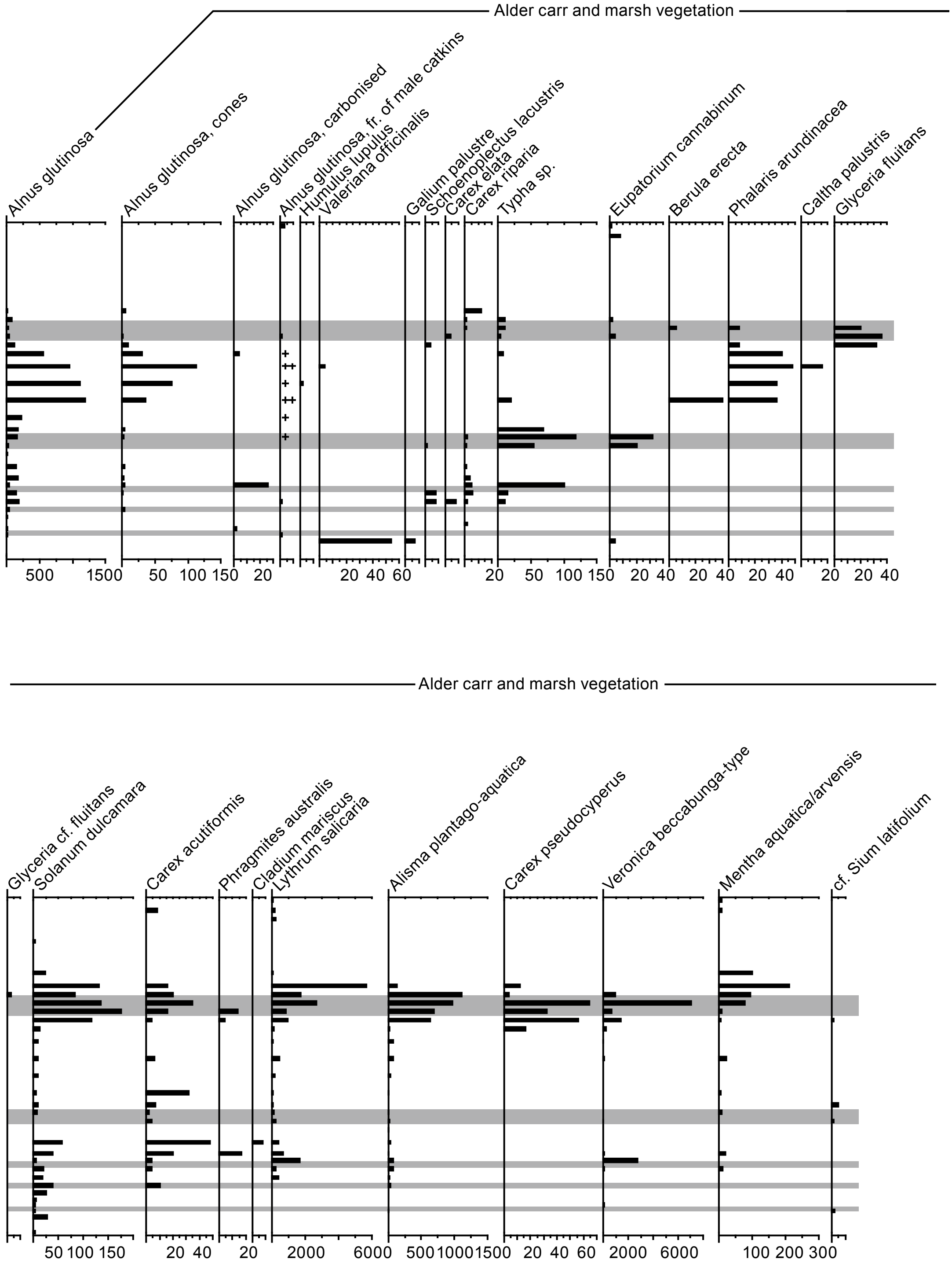
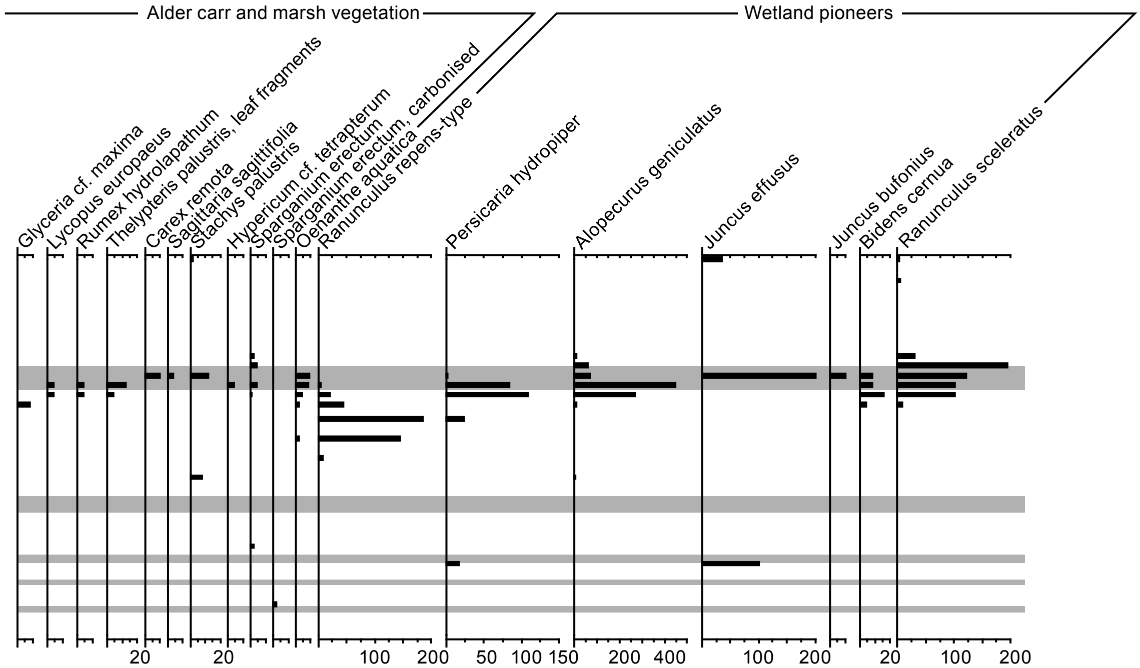


Figure III.19 part 2.



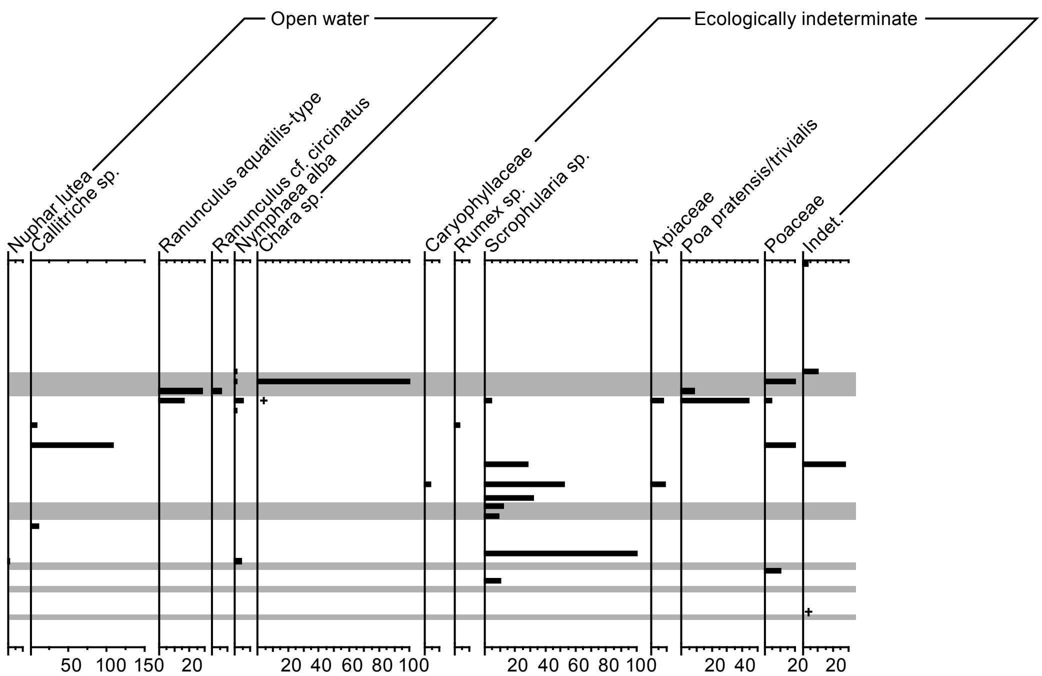
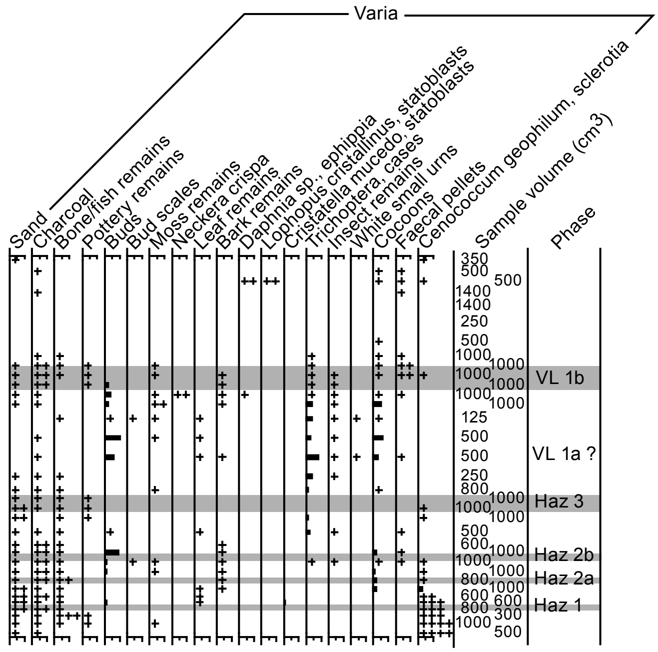


Figure III.19 part 3.



Analyst: W.J. Kuijper

Figure III.19 The Hazendonk, unit C, southern section of square 41, macroremains diagram, + = few (1-10), ++ = some tens (10-49), +++ = many tens (50-99), ++++ = some hundreds (100-499), part 4.

The absence of cereals during phases Haz 2a and 2b in the section of square 41 corresponds with the scarcity of cereals dating to phase Haz 2 at the site. Both phases 2 and 3 are characterised by high values of *Urtica dioica* and *Typha* sp. The diagram indicates that phase Haz 3 may have resulted in a decrease in alder. Phase 3 contains carbonised fruits of *Rubus fruticosus* and cereals. Phase VL 1a is only tentatively distinguished since it was not recognised in this section during excavation. Charcoal is present below and above the VL 1a level, while bone remains are present at an even higher depth. The high values of *Cornus sanguinea* and *Sambucus* sp. suggest that the vegetation became more open. Phase VL 1b is characterised by a thick horizon rich in herbs of dry to moist terrain indicative of enriched and disturbed conditions, which corresponds with the trampling zone of this phase that stretched into the marsh. In contrast to the previous occupation horizon, cereals are absent in this horizon and carbonised macroremains are scarce, indicating that human impact had another character at the sampling point than during previous phases. It could concern a trampling zone of cattle roaming outside the palisade and into the edges of the marsh. The very upper part of the diagram could possibly reflect phase VL 2b, but the sediment contains too little macroremains to investigate this further.

III.3.7 Comparison of proportions of dryland *versus* wetland vegetation

The geological information as well as the pollen and macroremains diagrams indicates that the vegetation at the Hazendonk gradually submerged. The summary diagrams presented above do not show the decreased pollen rain (influx) of dryland taxa and increased pollen rain of wetland taxa since they only represent a summary of the dryland vegetation. Therefore, the proportion of dryland *versus* wetland taxa was investigated by calculation of percentage diagrams based on an adapted pollen sum. Generally influx diagrams are used instead to investigate changes in the influx of taxa, based on the addition of marker pollen and calculations of pollen concentrations. The calculation of concentrations of pollen grain was however not possible in this study since marker pollen grains were not added. The percentage calculations used in the new calculation are based on a pollen sum that includes all taxa that can be assigned to either dryland or wetland vegetation with some certainty. The group of dryland vegetation includes dryland trees, shrubs, herbs and spore plants. The group of wetland vegetation includes wetland trees, shrubs, herbs and spore plants, Poaceae, Cyperaceae and water plants. Taxa with an unknown ecology (Ecol. indet.) were excluded from the pollen sum. The groups of Poaceae and Cyperaceae may also include dryland taxa but it is expected that they mostly represent wetland taxa.

The material from square 57, core 3 and core 2 was all sampled in the same unit of the excavation. Despite small differences in distance to the dune, the results can be compared to each other in order to reconstruct the vegetation (with some overlap). Figure III.20 (next page) shows the summary diagrams of square 57, core 2 and core 3, all based on the new pollen sum that includes both dryland and wetland taxa. The summary diagrams show the percentages of pollen grains of dryland *versus* wetland vegetation while the major occupation periods are indicated. The figures demonstrate that there is a trend that the dryland vegetation pollen rain decreased through time from *c.* 40 to 20% at the expense of wetland vegetation. This is probably explained by the rise of the ground water table, causing the submergence of the dune. The resulting decrease in dryland vegetation is characteristic of the development of vegetation at dunes in the river area during the middle of the Holocene in general.

The diagrams additionally show that the percentage of wetland vegetation increased during the Hazendonk occupation periods, in the first place caused by high values of *Alnus* sp. collected during the excavation (as indicated by the pollen diagrams presented earlier). These increases in *Alnus* sp. are probably caused statistically by a reduced pollen precipitation of dryland pollen grains, since the *Alnus* macroremains show a contrasting decrease during occupation periods. In contrast to the Hazendonk phases, the diagrams show a reduction of *Alnus* sp. during the phase VL 1b. This reduction might indicate that the anthropogenic influence during the Vlaardingen occupation periods had more impact on *Alnus* sp. than before, assuming that the *Alnus* vegetation was part of the local vegetation and became relatively strongly reduced. In square 57 at approximately 4.19 m -NAP, an exceptional high value of *Alnus* pollen disturbs the general pattern. This extreme value cannot be related to anthropogenic influence but instead is an unexplained variation in the percentage of *Alnus* sp. that does not necessarily indicate fluctuations of the natural vegetation (*cf.* Waller *et al.* 2005).

III.3.8 Macroremains from the excavation

Table III.11 (at the end of appendix III) shows the identifications of the macroremains that were collected during the excavation in search of concentrations and by the analysis of sieve residues. Most samples were collected from refuse layers and colluvia while five samples were collected from pits and two from a channel fill. The samples date to the occupation phases Haz 1 to VL 2b except for Vlaardingen 1a, and are discussed for each period separately where possible. The samples of phase VL 2b could be separated stratigraphically in two periods. Table III.12 shows handpicked finds. Figure III.21 shows a selection of macroremains. The analysis of crop plants and potential weeds is discussed separately below.

phase	Haz 1	Haz 2	Haz 3	VL 1b	VL 2b	unknown
number of samples	15	8	16	6	3	7
taxon						
buds	-	-	-	-	41	-
Corylus avellana	21, 6 c	21	32	7	1	15
Crataegus monogyna	1 c	-	-	-	-	-
Malus sylvestris	2 c	1 c	-	-	-	-

c = carbonised - = not present

x, yc = x macroremains including y carbonised macroremains

Table III.12 The Hazendonk, various phases, handpicked macroremains.

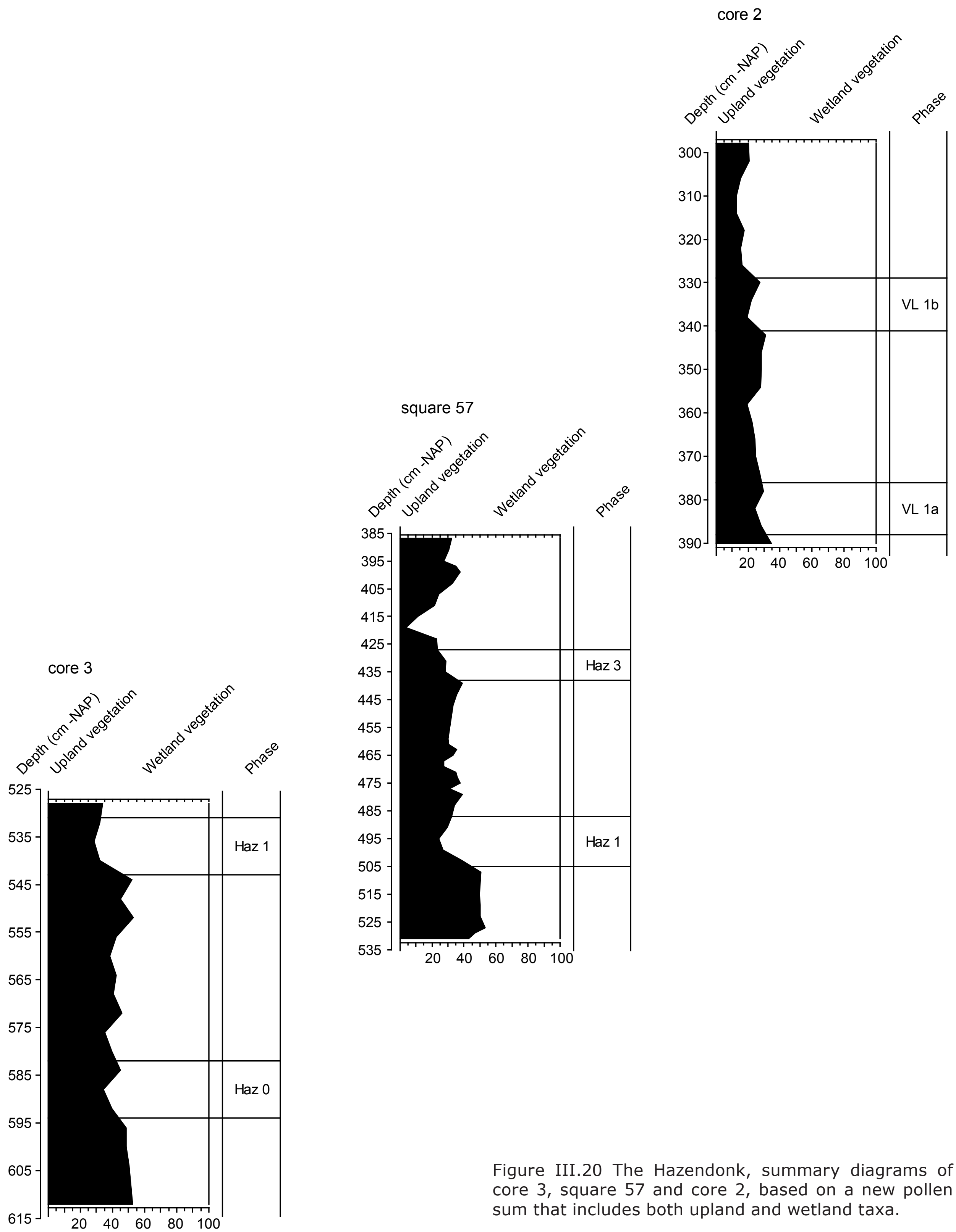


Figure III.20 The Hazendonk, summary diagrams of core 3, square 57 and core 2, based on a new pollen sum that includes both upland and wetland taxa.

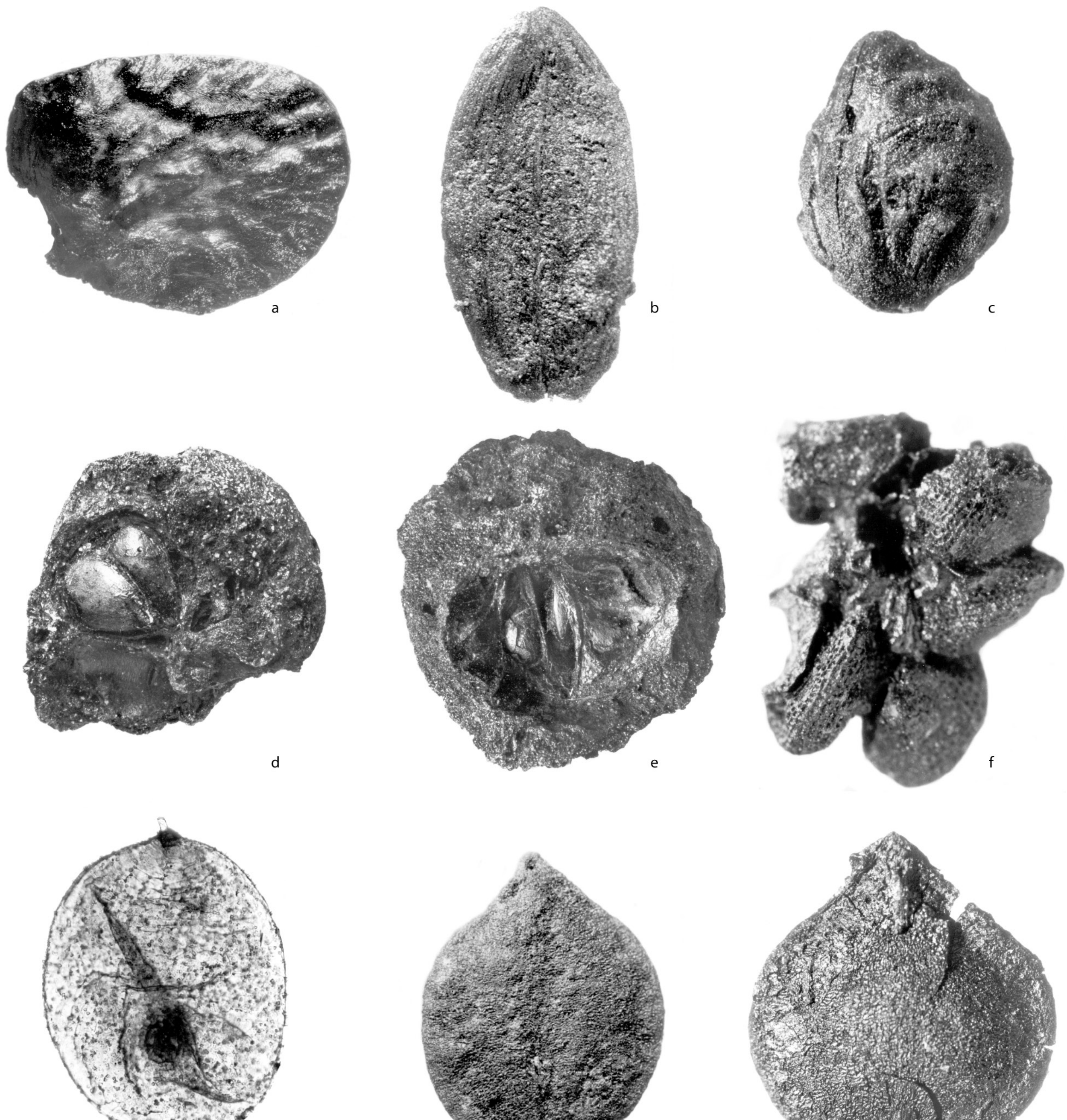


Figure III.21 The Hazendonk, non-cultivated macroremains. a) *Acer campestre*, waterlogged, M41 (VL 2b), 7.8 x 5.8 x 1.3 mm; b) *Fraxinus excelsior*, waterlogged, section 41 (361-351 cm -NAP), 10.5 x 5.5 x 1.0 mm; c) *Prunus padus*, waterlogged, M41 (VL 2b), 7.0 x 5.6 x 5.2 mm; d) *Malus sylvestris*, carbonised, M74 (Haz 3), 1.75 x 1.8 mm; e) *Malus sylvestris*, carbonised, M74 (Haz 3), 1.6 x 1.9 mm; f) *Solanum nigrum*, berry, carbonised, M163 (Haz 1); g) *Veronica beccabunga*-type, waterlogged, section 41 (VL 1b), 0.6 x 0.4 x 0.2 mm; h) *Viburnum opulus*, waterlogged, section 41 (410-400 cm -NAP), 7.0 x 6.0 x 1.3 mm; i) *Viburnum opulus* (with scale), carbonised, M74 (Haz 3), 6.3 x 6.1 x 2.3 mm, photographs: W. Meuzelaar and J. Pauptit.

The samples of phase Haz 1 were all collected in two squares in unit C. Most of the plant remains from the Hazendonk 1 horizon are carbonised, and it is therefore unclear whether they reflect the natural vegetation. The assemblage representing woodland of dry terrain (group 1) is nevertheless similar to later phases, and resembles the material from the cores and section. The taxa of woodland of dry terrain can therefore probably be interpreted as the natural vegetation. The importance of water- and marsh plants (group 4, 5, and 6) was still restricted in this phase.

Phase Haz 2 is represented by very few samples (N = 1 to 4) since refuse of this phase was scarce. The finds include carbonised and waterlogged macroremains. The vegetation during phase Haz 2 was rich in shrubs, pointing to open vegetation. *Quercus* remains were not found but this is probably due to the limited number of samples. The number of riparian/marsh taxa increased compared with phase Haz 1, wich is probably related to the rising water table.

All samples certainly dating to phase Haz 3, except for one, were collected in square 26 (unit B), which possibly restricts the representativity of the data. The finds consist of carbonised and waterlogged macroremains. Important woodland elements were *Quercus* sp., *Malus sylvestris*, *Corylus avellana*, *Cornus sanguinea*, *Sambucus nigra* and *Rubus fruticosus*. The samples indicate diverse vegetation (woodland elements of dry terrain, alder carr and marsh, but no open water).

The samples of phase VL 1b contained a large quantity of fine charcoal remains, pottery remains, flint remains and fish- and bone remains. The botanical macroremains were found in both a carbonised and waterlogged state. The juvenile cupulae of *Quercus* sp. indicate that this species was still present on the dune. In contrast, remains of *Tilia* sp. were not present in this layer or younger layers. *Alnus* sp. was present, but the number of remains suggests limited importance. Plants of disturbed environments and moist eutrophic soils were well represented during this phase, and this is similar to contemporaneous samples from cores and sections. Important riparian/marsh species were *Carex riparia*, *Carex acutiformis*, *Sparganium erectum*, *Lythrum salicaria* and *Solanum dulcamara*. These taxa indicate terrestrialisation, which was possibly characterised by the presence of floating mats, and eutrophic conditions.

The macroremains assemblage of phase VL 2b indicates a mixture of eutrophic marsh/riparian vegetation and some dryer elements. Interestingly, *Ranunculus cf. fluitans* became present, which is characteristic of running eutrophic water. This corresponds with the fluvial activity during this period as indicated by the geological reconstruction (see introduction). Apparently, the samples of phase VL 2b contained more *Alnus* remains than previous horizons, although an exact comparison is not possible because of the sampling methods. A pit in square 25 (sample M41) seems to have contained a concentration of waterlogged remains from *Quercus* sp., *Acer campestre* and *Alnus glutinosa*.

III.3.8.1 Crop plants

The crop plants found at the Hazendonk are the cereals emmer wheat (*Triticum dicoccon*) and naked barley (*Hordeum vulgare* var. *nudum*). The combination of these two species is comparable with other Dutch wetland sites from the Early and Middle Neolithic. Carbonised grains and chaff remains were present in the refuse layers phases Haz 1, 3 and VL 1b (see table III.13).

phase taxon	Haz 1	Haz 2	Haz 3	VL 1b	VL 2b
Hordeum vulgare var. nudum	+	-	+	+	(+)
Triticum dicoccon	+	(+)	+	+	-

+ = present (+) = present in low numbers in a single sample - = not present

Table III.13 The Hazendonk, various phases, cereal identifications, all carbonised.

One sample of phase Haz 2 contained a few carbonised grains of *T. dicoccon* while a single sample of phase VL 2b contained a few carbonised grains of *H. vulgare* var. *nudum*. The scarcity of the two cereal species in some phases is probably related to limited sampling and the limited presence of refuse dating to these phases. Waterlogged remains of crop plants were present in the section samples from square 41, dating to phases Haz 1 and 3. Cereal pollen was found in phase Haz 1, Haz 3 and VL 1b. The diagram of Voorrips (Louwe Kooijmans 1974) shows a single cereal pollen grain for phase Haz 0, but the absence of further data from this layer restricts interpretation.

The cereal finds of phase Haz 1 consisted of concentrations of emmer wheat and naked barley that were exceptionally well preserved. Some samples consisted mainly of emmer, while other samples represent a mix of both cereals. Emmer wheat was generally dominant (see fig. III.22a). The emmer grains were often underdeveloped and sometimes unripe, and showed a variation in morphology, sometimes resembling *T. monococcum* or *T. aestivum* (see fig. III.22b-d). All the wheat was identified as emmer wheat.[32] The variation in morphology is explained by unequal ripening of the ears and poor development of part of the emmer.[33] The presence of *T. aestivum* is rejected because of the small quantities of grains of this type and because of the results of carbonisation experiments with emmer wheat (Braadbaart 2004, 2008). The presence of *T. monococcum* is rejected because of the small quantities of grains of this type and since the material contains twisted spikelet forks that explain this type of grains in emmer wheat (*cf.* Cappers *et al.* 2004).

The good preservation (see fig. III.22e) allowed investigation of the stage of crop processing. Some of the emmer grains were still hulled in their chaff (see fig. III.22f) and the material contained many emmer chaff remains, including occasional collars (the lowest rachis segments of the ear, fig. III.22g-h) and many spikelet forks and rachis segments (fig. III.22i-j). There are occasional finds of rachis remains that were still attached to each other. The finds of grains hulled in chaff and the presence of the many chaff remains including rachis fragments and collars indicates that the crop product was hardly processed and represents complete ears of emmer wheat. The good preservation indicates that the material must have been carbonised almost *in situ*. It is presumed that trampling, transport or movement of the carbonised material would have led to a minor preservation state.

The grains of naked barley were normally developed (see fig. III.22k-l). Interestingly, the grains of naked barley were found partly hulled in chaff as well (see fig. III.22m). The concentrations furthermore contained large quantities of internodia of naked barley (see fig. III.22n-p). Again, rachis remains were sometimes still attached to each other (fig. III.22q-r), and again collars were present in the samples (see fig. III.22s-t). These finds support the conclusion that the crop product was hardly processed and represents at least the fragments of ears, and possibly complete ears of naked barley.

Three concentration samples contained considerable quantities of rye brome (*Bromus secalinus*-type, see fig. III.22u-w), which was more common in these samples than naked barley. The relatively large numbers of this taxon may suggest that this weed was tolerated or cultivated, as has been suggested for the Rhineland (Bakels 1981; Knörzer *et al.* 1999; see also Zohary and Hopf 2000, 70, see however paragraph 11.2.1). There were no finds of chaff remains of rye brome.

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32 The cereals were initially identified and published as naked barley, emmer and einkorn (Louwe Kooijmans 1976, 259). The identifications of einkorn were later revised as emmer (Bakels 1981, 1986; Bakels and Zeiler 2005).

33 Bakels (1981, 143): "Apparently this particular emmer crop is not normal. In addition to well-developed kernels, there are numerous too slender ones that resemble somehow einkorn. Initially they were even identified as such. Since however many intermediate forms between the two species were found and since the T/B index, for example, shows a single peak, all kernels are considered to be emmer. Furthermore it could be seen from the rachis segments that there were initially two kernels per spikelet base but that sometimes only one had reached full development. The kernels with the morphology of einkorn are therefore probably kernels from underdeveloped spikelets."

Figure III.22 The Hazendonk, phase Haz 1, carbonised cereal remains. a) *Triticum dicoccon*, grains, M164. Please note the flattened ventral sides characteristic for *T. dicoccon*. b) *T. dicoccon*, grain, square 39, 6.3 x 3.5 x 3.1 mm, normal grain; c) *T. dicoccon*, grain, square 39, 4.6 x 3.4 x 2.4 mm, similar to *T. aestivum*; d) *T. dicoccon*, grain, square 39, 5.7 x 2.1 x 3.1 mm, similar to *T. monococcum*; e) *T. dicoccon*, grain, 39.184.

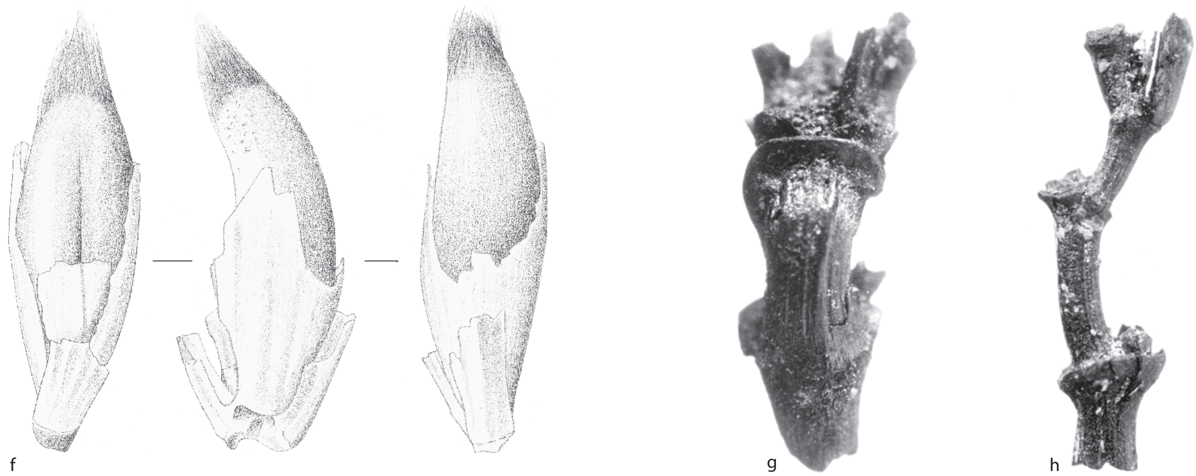
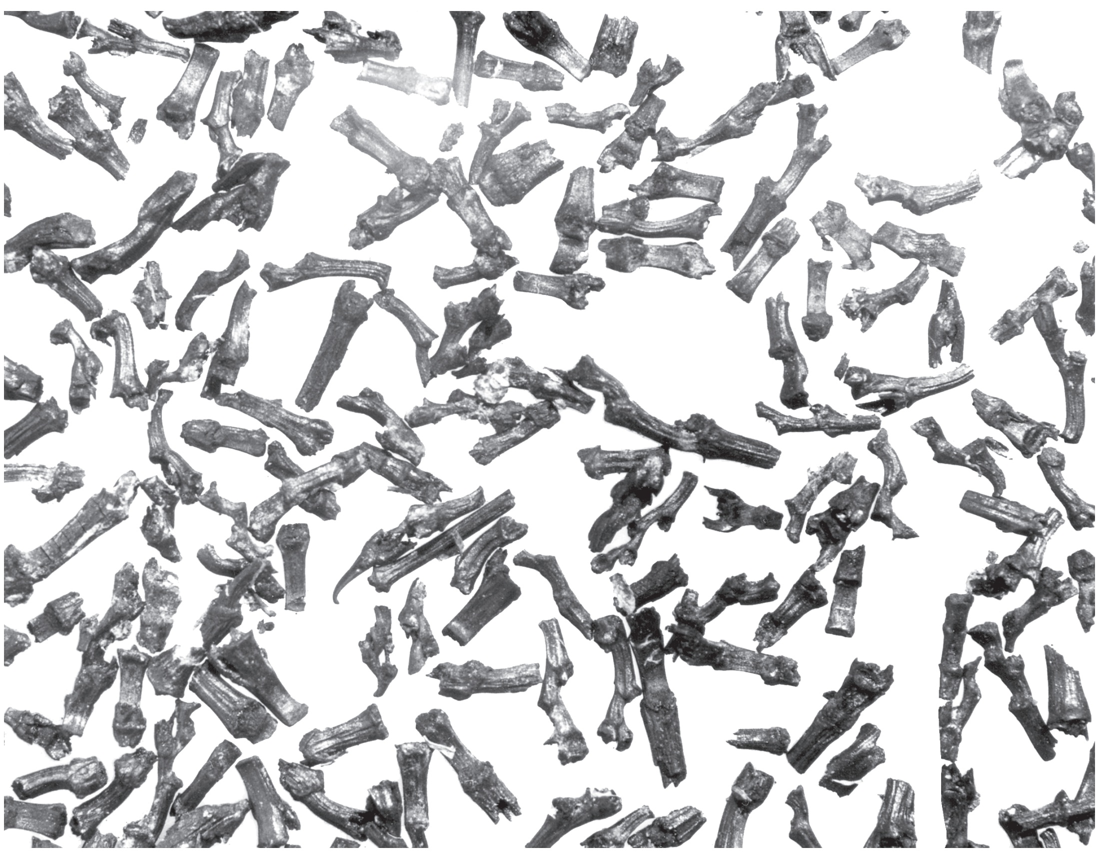


Figure III.22 The Hazendonk, phase Haz 1, carbonised cereal remains. f) *T. dicoccon*, grain in chaff, M164 (Haz 1), 8.3 x 3.3. x 2.2 mm (hairs and chaff included); g) and h) *T. dicoccon*, collars, 39.184 (Haz 1).

Next page: Figure III.22 The Hazendonk, phase Haz 1, carbonised cereal remains. i) *T. dicoccon*, spikelet forks, 39.185 (Haz 1), mean size 1.8 x 0.8 mm (N = 100), please note the variable width of the forks and the presence of twisted forks; j) *T. dicoccon*, rachis fragments, 39.185 (Haz 1), please note the presence of several fragments with culms.

i



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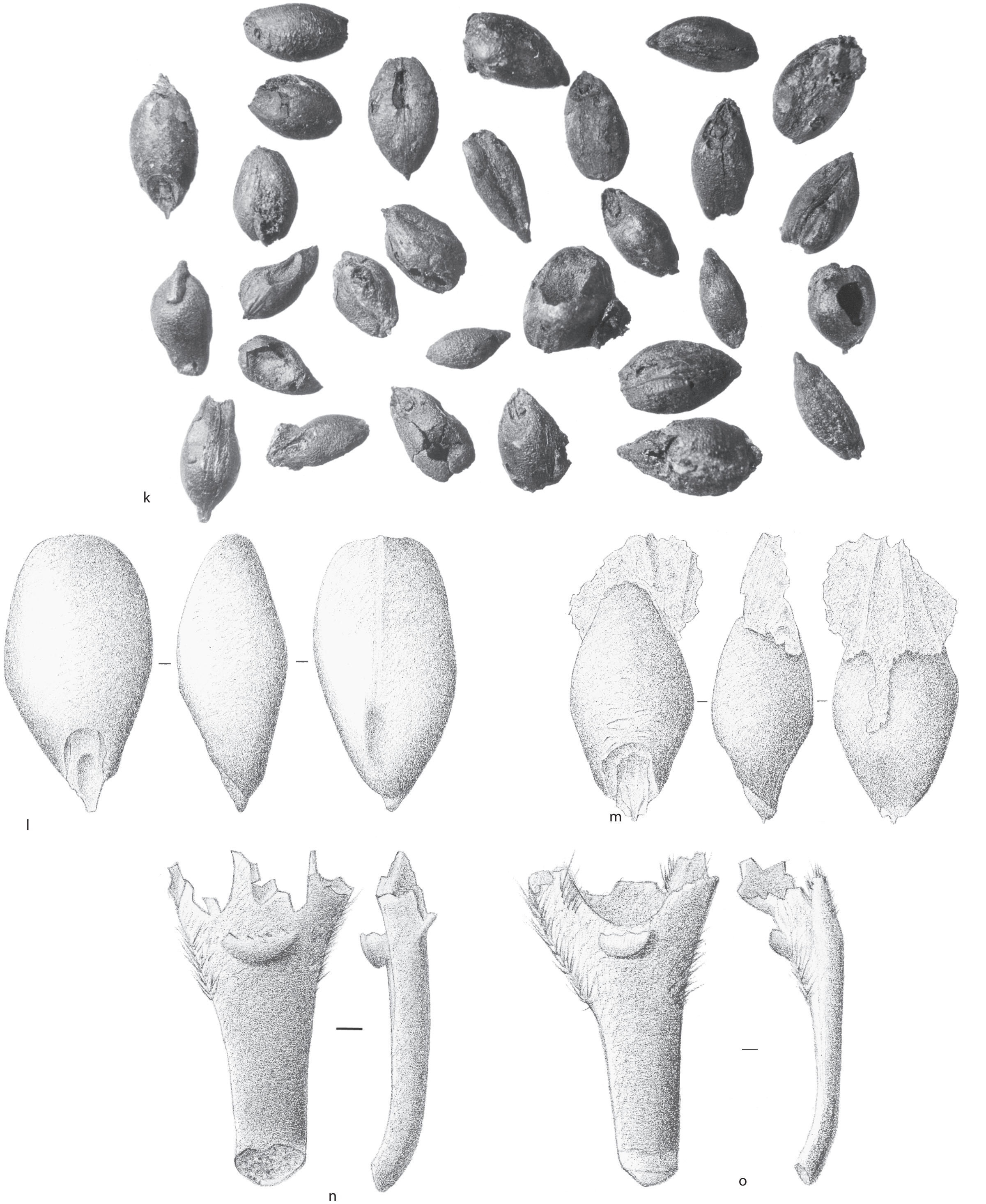

Figure III.22 The Hazendonk, phase Haz 1, carbonised cereal remains. k) *Hordeum vulgare* var. *nudum*, grains, M164, mean size 4.5 x 2.1 x 2.3 mm (N = 100). l) *H. vulgare* var. *nudum*, grain, M164, size 5.9 x 3.4 x 2.7 mm; m) *H. vulgare* var. *nudum*, grain with attached remains of chaff, M164, 7.5 x 3 x 2.5 mm; n) and o) *H. vulgare* var. *nudum*, internodia, M164, 4.3 x 2.5 x 0.6 mm and 3.7 x 1.8 x 1 mm, please note the difference in width.

Figure III.22 The Hazendonk, phase Haz 1, carbonised cereal remains. p) *H. vulgare* var. *nudum*, internodia, M164, magnification 5.8 x; q) and r) *H. vulgare* var. *nudum*, rachis fragments, M164, please note the size differences and the good preservation; s) and t) *H. vulgare* var. *nudum*, collars, M164.

u

v

w

Figure III.22 The Hazendonk, phase Haz 1, carbonised macroremains. u) *Bromus secalinus*-type, grains, M163, mean size 4.9 x 1.8 x 0.9 mm (N = 48), v) and w) *B. secalinus*-type, grains, M163.
All photographs in figures III.22 a to w by W. Meuzelaar; drawings by E. van Driel after W.J. Kuijper.

The identified cereal finds (grains and chaff including collars) provide information on harvesting methods. Harvesting was probably not done by the beating of ears or picking or stripping without tools, since these methods would have resulted in the collection of single and equally matured grains instead of the attested complete ears that were sometimes poorly developed. The stripping of emmer wheat with knives can furthermore tentatively be excluded since this method usually produces a break above or below the basal spikelet, which does not result in the harvesting of collars (pers. comm. Anderson 2007; see also Mery *et al.* 2007, fig. 15). There is however some natural variability in the location of the break points and therefore the harvesting of collars cannot be excluded. The arguments that are used to reject the practice of stripping of emmer wheat tentatively reject the practice of *mesorias*[34] as well, assuming that this harvesting method results in the breaking of the ear at the same fragile point. Stripping and the use of *mesorias* was probably not practised to naked barley either since stripping is effective only for hulled cereals that have a semi-fragile rachis, while it is less effective for free-threshing cereals that have a relatively solid rachis (pers. comm. Anderson 2007; Mery *et al.* 2007, 1110; Zapata Peña 2007). Harvesting methods that could alternatively have been applied are harvesting with sickles and uprooting (Anderson 1992). Harvesting methods are further discussed in chapter 11.

Most of the cereal samples of the Hazendonk 1 horizon were found in concentrations that may possibly represent a single large concentration. The volume of most samples is unfortunately unknown and quantitative comparison of the samples is therefore not possible. The concentrations have alternatively been investigated by comparison of the content, spatial analysis and comparison of the T/B index of emmer wheat grains of three samples ((100 x thickness)/breadth, *cf.* Helbæk 1952). Firstly, the characteristics of the grains suggest that the samples 39.154, 39.184, 39.185, M157, M160 and M164 all contained poorly developed emmer wheat. Sample M164 and M157 are different because of the presence of considerable numbers of *Hordeum* remains, while sample M164 additionally stands out because of its large number of internodia of naked barley. This suggests that the various samples reflect different deposition events. Secondly, spatial analysis (see fig. III.23) shows that all concentration samples from phase Haz 1 were collected in two squares from unit C. The distribution of the samples at approximately equal height on the slope of the dune and the absence of known structures contrastively indicates that the cereals were deposited in a dump zone during a single event.

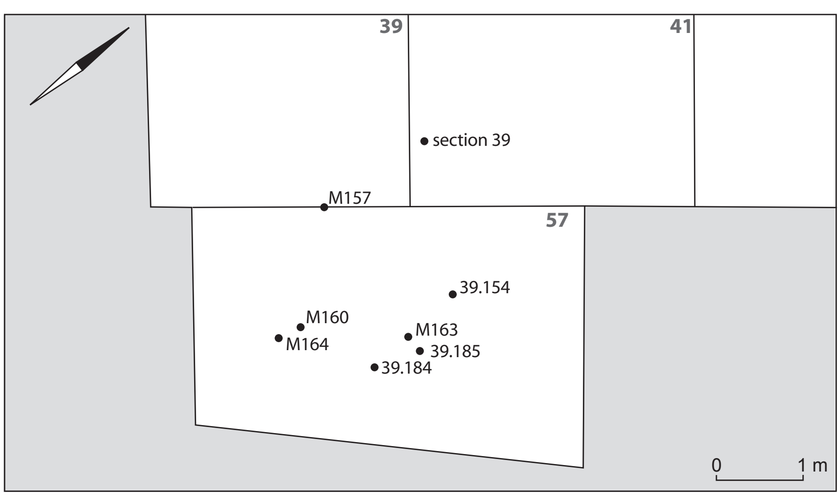

Figure III.23 The Hazendonk, unit C, phase Haz 1, location of the macroremains samples.

34 *Mesorias*: an implement consisting of two wooden sticks between which the ears are hold and then pulled off.

It is however possible to distinct a separate cluster consisting of 39.154, 39.184, 39.185 and M163, while M157, M160 and M164 are located outside this cluster. Thirdly, the results of the measurements of the T/B index of emmer grains of three samples are shown in figure III.24 and table III.14. Figure III.24 shows that the three measured samples (39.154, 39.185 and M157) are likely to be part of the same population, although M157 could also be independent. In conclusion, the emmer wheat of various samples probably originates from a single crop product, and possibly underwent the same processing sequence. The presence and type of remains from naked barley as well as the spatial distribution however shows variation between the samples, indicating the existence of three groups of samples. Nevertheless, the close distance between the samples and the similar height suggests that the various deposition processes were comparable.

The material from phases later than Haz 1 only contains small quantities of cereals that do not represent concentrations. This contrast to the samples from phase Haz 1 restricts the comparison between the cereal finds of phase Haz 1 and other phases. The only cereal species present in the Haz 2 horizon is *Triticum dicoccon*. In contrast to the previous phase, Haz 2 contained only half a grain of *cf. Bromus secalinus*-type, which may belong to phase Haz 1 after all as a result of taphonomy and site formation processes (*cf.* Amkreutz *et al.* 2008). In the material of Haz 3, *Triticum dicoccon* (grains and a small number of chaff remains) and *Hordeum vulgare* var. *nudum* (only grains) were present. The cereal species and the number of cereal remains of VL 1b are similar to Haz 3, containing *Triticum dicoccon* and *Hordeum vulgar*e var. *nudum* (mainly grains but also few chaff remains of both species, only carbonised). Sample M20 (unit E) of phase VL 2b is the youngest sample that contains cereal grains, which were identified as *Hordeum vulgare* var. *nudum* (carbonised).

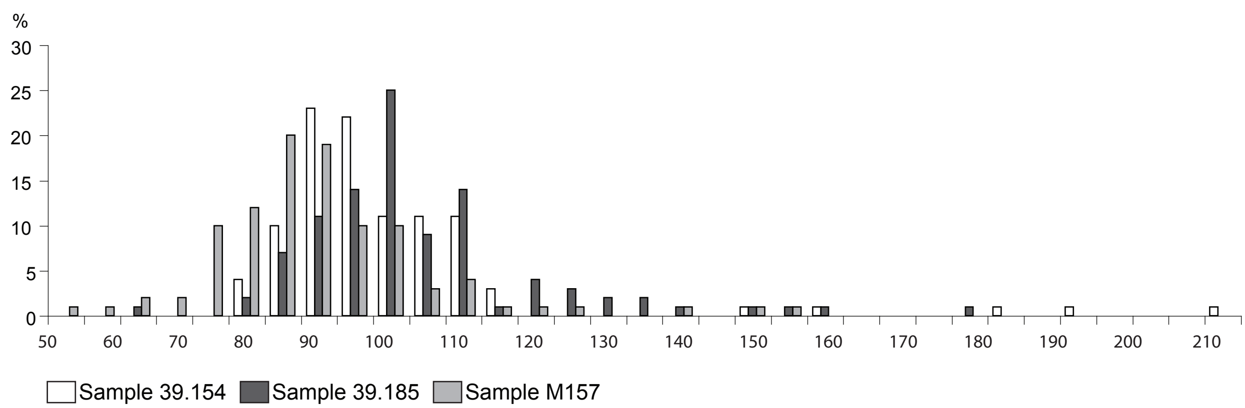

Figure III.24 The Hazendonk, T/B index of *Triticum dicoccon* of 3 samples that contained concentrations of cereals. T/B index: (100 x thickness)/breadth.

sample square TB	39.154 57	39.185 57	M157 39
mean	95.4	99.1	85.1
min	73.0	58.0	51.7
max	211.1	172.7	142.9

Table III.14 The Hazendonk, phase Haz 1, T/B index values of *Triticum dicoccon* of samples 39.154, 39.185 and M157, based on measurements of 100 grains of each sample. T/B index: (100 x thickness)/breadth.

III.3.8.2 Carbonised macroremains of non-cultivated plants

The presence of carbonised remains of edible parts of plants is generally used as an indication of use and/or consumption (see chapter 9). Table III.15 shows the carbonised plant remains from the Hazendonk for each phase (data from cores and sections are included). The table shows that a large variety of taxa has been found in a carbonised state. The carbonised macroremains of *V. opulus* are unique for Dutch prehistoric sites; a parallel has been found at Doel Deurganckdok in 2003 (Bastiaens *et al.* 2007).

The function of the macroremains found in a carbonised state is not immediately clear, and the large variety makes one question whether all taxa where all intentionally used. The unspecific context of the carbonised remains, mostly collected in refuse layers, gives little additional information. A first possible function of the taxa found in a carbonised state is plant food. Taxa known as probable plant food sources found in a carbonised state are *Quercus* sp., *C. avellana*, *C. monogyna*, *P. spinosa*, *M. sylvestris*, *C. sanguinea*, *R. fruticosus*, Rosaceae, *R. ficaria*, *T. natans*, *N. alba*, *B. secalinus*-type and herbs like *U. dioica*, *C. album*, *P. maculosa*, *P. lapathifolia* and *F. convolvulus*. Other taxa found in a carbonised state that are less well-known as food plants may have been consumed as well. Taxa that are known as a food source but were only found in a waterlogged state at the Hazendonk are *e.g. Sambucus nigra*, *Rubus caesius*, *Typha* sp. and *Nuphar lutea* (this selection of potential food plants is based on Bakels 2005; Bakels and Van Beurden 2001; Van Zeist 1970). Frequency analysis of the carbonised remains in all samples shown in table III.11 demonstrates that the carbonised remains of hazelnut were most frequently found (in *c.* 50% of the samples), followed by the cereals. Other taxa found in a carbonised state in more than 10% of the samples are *Cornus sanguinea*, *Prunus spinosa*, *Malus sylvestris*, *Crataegus monogyna*, *Nymphaea alba*, *Galium aparine*, *Bromus secalinus*-type and *Fallopia convolvulus*. The edibility and frequency together suggest consumption for most of these taxa. The finds of carbonised halves of crap apples support that people dried and stored these fruits. Other explanations for the presence of carbonised macroremains are that taxa were used for other functions, such as fuel, thatching and wickerwork. The presence of the many marsh taxa could furthermore be explained by the burning of organic material found in the drift litter zone or the burning of local marsh vegetation during domestic activities. The presence of certain potential arable weeds may be explained by accidents and the discarding of waste during cereal preparation.

The carbonised macroremains indicate occupation between summer and winter for all phases, either continuously or intermittently. Summer indications are strongest for the phases Haz 1 and 3. These results correspond with the zoological results (Zeiler 1997). There is no strong evidence against spring occupation since botanical evidence of spring occupation based on macroremains is usually scarce or absent at comparable sites.

Analysis of the separate phases interestingly shows that the number of carbonised taxa that most probably functioned as food plants during the Late Neolithic Vlaardingen phases is smaller than the number of the Swifterbant culture and Hazendonk group (see fig. III.25[35]), although the difference is probably not significant. The difference cannot be related to the number of samples, the type of samples, the extent and thinkness of the refuse layer or site function. It therefore may possibly represent a reduction of the number of food plants related to a new phase of the neolithisation process and a shift in subsistence in the Late Neolithic. Alternative explanations other than the effect of neolithisation can however not be excluded, such as the reduced variety of the vegetation due to the reduced surface of the dune and other nearby dunes, or a shift in seasonality. The apparent decrease in carbonised food plants in the Late Neolithic therefore deserves further investigation (see also paragraph 9.3.4).

35 The selection of food plants used in the figure includes *Cornus sanguinea*, *Corylus avellana*, *Crataegus monogyna*, *Malus sylvestris*, *Prunus spinosa*, *Quercus* sp., Rosaceae, *Rubus fruticosus*, *Ranunculus ficaria* and *Trapa natans*.

phase taxon	Haz 1	Haz 2	Haz 3	VL 1b	VL 2b
Group 1					
Cornus sanguinea	+	+	+	+	-
Corylus avellana	+	+	+	+	+
Crataegus monogyna	+	+	+	+	-
Malus sylvestris	+	+	+	-	-
Malus sylvestris, parenchyma	-	-	+	-	-
Prunus spinosa	-	-	+	+	-
Quercus sp.	+	-	-	+	-
Quercus, cupulae with content	-	-	-	+	-
Rubus fruticosus	-	-	+	-	-
Tilia platyphyllos	+	-	+	-	-
Tilia sp.	+	-	-	-	-
Viburnum opulus	+	-	+	-	-
Ajuga reptans	-	-	+	-	-
Chaerophyllum temulum	+	-	-	-	-
Galium aparine	-	+	+	+	+
Galium odoratum	-	+	-	-	-
Ranunculus ficaria, tubers	+	+	+	-	-
Urtica dioica	+	-	-	-	-
Group 2					
Brassica rapa	-	-	+	-	-
Bromus secalinus-type	+	cf. +	-	-	-
Capsella bursa-pastoris	+	-	-	-	-
Chenopodium album	+	-	-	+	-
Elytrigia repens	+	-	-	-	-
Fallopia convolvulus	+	+	-	+	-
Persicaria lapathifolia	+	-	-	+	-
Persicaria maculosa	+	-	-	-	-
Solanum nigrum	+	-	-	+	-
Veronica hederifolia	-	-	+	-	-

Tabel III.15 part 1.

phase taxon	Haz 1	Haz 2	Haz 3	VL 1b	VL 2b
Group 3					
Hordeum vulgare var. nudum	+	-	+	+	+
Triticum dicoccon	+	+	+	+	-
Group 4					
Alnus glutinosa	+	+	-	+	-
Alnus glutinosa, cones	+	-	-	-	-
Group 5 and 6					
cf. Berula erecta	+	-	-	-	-
cf. Euphorbia palustris	+	-	-	-	-
Iris pseudacorus	-	-	+	+	-
Lathyrus palustris/Vicia cracca	-	-	+	-	-
Menyanthes trifoliata	-	-	+	-	-
Oenanthe aquatica	+	-	-	-	-
cf. Phragmites australis, stem fragments	+	-	-	-	-
Rumex cf. crispus	+	-	-	-	-
Schoenoplectus lacustris	+	-	-	-	-
Sparganium erectum	+	+	-	-	-
Group 7					
Nymphaea alba	+	-	-	+	+
Trapa natans	-	-	+	-	-
Group 8					
Mentha aquatica/arvensis	-	-	-	+	-
Phleum sp./Poa annua	+	-	-	-	-
Rosaceae	+	-	-	-	-
Rumex sp.	+	-	-	-	-
Scrophularia sp./Verbascum sp.	-	-	-	+	-
Veronica austriaca/chamaedrys	+	-	-	-	-

+ = present - = not present

Table III.15 The Hazendonk, taxa found in a carbonised state for each phase, group = ecological group (see table III.2), part 2.

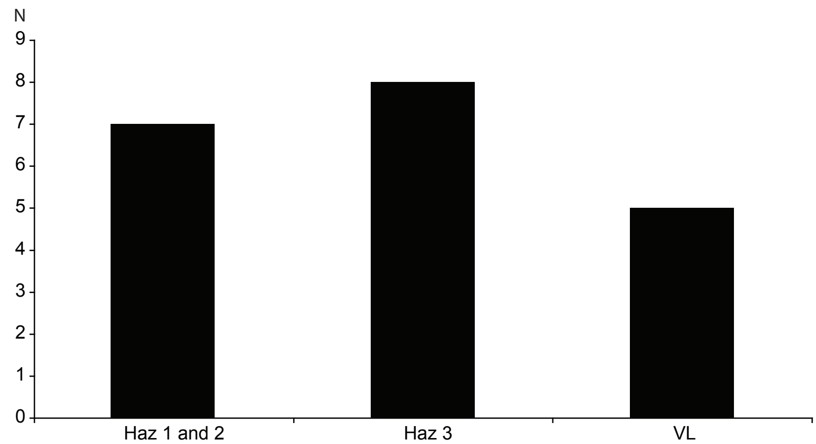

Figure III.25 The Hazendonk, number of carbonised non-cultivated food plants for phases of the Swifterbant culture (Haz 1 and 2), the Hazendonk group (Haz 3) and the Late Neolithic Vlaardingen group (VL).

III.3.8.3 Arable weeds

The analysis of weeds can result in reconstruction of crop cultivation practices. Such an approach starts with the distinction of arable weeds: which taxa grew in the arable plots? Discussion of the weeds from the Hazendonk is hampered by two problems: it is not certain whether arable farming was practised at the site (see below), and it is unclear which taxa represent true field weeds instead of local disturbance indicators. Natural and anthropogenic processes at the Hazendonk other than arable farming probably resulted in conditions that were similar to ecological conditions of fields, which may explain the presence of disturbance indicators (see also chapter 10).

In the first place, a selection of potential arable weeds was made, including herb taxa of all habitats where one could locate an arable field: woodland and woodland edges of dry terrain, grassland, and open and/or disturbed dry to slightly humid terrain (see chapter 10). The selection is based on all data from pollen and macroremains that are available from the Hazendonk (including taxa from the study of Van der Wiel 1982) but only includes taxa that are related to occupation phases. The upper part of table III.16 shows this group of potential arable weeds found at the Hazendonk. The resulting selection comprises a large group of taxa that were probably not all true field weeds, since such a relationship with crop cultivation is not strongly supported by context.

Secondly, it has been investigated which potential arable weeds were present in a carbonised state in samples that contain concentrations of carbonised cereals. It is expected that these samples represent crop products mixed with weeds that were not removed from the crop product yet (*cf.* Hillman 1981), and that the macroremains found in the same preservation state as the cereals underwent the same preparation and deposition processes. Concentrations of cereal remains were only found in the material of phase Haz 1. Densities could not be calculated since the volume of most samples is unknown. All samples from phase Haz 1 were included in this analysis. Table III.16 (conc.) shows the 31 taxa found in a carbonised state in samples that contain concentrations of carbonised cereals. There are two reasons that indicate these taxa are probably not truly associated with the cultivation of cereals. In the first place, cereals are usually cultivated in a relatively high, dry and open environment, which contrasts with the varied and wet conditions that are indicated by this assemblage of carbonised macroremains.

category and context taxon	C	W	P	conc.	fr.
Ajuga reptans	+	+	-	-	-
Alopecurus myosuroides/pratensis	-	+	-	-	-
Anthriscus sylvestris	-	+	-	-	-
Anthoxanthum odoratum	-	+	-	-	-
Artemisia sp.	-	-	+	-	-
Brassica rapa	+	-	-	-	-
Bromus secalinus-type	+	-	-	+	+
Capsella bursa-pastoris	+	-	-	+	-
Carex remota	-	+	-	-	-
Chaerophyllum temulum	+	-	-	+	-
Chenopodiaceae	-	-	+	-	-
Chenopodium album	+	+	-	+	+
Chenopodium ficifolium	-	+	-	-	-
Elytrigia repens	+	-	-	+	-
Fallopia convolvulus	+	+	-	+	+
Galium aparine	+	+	-	-	-
Galium odoratum	+	-	-	-	-
Galium spurium	-	+	-	-	-
Glechoma hederacea	-	+	-	-	-
Lamium album	-	+	-	-	-
Lapsana communis	-	+	-	-	-
Persicaria maculosa	+	+	-	+	+
Persicaria lapathifolia	+	+	-	-	-
Plantago lanceolata	-	-	+	-	-
Plantago major	-	-	+	-	-
Phleum sp./Poa annua	+	-	-	+	-
Polygonum persicaria-type	-	-	+	-	-
Polygonum aviculare-type	-	-	+	-	-
Ranunculus ficaria, tubers	+	-	-	+	-
Ranunculus arvensis	-	-	+	-	-
Rumex acetosella	-	+	-	-	-
Rumex acetosa-type	-	-	+	-	-
Silene latifolia ssp. alba	-	+	-	-	-

Table III.16 part 1.

category and context taxon	C	W	P	conc.	fr.
Solanum nigrum	+	+	-	+	+
Stellaria media	-	+	-	-	-
Urtica dioica	+	+	-	+	-
Valeriana officinalis	-	+	-	-	-
Verbena sp.	-	-	+	-	-
Veronica austriaca/chamaedrys	+	-	-	+	-
Veronica hederifolia	+	-	-	-	-
Veronica sp.	-	+	+	-	-
Alnus glutinosa				+	+
Alnus glutinosa, cones				+	+
cf. Berula erecta				+	-
Cornus sanguinea				+	+
Corylus avellana				+	+
Crataegus monogyna				+	+
cf. Euphorbia palustris				+	-
Malus sylvestris				+	+
Nymphaea alba				+	+
Oenanthe aquatica				+	-
cf. Phragmites australis,					
stem fragments				+	-
Quercus sp.				+	-
Rosaceae				+	-
Rumex cf. crispus				+	-
Rumex sp.				+	-
Schoenoplectus lacustris				+	-
Sparganium erectum				+	+
Tilia sp.				+	-
Viburnum opulus				+	-

C = carbonised macroremains
W = waterlogged macroremains
P = pollen

conc. = taxa found in a carbonised state in the concentrations of phase Haz 1
fr. = taxa found in the concentrations of phase Haz 1 relatively frequent
+ = present
- = not present

Table III.16 The Hazendonk, potential arable weeds, part 2.

In the second place, comparison of the samples with concentrations of carbonised cereals shows a trend that samples higher on the slope of the dune contain more carbonised macroremains of dryland species and less carbonised macroremains of water plants then samples lower on the slope (M160 and M164, square 57 in contrast to other samples in square 57). It therefore seems that the samples of phase Haz 1 are of a mixed origin, resulting from different deposition processes, and do not represent a pure crop product. The removal of taxa from table III.16 that were only found in a single sample of phase Haz 1, or that are represented by a single carbonised seed or fruit only, results in a list of 13 taxa (see table III.16, fr.). Further removal of potential food plants and wetland taxa results in a list of five taxa that most probably represent arable weeds during phase Haz 1: *Bromus secalinus*-type, *Chenopodium album*, *Fallopia convolvulus*, *Persicaria maculosa* and *Solanum nigrum*. *C. album* and *F. convolvulus* are represented by a few fruits only, which may indicate that they did not function as arable weeds (but see also chapter 10) or that they were already removed from the crop product.

Concentrations of carbonised cereals were absent in the material of phases later than phase Haz 1 and a comparable weed analysis was not possible. For the samples of these phases it has instead been investigated which taxa are present in a carbonised state in samples that contain carbonised cereal remains. Only the material from phases Haz 3 and VL 1b consist of sufficient samples that allow relevant analysis. Taxa that are frequently found in samples from Haz 3 with carbonised cereal remains are *M. sylvestris*, *C. avellana* and *C. sanguinea*, which probably represent food plants instead of arable weeds. Taxa that are frequently found in relevant samples from VL 1b are *C. avellana*, *P. spinosa*, *G. aparine* and *N. alba*, which probably do not represent arable weeds either. It must thus be concluded that this approach is not useful for the reconstruction of arable weeds at the Hazendonk. The result furthermore suggests that *G. aparine* may represent a food plant.

The analysis of potential arable weeds from the material from phase Haz 1 indicates that the most likely candidates are *B. secalinus*-type, *P. maculosa* and *S. nigrum*. The latter species was distinguished as a probable arable weed at Brandwijk-Kerkhof as well (see appendix II). The plants of all three taxa have a relatively large length. The absence of shorter taxa suggests that the cereals were harvested by collecting only the upper halve of the plant, which makes uprooting unlikely. *B. secalinus*-type is known as a winter crop weed while *P. maculosa* and *S. nigrum* are known as summer crop weeds, which does not give a uniform conclusion on the season of crop cultivation. The last two species were already present in the area before the introduction of crop plants and were probably part of the local vegetation at the Hazendonk (Bakels and Van Beurden 2001; Bakels *et al.* 2001). *B. secalinus*-type is contrastively not found at other, earlier and later sites in the central river area and is almost only found in the material of phase Haz 1. The ecology of *B. secalinus*-type is not very specific and allows crop growth at the Hazendonk as well as in other regions, although it is characteristic of soils poor in lime (calcium). The presence of *B. secalinus*-type is therefore a minor indication of the import of cereals or sowing seed from outside the river area. The taxon is known as an arable weed from the LBK and Rössen culture (Bakels and Rouselle 1985; Knörzer *et al.* 1999). It is not known from Michelsberg sites but this may be related to the small data set available on the Michelsberg culture (Bakels 2007).

III.3.9 Wood analysis

Table III.17 shows the unworked wood remains of the Hazendonk (N = 225). Most wood dates to phase VL 1b, followed by phases Haz 1 and Haz 3, while only a small quantity of data is available for phases Haz 2 and VL 1a. The variation of the numbers of finds per phase is related to the quantity of refuse of the phases. The preservation of the wood was good.

In the assemblage of unworked wood of phase Haz 1, *Alnus* sp. dominates, followed by *Fraxinus* sp. and *Quercus* sp. A sample collected in square 57 contained wood from *Alnus* sp., *Fraxinus* sp., *Quercus* sp., *Cornus* sp., *Acer* sp., *Viburnum* sp. and Pomoideae (N = 32). The composition of this sample corresponds with the variety of the vegetation at that location and time as indicated by the pollen and macroremains. Other unworked wood remains from phase Haz 1 are identified as *Quercus* sp.

	N						%					
phase taxon	Haz 1	Haz 2	Haz 3	VL 1a	VL 1b	total	Haz 1	Haz 2	Haz 3	VL 1a	VL 1b	total
Acer sp.	3	-	-	-	1	4	7	-	-	-	1	2
Alnus sp.	13	-	27	3	50	93	29	-	51	x	42	41
Cornus sp.	3	-	3	-	6	12	7	-	6	-	5	5
Corylus sp.	-	-	5	-	2	7	-	-	9	-	2	3
Fraxinus sp.	5	1	6	-	17	29	11	x	11	-	14	13
Pomoideae	1	-	2	-	4	7	2	-	4	-	3	3
Prunus sp.	-	-	-	-	2	2	-	-	-	-	2	1
Quercus sp.	6	-	-	-	4	10	13	-	-	-	3	4
Salix sp.	-	-	-	-	6	6	-	-	-	-	5	3
Ulmus sp.	-	1	10	4	6	21	-	x	19	x	5	9
Viburnum sp.	3	-	-	-	-	3	7	-	-	-	-	1
Indet.	11	-	-	-	20	31	24	-	-	-	17	14
total	45	2	53	7	118	225						

- = not present

x = no meaningful percentages

Table III.17 The Hazendonk, unworked wood for each phase (Van den Berg unpublished data).

In phase Haz 3, *Alnus* sp. and *Ulmus* sp. dominate, followed by *Fraxinus* sp. and *Corylus* sp. A sample collected in square 26 contained wood of *Alnus* sp., *Ulmus* sp., *Corylus* sp., *Cornus* sp., *Fraxinus* sp. and Pomoideae. The other identified unworked remains from phase Haz 3 were identified as *Fraxinus* sp. The unworked wood of phase VL 1a consisted of wood of *Alnus* sp. and *Ulmus* sp.

In the assemblage of phase VL 1b, *Alnus* sp. dominates, followed by *Fraxinus* sp. The assemblage of this phase shows maximal diversity, probably related to the large number of identifications. Identified trunks are from *Fraxinus* sp. (N = 2, mean diameter = 84 mm), *Alnus* sp. (N = 7, mean diameter = 150 mm) and *Quercus* sp. (N = 2, mean diameter = 70 mm). The branches and twigs show a larger variety: *Alnus* sp., *Corylus* sp., Pomoideae, *Fraxinus* sp., *Ulmus* sp., *Prunus* sp. and *Salix* sp. For 65 identifications it is not known which part of tree or shrub they represent. Most of these were part of two samples from square 8, unit C, and will probably represent small wood fragments.

It was initially expected that the unworked wood would represent the natural vegetation of the site. However, the assemblage does not show a clear development from dry woodland into alder carr vegetation since *Alnus* sp. dominates the assemblage of several phases. Only *Fraxinus* sp. shows a minor increase through time. The poor correspondence of the changes in the wood assemblage with the development of the natural vegetation could be explained by the small sample size, selective preservation and/or by the interpretation of the waste of wood working as unworked wood.

The assemblage of worked wood (see table III.18) includes worked and possibly worked wood with an unknown function (N = 18). This group was distinguished in 2007 based on information in the description about the presence of traces of splitting of the wood (Dutch: *splijthout*). It is thus assumed that the splitting is the result of human action (*cf.* Louwe Kooijmans, Hänninen and Vermeeren 2001, 437) although it could also be the result of natural processes. The importance of *Quercus* sp. in the worked wood compared with the unworked wood possibly indicates the selection of this taxon.

Table III.19 shows the wood identifications of artefacts (N = 90). The assemblage of artefacts mainly consists of artefacts from phases VL 1a and 1b, and a small number of artefacts from phases Haz 1 and VL 2b. The material from phase Haz 1 consists of a hammer of Pomoideae (head) and *Fraxinus* sp. (haft). The artefact of phase VL 1a is a small trackway made of unworked branches of *Ulmus* sp. and *Alnus* sp. (4535±35 BP: 3370-3100 BC; Lanting and Van der Plicht 2000). The orientation of the trackway was directed straight away from the dune. The length is unknown since the path was not excavated completely. The unworked wood of phase VL 1a was found in the same unit as the trackway and it concerned the same species. Therefore, it can be questioned whether the unworked wood of this phase represents the natural vegetation or waste deposited during preparation of the trackway. An important group of artefacts dating to phase VL 1b is a series of pointed posts of *Alnus* sp. (N = 27), forming a palisade (see fig. 14.2 in Out 2008c). The mean diameter of 21 of the posts was 129 mm (range 75-170 mm). The distance between the posts was *c.* 25 cm (Louwe Kooijmans 1977b). The description of most posts indicates that it concerns split wood, indicating that they were split or possibly that the wood was ripped off. Twenty-one posts were cut (worked) and three were certainly not. The working traces were sometimes very simple, sometimes twofold or fourfold, and sometimes all around a post. Posts other than those from the palisade were made of *Alnus* sp., *Ulmus* sp. and *Corylus* sp. Other artefacts from phase VL 1b are a dugout canoe of *Quercus* sp. (4400±60 BP: 3340-2900 BC), a paddle of *Fraxinus* sp., a fragment of bow of *Taxus* sp. (length of fragment 44 cm), spears and arrow shafts of *Viburnum* sp., *Corylus* sp. and *Salix* sp., a haft of *Euonymus* sp., a fragment of a haft of Pomoideae and a small tray of *Ulmus* sp. (the bottom of a container). Several artefacts are drawn in Louwe Kooijmans (1985). The spatial distribution of the unworked wood and the artefacts from phase VL 1b was approximately similar. The material from phase VL 2b consists of a pointed post of *Alnus* sp., found in a concentration of bone. The choice for specific taxa for the paddle, the canoe and the bow support the selective use of wood based on the quality of the wood and the function of the artefacts, since we know of similar artefacts made of the same taxa from other excavations (see chapter 8).

phase taxon	Haz 1	Haz 2	Haz 3	VL 1a	VL 1b
Acer sp.	-	-	-	1 ?	-
Alnus sp.	-	1	1	-	2
Corylus sp.	1 ?	-	-	-	-
Fraxinus sp.	-	-	1	-	3 + 1?
Quercus sp.	4 ?	-	-	-	2
Ulmus sp.	-	-	-	-	1
total	5 ?	1	2	1 ?	8 + 1?

- = not present ? = possibly worked

Table III.18 The Hazendonk, worked and possibly worked wood remains for each phase (Van den Berg unpublished data).

The wood of *Taxus* sp. and *Euonymus* sp. is only present in the manipulated wood remains, which may indicate the import of wood. The pollen identifications however indicate that the wood of both species may also be of local origin (diagram square 57, Van der Wiel 1982 and the recalculated diagram of Voorrips, see appendix IV). Scarce identifications of wood and charcoal of *Euonymus* sp. are also available from other sites in the river area (see appendices I and II).

Wood fragments that were partly carbonised were identified as *Fraxinus* sp. (Haz 3: N = 1, VL 1b: N = 1) and *Alnus* sp. (VL 1b: N = 3). These identifications are included in the table of unworked wood remains. A single fragment of bark was identified as *Betula* sp. (find number 33.553, phase VL 1b). It may concern a piece collected elsewhere by people for the production of tar or rope since *Betula* sp. was probably very scarce at the dune.

phase	taxon	interpretation	N
VL 2b	Alnus sp.	pointed post	1
VL 1b	Alnus sp.	pointed posts	31
		small plank	1
	Corylus sp.	pointed post	1
		spear	1
		arrows	2**
	Euonymus sp.	haft	1
	Fraxinus sp.	paddle	1
	Pomoideae	head of a haft	1
	Quercus sp.	dugout canoe	1
		planks	3*
	Salix sp.	spears	2
		arrow	1
	Taxus sp.	bow	1
	Ulmus sp.	small tray	1
		pointed posts	2
	Viburnum sp.	spears	2**
	Indet.	plank	1
		post	1
VL 1a	Alnus sp.	trackway of unworked branches	9
	Ulmus sp.	trackway of unworked branches	24
Haz 1	Fraxinus sp.	haft	1
	Pomoideae	head of a hammer	1

* = possibly fragments of the canoe ** = possibly two fragments of the same artefact

Table III.19 The Hazendonk, identifications and interpretation of wooden artefacts for each phase (Van den Berg unpublished data).

Wood identifications from a single core by Van der Wiel (1982) concern *Alnus* sp., *Fraxinus excelsior* and (*Populus cf. nigra*/) *Salix* sp. *Fraxinus excelsior* was found frequently around phase Haz 2 until phase Haz 3, while *Alnus* sp. was found frequently from phase Haz 3 onwards. These results correspond with the data of pollen and macroremains presented here, although alder was already present in the local vegetation during phase Haz 1.

III.3.10 Moss analysis

Table III.20 shows identifications of mosses from the Hazendonk, representing *Neckera crispa*, *Homalia trichomanoides*, *Isothecium myosuroides* and *Thamnobryum alopecurum*. All moss species have their habitat on roots and/or trunks of trees in dark, humid to moist deciduous woodland, on eutrophic or calcareous soil, on single trees in river forelands that get overflowed in winter, on coppices and sometimes on dead wood. The mosses favour various deciduous tree species that are present at the Hazendonk (Touw and Rubers 1989). *N. crispa* is commonly found at Dutch wetland sites (Kuijper 2000), while *Isothecium myosuroides* was also found at Bergschenhoek and Swifterbant (see appendix V).

phase	Haz 1	Haz 3	VL 1b	VL 1b	VL 2b
sample taxon	core 3: 5.28 m -NAP	section square 57: 4.43 m -NAP	section square 41: 3.41 to 3.26 m -NAP	section square 41: 3.31 to 3.26 m -NAP	M22
Homalia trichomanoides	-	-	-	-	+
Isothecium myosuroides	-	-	-	-	+
Neckera crispa	+	+	+	-	+
Thamnobryum alopecurum	-	+	-	+	-

\+ = present - = not present

Table III.20 The Hazendonk, mosses (Touw, unpublished data).

III.4 Discussion

III.4.1 Reconstruction of the natural vegetation

The extensive sampling program at the Hazendonk has resulted in a large species list, underlining the variety of the vegetation. The natural vegetation on the high-located dry parts of the Hazendonk consisted of meso- to eutrophic deciduous woodland vegetation of dry terrain, dominated by patches of *Tilia* sp. and *Quercus* sp. On the slightly lower parts of the slope *Tilia* sp. was of less importance while *Quercus* sp., *Fraxinus* sp., *Acer campestre*, possibly *Ilex aquifolium*, *Ulmus* sp. and *Alnus* sp. may have been growing close to each other or even mixed. *Quercus* sp. usually grows on dryer soil than *Alnus* sp., but the taxa can co-occur when organic sediment is present on top of a mineral subsurface (see also paragraph II.4.2). The vegetation on the slopes was very rich in shrubs, such as *Corylus avellana*, *Cornus sanguinea*, *Ligustrum vulgare*, *Viburnum opulus*, *Rhamnus cathartica*, *Sambucus nigra* and others. The vegetation was possibly comparable with hardwood alluvial woodland, characterised by a flooding frequency varying between less than ten days a year to once in twenty years (Wolf *et al.* 2001, 129). On the lowest parts of the slopes of the dune that were directly influenced by the groundwater, the natural vegetation consisted of alder carr that was rich in shrub vegetation as well.

Most taxa of trees and shrubs found in the macroremains assemblage were probably present in the vegetation of the dune. This is, however, less clear for *Euonymus europaeus*, *Malus sylvestris*, *Prunus padus*, *Prunus spinosa* and *Taxus baccata*. Finds of *Euonymus europaeus* and *Taxus baccata* include pollen and worked wood (discussed in the paragraph on wood above). *Malus sylvestris* was probably present, since there are finds of waterlogged seeds and fruits from various phases. Collection at other locations than at the dune can however not be excluded. The local presence of *Prunus padus* remains unclear since macroremains of this species were very scarce, found in phase VL 2b only. Macroremains of *Prunus spinosa* were more common, but were only found during some phases as well (phase Haz 3 and VL 1b). Two identifications of unworked wood tentatively supports presence of *Prunus* sp. in the local vegetation during phase VL 1b, but this identification is not up to species level and could represent *P. padus* and/or *P. spinosa*.

The natural vegetation in the surrounding wetlands consisted of marsh vegetation and vegetation of open water. An important part of the wetland vegetation consisted of taxa that indicate eutrophic conditions and the presence of open patches such as *Urtica* sp., *Symphytum* sp., *Solanum dulcamara*, *Lycopus europaeus*, *Eupatorium cannabinum*, *Filipendula ulmaria* and *Lythrum salicaria*. These taxa could have grown as forb vegetation in well-developed reed vegetation or as the undergrowth of open *Alnus* vegetation. The diagrams additionally show the minor presence of mesotrophic grassland taxa that probably grew in somewhat mesotrophic reed vegetation: *Rinanthus* sp., *Gentiana* sp., *Parnassia* sp., *Pedicularis* sp. and *Saxifraga granulata*. At the lower parts of the slope of the dune, a variety of riparian plants were present, amongst which were *Alisma plantago-aquatica*, *Butomus* sp., *Sagittaria* sp., *Sparganium emersum*, *Sparganium erectum*, *Typha angustifolia/latifolia*, *Rorippa amphibia* and *Oenanthe aquatica*. These taxa generally indicate riparian vegetation of moderate to very eutrophic water with a maximal depth of 1.5 metres. Pollen of the riparian taxa *Littorella* sp. and *Elatine* sp. additionally indicate clear water of high quality that is poor in nutrients (Weeda *et al.* 1987, 1988), while *Elatine* sp. also indicates fluctuating water levels (Brinkkemper *et al.* 2008). The pollen of *Littorella* sp. may have been transported from elsewhere, but *Elatine* sp. was present in the local vegetation, as indicated by finds of seeds of *E. triandra* (see core 3). The vegetation of the large bodies of open water consisted of a variety of taxa including *Nymphaea alba*, *Nuphar lutea*, *Trapa natans*, *Hottonia palustris*, *Hydrocharis morsus-ranae*, *Myriophyllum spicatum*, *Potamogeton* sp., *Stratiotes aloides*, *Lemna* sp. and *Callitriche* sp. These taxa indicate moderate to very eutrophic water with a depth between 0.5 and 2 metres. Non-pollen palynomorphs such as Zygnemataceae additionally indicate the presence of shallow pools, probably as part of the alder carr and the riparian zone.

The archaeobotanical remains indicate that there was no direct marine influence at the Hazendonk. The only identifications indicative of saline conditions are pollen grains of *Plantago coronopus* (square 57, after phase Haz 1), pollen grains of *Glaux* sp. (core 2, after phase VL 1b) and Hystrichosphaeridae (phase VL 1b). The scarcity of identifications of these taxa indicates that the relevant remains have been transported from the coastal zone into the river area during extreme marine influxes into the river area. The freshwater conditions are confirmed by the identifications of freshwater molluscs (*Anodonta* sp./*Unio* sp., *Bythinia tentaculata* and *Valvata piscinalis*).

III.4.2 Development of the natural vegetation

The analyses of the cores and sections show that the quantity of surface at the dune covered with dryland vegetation gradually decreased by submerging. Simultaneously, the surface covered with wetland vegetation expanded (see also fig. III.20). The lower part of the section of square 57 shows that *Tilia/Quercus* woodland was initially present near unit C where occupation took place, while core 3 shows that alder carr was already present several metres further down the slope at that time. The *Tilia/Quercus* vegetation was quickly replaced by woodland dominated by *Quercus* sp., *Fraxinus* sp. and *Alnus* sp. at the sample points after phase Haz 1, and was gradually replaced by alder carr. The section of square 57 shows an increase in *Fraxinus* sp. before phase Haz 3 (see also diagram square 41), which corresponds with the wood identifications of Van der Wiel (1982).

The diagram of square 57 furthermore shows an increase in *Ulmus* sp. after phase Haz 3, which is unfortunately not registered in other diagrams. Core 2, following the diagram of square 57 in time, shows maximal development of alder carr between phases VL 1a and VL 1b (macroremains). The higher-located section of square 41 shows the initial development of alder carr after phase Haz 2a, the presence of *Fraxinus* sp. before phase Haz 3 and confirms the maximal development of alder carr between phases Haz 3 and VL 1b (macroremains). The sections M86 and M87 show the presence of oak and alder near the sample locations during phase VL 1b despite the submerging process. *Salix* vegetation developed at the southeastern side of the dune after phase VL 1b (*cf.* Vander Wiel 1982). Woodland of dry terrain probably remained present on the top of the dune during all phases. This is indicated by the remains of *Corylus* sp. and *Quercus* sp. in the VL 1b horizon (section square 41 and M87), and the presence of the remains of *Acer campestre* and *Quercus* sp. including juvenile *Quercus* remains in macroremains samples dating to phase VL 2b. *Tilia* sp. nevertheless probably disappeared from the dune after phase Haz 3, since the youngest macroremains of *Tilia* sp. date to phase Haz 3, and since the curve of *Tilia* sp. is low and stable after phase Haz 3.

III.4.3 Human impact

III.4.3.1 Indications of human impact in the diagrams

Occupation resulted in a decrease in *Tilia* sp. during all the Hazendonk phases, and *Tilia* sp. only partially recovered afterwards. The disappearance of *Tilia* sp. is probably primarily related to the combination of human impact and the rising ground water table. Comparable examples of human impact resulting in a decrease in *Tilia* sp. are discussed in paragraph 8.3. *Quercus* sp. also suffered from human impact, but this taxon suffered less from the wet conditions and remained present longer at the dune. People probably cleared trees of *Fraxinus* sp. during the occupation phases Haz 2 and 3. The macroremains diagrams shows that *Alnus* trees were reduced during most occupation phases, which is indirectly supported by the important role of *Alnus* sp. in the wood assemblage, although the pollen diagrams show increased values due to better pollen dispersal. The curve of *Pinus* sp. shows decreases during occupation phases as well but this does not represent human impact since the taxon was not present at the dune. The decreases in *Pinus* sp. are interpreted as a statistical result of the increased values of other taxa, which could have been demonstrated when marker spores had been added.

Most occupation phases are characterised by an increase in the number and the diversity of dryland shrubs such as *Corylus avellana*, *Viburnum opulus*, *Rhamnus cathartica*, *Ligustrum vulgare*, *Sambucus nigra* and *Cornus sanguinea*. The increase in pollen of these shrubs indicates the development of secondary vegetation in reaction to the increased presence of light and open patches that were created by woodland clearance. The increased presence of shrubs could also represent the presence of hedges around small arable plots (Groenman-van Waateringe 1978) but this remains very hypothetical (see also paragraph 8.8.2). The percentage of *Corylus* sp. decreased during phase VL 1b in contrast to the earlier phases, while the number of macroremains decreased as well, suggesting that the number of *Corylus* trees/shrubs strongly decreased through time.

Occupation is characterised by a relatively high diversity of herbs and spore plants. Occupation leads to the presence or peaks of pollen of *Allium* sp., *Artemisia* sp., Chenopodiaceae, *Polygonum persicaria*-type, *Rumex acetosa*-type, *Polypodium* sp. and *Pteridium* sp. in the dryland vegetation. The climber *Humulus* sp. and the wetland herbs *Urtica* sp., *Symphytum* sp., *Solanum dulcamara*, *Lycopus europaeus*, *Eupatorium cannabinum*, *Filipendula ulmaria*, *Lythrum salicaria*, *Lotus*-type, Ranunculaceae and *Mentha*-type also show increased values during most occupation phases. The combination of these taxa indicates disturbance, tread and the increased availability of light and nutrients. *Plantago lanceolata* and *Plantago major/media* are present from phase Haz 1 onwards but they are not strictly related to occupation phases. The peak values of *Allium* sp. suggest the absence of intensive grazing (Troels-Smith 1954), which appears to be in contradiction with the presence of domestic animals during all phases.

This could possibly be explained by the interpretation that the *Allium* pollen does not represent the natural vegetation but waste instead, at least during phase Haz 1, although the expected moment of collection – before flowering – does not correspond with the presence of pollen.

The curve of Poaceae (probably mainly representing wetland taxa such as *Phragmites australis*, *Glyceria fluitans* and *Phalaris arundinacea*) often shows initially low values during occupation, followed by a peak at the end of occupation phases. The low values could be related to the use of *Phragmites australis* by people (cutting and burning) or grazing and destruction by animals, while the peak values at the end of the occupation phases indicate the recovery of the vegetation in open terrain or increased flowering in reaction to anthropogenic influence. The Cyperaceae and monoletae psilatae fern spores show a fall during most occupation phases. This could be related to human influence or grazing as well.

The pollen and macroremains diagrams show the initial recovery of the vegetation after the main occupation phases (Haz 1, Haz 3 and VL 1b), characterised by high values of certain anthropogenic indicators, which seems to represent the optimal growth of herbs and ferns indicative of human impact that benefit from open, disturbed terrain and the absence of human activity, followed by the true recovery of the natural vegetation that is characterised by moderate values in the diagrams and that is related to the final complete absence of the effects of human impact on the vegetation. Taxa showing high values characteristic of such initial recovery of the vegetation are for example Chenopodiaceae, *Artemisia* sp., *Urtica* sp., *Lythrum* sp., *Solanum dulcamara*, *Sparganium erectum*, Apiaceae and Rubiaceae, although the precise list of taxa varies per phase. After phase Haz 1 this concerns both dryland and wetland taxa (diagram square 57), after phase Haz 3 it already concerns more wetland taxa and after phase VL 1b it mainly concerns wetland taxa. This shift of taxa is related to the increase in the water table and the changes in the natural vegetation at the sample points. For the changes after phase VL 1b it is not precisely clear in which way the development of the vegetation is influenced by changing water conditions (as indicated by the presence of *Salix* sp.) and the recovery from human impact.

Summarising, anthropogenic influence on the vegetation resulted in the clearance of both dryland and wetland trees, the presence of open patches, the increased presence of nutrients because of the deposition of waste, and the presence of taxa that are characteristic of disturbance and human activity. It usually took some time for the vegetation to recover after occupation, which is visible after phases Haz 1, Haz 3 and VL 1b. Some taxa were not able to recover because of the repeated occupation pressure, changing environmental conditions and competition.

The extensive analysis of non-pollen palynomorphs allowed the investigation of the relationship between NPP's and occupation. Most taxa that increase during occupation, which makes them potential anthropogenic indicators, are not known as typical anthropogenic indicators. The possible anthropogenic indicators do not include types indicative of the presence of dung except for type 169 that possibly indicates the presence of dung.[36] Fifty percent of the 28 taxa that show increased values during occupation increase during a single phase only. For these taxa it is therefore not possible to conclude whether they are indeed indicative of human impact, or that the increase in these taxa accidentally co-occurred with occupation. Interestingly, there are four types that show a more consequent reaction to occupation. Type 361, psilate *Spirogyra* sp., type 44 (*Ustulina deusta*), type 121 and type 373 (*Mougeotia laetevirens*) show increased values during at least three different phases, and appear to be relatively good indicators for human impact at the Hazendonk. Type 361 was already known as an anthropogenic indicator (Van der Wiel 1982). Type 44, also known as *Kretzschmaria deusta*, is a parasite of deciduous trees, and it can be assumed that it benefited from clearance activities by men, resulting in the increased susceptibility of trees for parasites (*cf.* Innes *et al.* 2006 that demonstrate an increase in type 44 contemporaneous with a presumably anthropogenic decrease in *Ulmus* sp. and *Tilia* sp. in North Wales).

36 Other NPP's indicative of dung may have been present in the case that they remained unidentified.

The precise relationship to occupation with other types is however more difficult to explain; perhaps an increase in eutrophic conditions during occupation plays a role. *Spirogyra* sp. and *Mougeotia laetevirens* indicate shallow, stagnant, mesotrophic to eutrophic water, while it has been suggested for type 121 that it shows optimal values during the presence of lakes (Pals *et al.* 1980). The results of Van der Wiel (1982) tentatively support the results on the use of NPP's as indicators for human impact, since her diagram shows maxima of type 361 and *Spirogyra* sp. during occupation as well.

Comparison of changes in the NPP curves between the various cores during separate phases shows that human impact led to different responses in NPP curves in different cores. Changes during phases Haz 0 and 1 in the section of square 57 and core 3 are not similar. The correspondence in square 57 and core 2 during phase VL 1a consists of an increase in type 361 only, while in both cores several other types additionally increase. Most types that increase during two occupation phases were furthermore found in a single core only. This result indicates that the occurrence of taxa represented by the types is strongly influenced by differences between the cores, *i.e.* environmental conditions (type of subsurface, water depth, natural vegetation, presence of hosts, *etc.*) and the strength of human impact. This sensibility makes it very difficult to predict which NPP's to expect during the analysis of occupation phases at comparable archaeological sites. The absence of these species furthermore does not indicate the absence of occupation. The presence of the four taxa that are the best anthropogenic indicators in this study do not necessarily indicate occupation either, since they also occur under natural conditions in between occupation phases when people were probably not present at all.

The main changes in the pollen diagrams related to human impact at the Hazendonk as discussed above have been summarised in a model diagram (see fig. III.26). The model shows two phases, one representative of the Hazendonk phases and one representative of the Vlaardingen phases (mainly based on phase VL 1b). Future analyses can investigate whether this model can be applied to other sites as well (though see the note in paragraph 2.8.3.1). The comparison of data with this model is only possible when the environmental conditions and methodological aspects are comparable.

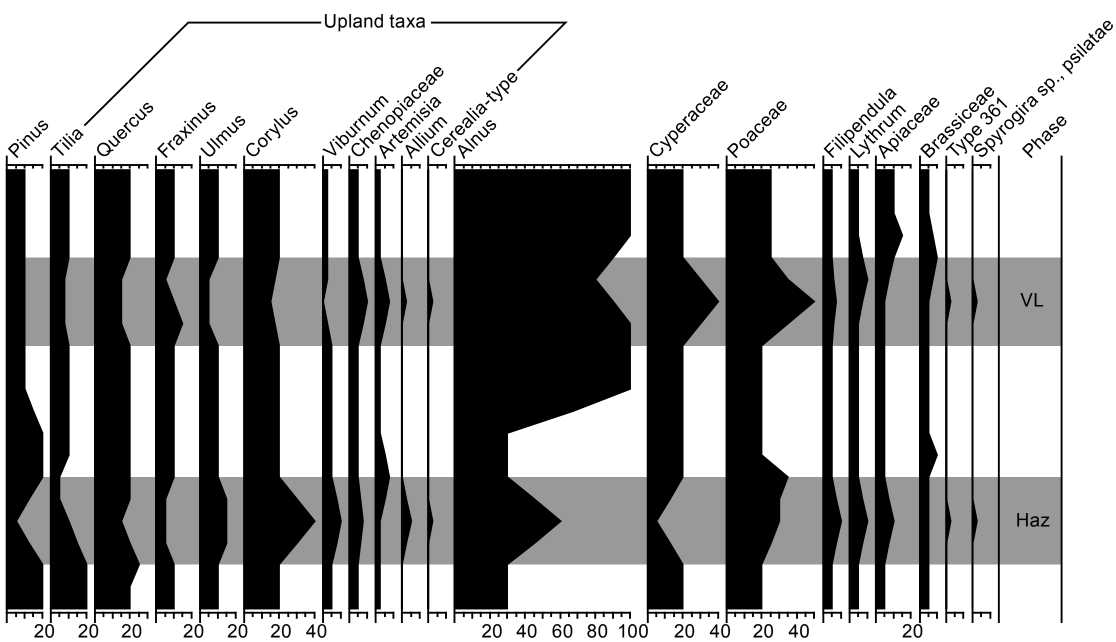

Figure III.26 The Hazendonk, model pollen diagram of changes related to human impact.

III.4.3.2 Further interpretation of indications of human impact

All occupation phases that were recognised as a horizon in the sediment during excavation of the squares near the pollen sample locations could be detected in the pollen diagrams, since the changes occurred contemporaneously in the curves of many taxa, since the same changes occurred repeatedly, since the vegetation recovered (partly) afterwards and since changes in the pollen diagrams could be linked to the presence of fine charcoal particles. The possibility to recognise occupation resulted in the confirmation of the existence of phase Haz 0 (*cf.* Louwe Kooijmans 1974) and in indications of two extra occupation periods that were not recognised in the field or during previous pollen analysis, probably related to phase VL 1a (sample boxes of unit C, square 57, after phase Haz 3). This distinction of occupation phases demonstrates the value of the archaeological application of pollen analysis.

All phases that were recognised in the sediment can be distinguished as continuous occupation phases in the diagrams. This means that either all distinguished phases represent continuous occupation, or that sub-phases do not come to expression in pollen, NPP and macroremains diagrams. The analysis of the pollen and macroremains diagrams of Brandwijk-Kerkhof indeed showed that a two-phased occupation period recognised by micromorphological analysis resulted in a single signal of human impact (see Out 2008a). The continuous evidence of human impact during phases Haz 1, Haz 3 and VL 1b thus does not guarantee continuous occupation during these phases.

One of the research questions was how occupation intensity and distance influence the evidence of human impact. Figure III.27, representing the summary pollen diagrams of the sample series from unit C (based on an upland pollen sum), gives a summary of human impact on the dryland vegetation. The summary diagrams show that occupation phases Haz 1, Haz 3 and VL 1b give a rather similar, relatively strong signal, while phases Haz 0, Haz 2a, Haz 2b and VL 1a result in a relatively weak signal. The signal of phase Haz 1 seems somewhat stronger than the signal of phase Haz 3 and VL 1b. The signal of phase Haz 1 may be overrepresented (discussed in paragraph III.3.1), or may alternatively be indicative of local arable farming (see paragraph III.4.5). Comparison with the distribution and thickness of the occupation horizons (refuse layers) indicates that the strength of evidence of human impact in the diagrams can be related to the extent of the refuse layers (see fig. III.3). It is assumed that the extent of the refuse layers corresponds with occupation pressure, which can be defined as the combined effect of the number of people, the duration of visits and possibly the number of visits within single phases. Occupation and waste deposition took place near the pollen sample locations during all phases, resulting in a signal of all phases. The similarity in strength during the three main phases can be explained by a similar close distance between human activity and the sampling locations during various phases[37], similar occupation intensity, as well as by the similarity of the activities during all phases, related to the continuity of site function. The development of human impact through time and the fact that the strength of human impact is related to the extent of the refuse demonstrates that human impact did not increase with gradually ongoing neolithisation (*cf.* Out 2008c). If neolithisation was a major factor influencing the strength of human impact, one would expect that human impact would have increased through time, and especially during the Late Neolithic.

The double registration of phases Haz 1 and VL 1b enables the investigation of the effect of increasing distance between the sampling points and the anthropogenic influence on the dryland vegetation within a single period. Phase Haz 1 is represented in the diagrams of square 57 and core 3, located at 3.5 metres distance from each other. In the material of square 57, the signal of anthropogenic influence on the dryland vegetation is stronger than in core 3 (see fig. III.27). The distribution of refuse indicates that human activities

37 An exception to this is phase Haz 0. The main concentration of refuse of phase Haz 0 was located relatively far away from the sample locations, which may possibly partly explain the limited strength of the signal of this phase. The little quantity of refuse, indicative of little intensive occupation, is however considered as a more important factor explaining the limited human impact during this phase.

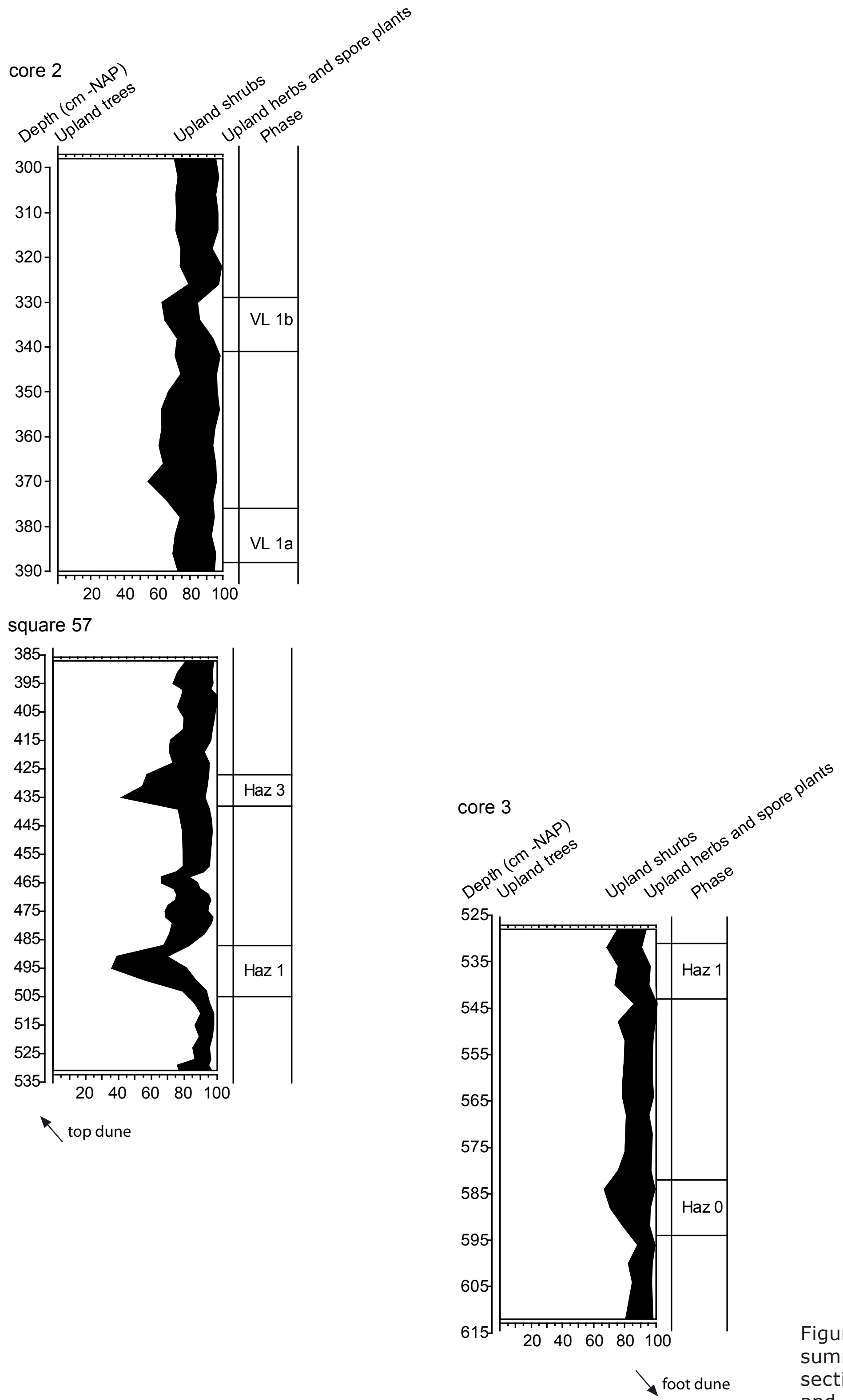

Figure III.27 The Hazendonk, summary diagrams of the section of square 57, core 2 and core 3.

during both phases were concentrated on the higher parts of the slope of the dune at unit C or above unit C, which explains the relatively strong signal in the section of square 57.

Phase VL 1b is represented in core 2 (unit C), M86 and M87 (unit B), and in the core of Van der Wiel (1982) (see fig. III.2 for the sample locations). Refuse was concentrated in unit C. Analysis of the summary diagrams shows that the evidence of human impact on the dryland vegetation of M87 is weaker than the signal of M86, and that the signal is even weaker in the core of Van der Wiel (1982), but there is no clear difference between the evidence of human impact between core 2 and M86 (see fig. III.28). These results can be explained by two factors. In the first place, the distance between the sample point and the top of the dune influences the strength of the signal of anthropogenic influence on the dryland vegetation, since activity was concentrated on the higher parts of the slope. This effect explains the decrease in the signal of human impact when comparing M86, M87 and the core of Van der Wiel, and corresponds with the comparison of signals of phase Haz 1. Secondly, core 2 is located further away from the top of the dune than M86, but closer to unit C where activity was concentrated, resulting in a signal of human impact in core 2 that is similar to the signal of M86.

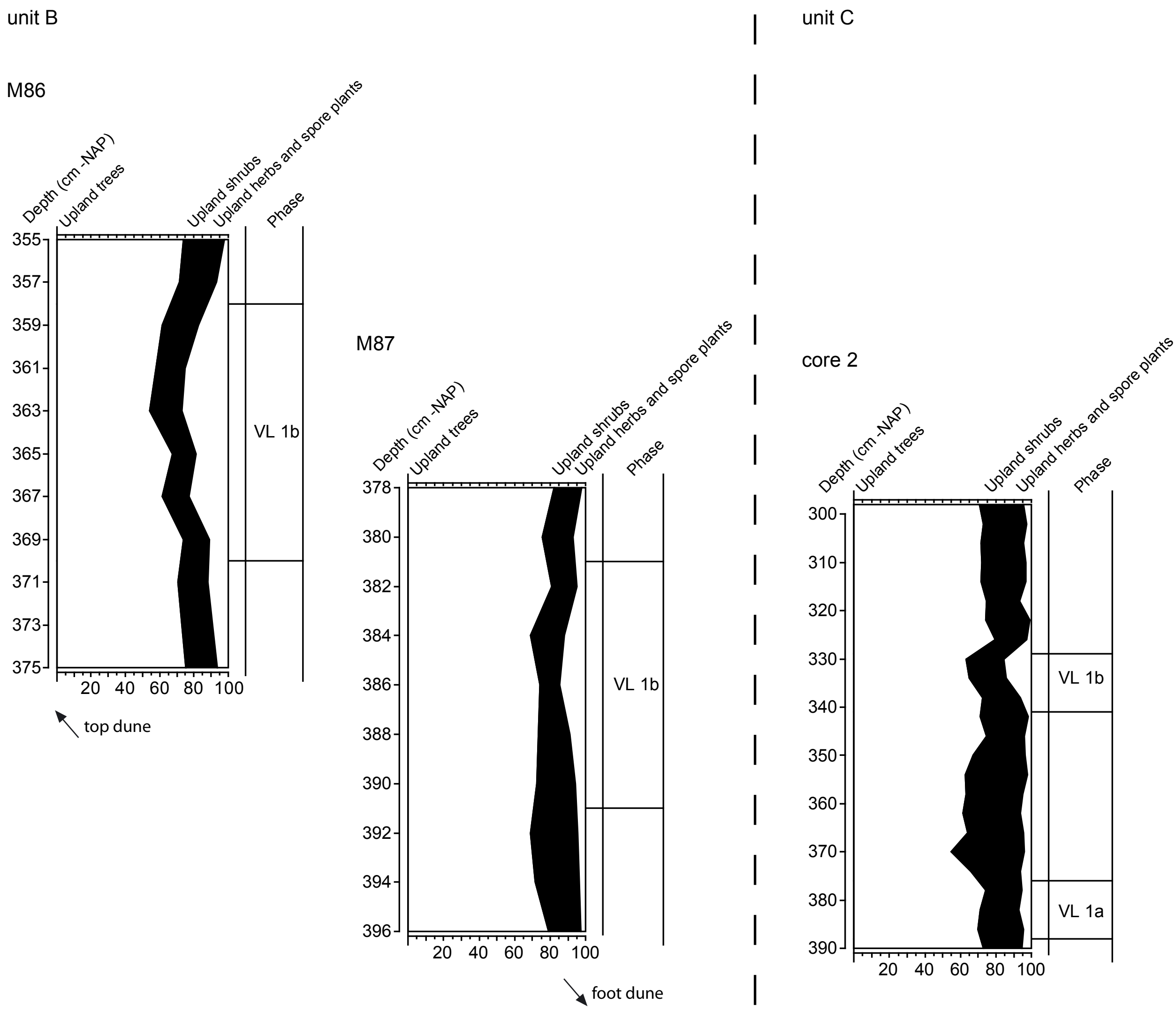

Figure III.28 The Hazendonk, summary diagrams of M86, M87 and core 2.

The decrease in the signal of disturbance of the dryland vegetation over a small distance of several metres during both phase Haz 1 and VL 1b in the first place indicates that the sample locations both represent very small woodland hollows (*cf.* Sugita 1994). The pollen rain from woodland hollows does not spread over large distances due to the presence of dense vegetation, and the signal of human impact that was created on the higher parts of the slope of the Hazendonk did therefore not spread over a large distance either. Secondly, the decrease in the signal over a small distance indicates that human impact was only of moderate strength during the main occupation phases, and thus even smaller during minor occupation phases. The data indeed indicate that human impact did not result in complete deforestation of the dune. Instead much of the woodland present on top of and around the dune remained relatively undisturbed. The precise degree of deforestation is however hard to reconstruct since the investigated cores and sections were all present at the southeastern side of the dune, and since local vegetation may have prevented the precipitation of pollen of the vegetation of the remaining parts of the dune at the sample locations. The development of particularly the western side of the dune is therefore poorly known.

The sampling of pollen in sediment that contains refuse layers may have resulted in overrepresentation of the dryland vegetation and human impact, since the refuse layers might contain eroded material from the top of the dune. The refuse could moreover have contained waste plant material as well. Colluviation processes might additionally have disturbed the stratigraphy. Comparative analysis of the available pollen and macroremains diagrams however indicates that it is possible to reconstruct the development of the vegetation and to reconstruct the relative strength of human impact at the various sample locations and for separate occupation periods, while there are only little indications of overrepresentation of taxa due to concentrations of plant waste. An exception is the peak of cereal pollen in phase Haz 1 that is probably related to the presence of cereal grains close to the analysed sections and cores. The distribution of charcoal as well as the curves of some NPP's furthermore suggest the presence of human activity during periods other than occupation phases, but these are not confirmed by changes in the diagrams, which indicates that they must be explained by other processes than human impact. The similarity of the presented results with the results of Van der Wiel (1982) and Voorrips (Louwe Kooijmans 1974), sampled at the same distance and further away from the dune respectively, further confirms the validity of sampling in refuse layers. An important advantage of sampling in the refuse layers at close distance to human activity is the possibility to detect small, local changes in the vegetation.

III.4.4 Plant subsistence

The macroremains indicate that the plant subsistence at the Hazendonk was based on both cultivated and gathered plants. This corresponds with the interpretation of the site-function as a semi-agrarian site with an extended broad-spectrum economy. The identified cultivated plants, emmer wheat and naked barley, were best represented in the material of phase Haz 1 with both grains, chaff remains and rachis fragments. The cereal remains suggest harvesting by uprooting or with sickles, although alternative methods cannot be excluded completely. The weeds reject uprooting as the harvesting method, although crop processing may have biased this result.

The best indications of consumption of wild plants come from the carbonised finds of edible taxa. The spectrum of gathered seeds and fruits that probably functioned as food at the Hazendonk is large, though comparable with the spectrum found at other Early and Middle Neolithic Dutch wetland sites. Taxa that were probably consumed are *Quercus* sp., *C. avellana*, *C. monogyna*, *P. spinosa*, *M. sylvestris*, *C. sanguinea*, *R. fruticosus*, *R. ficaria*, *T. natans*, *N. alba* and possibly *Galium aparine*, while several other taxa may additionally have been consumed as well. The data show a slight decrease in carbonised food plants during the Late Neolithic (from the Vlaardingen phases onwards), which can be explained in various ways. The macroremains do hardly provide any clear evidence of the use of plants for other purposes than consumption. Only a concentration of macroremains in a pit dating to phase VL 2b supports the use of plant remains, but the purpose of these remains is not directly clear. The carbonised macroremains indicate occupation between summer and winter for all phases, which corresponds with the zoological results on seasonality.

The wooden artefacts indicate that *Alnus glutinosa* was used on a large scale, which is probably related to its abundant availability in the natural vegetation. There is also evidence of the selective use of wood for specific artefacts because of the qualities of the wood and the function of the artefacts, which corresponds with information from other contemporaneous wetland sites. There are furthermore minor indications of the selective use of *Quercus* sp. for wood working. Most of the wood that people used was probably collected at the Hazendonk or in the exploitation area.

III.4.5 Local cultivation

Local arable farming at the Hazendonk has been the subject of debate from excavation onwards. In the years after excavation, indications of human impact resulted in the conclusion that cereal cultivation was practised (Louwe Kooijmans 1976, 255). The finds of rachis fragments and cereal pollen were considered to be indicative of small-scale local cultivation (Bakels 1981, 145). The interpretation shifted in the mid-eighties: "We strongly doubt on local crop cultivation. The dune was very small and the environment was not suitable at all" (Louwe Kooijmans 1985, 125, translated) and "crop cultivation played a minor role or did not take place at all" (Bakels 1986, translated). The most recently published conclusion is that local crop cultivation did probably not take place at the Hazendonk (Bakels and Zeiler 2005, 326; Van Gijn and Louwe Kooijmans 2005, 210-211). This paragraph aims to give an updated overview of the arguments on local crop cultivation at the Hazendonk.

A first important aspect of the discussion on local crop cultivation at the Hazendonk is our western, modern-day view on arable farming in view of the environmental conditions and the scale of cultivation. It is however argued in chapter 11 that these viewpoints should not result in a conclusion on local cultivation *a priori*.

The best evidence of local crop cultivation dates to phase Haz 1, but most finds can be explained by import as well, while there is also an important argument against local cultivation. Firstly, the finds of macroremains of phase Haz 1 that suggest the presence of ears of both crops can be seen as an indication of local crop cultivation. Especially chaff remains of naked barley would only be expected in regions where naked barley is cultivated, since it is expected that chaff remains of this free-threshing cereal would be removed before transport in order to reduce the product volume and weight. This argument in favour of local crop cultivation can however be rejected by the hypothesis that both hulled emmer wheat and free-threshing barley were transported in the ear to Dutch wetland sites (Bakels 2000). The transportation of naked barley in the ear may have been possible when the barley was harvested in dead-ripe state, with (part of) the stems still attached to the ear (Cappers 2006; Cappers and Raemaekers 2008). The delay of threshing would then result in optimal ripening of the barley, and possibly also in the protection of the grains. Furthermore, the transportation of naked barley in the chaff could have an economic reason after all when people used the chaff and possibly the stems (Cappers and Raemaekers 2008), or could be explained by the scarcity of working forces at the production location (Fuller *et al.* in press).

Secondly, the presence of the pollen of cereals could also be seen as an argument in favour of local crop cultivation, since the observed curves in the pollen diagrams are as expected in case of local crop cultivation. The presence of pollen can however also be explained by threshing activities after the import of cereals from elsewhere instead of local cultivation, since most pollen is produced during the threshing and processing of cereals instead of during flowering (Bottema 1992; Robinson and Hubbard 1977; Zohary and Hopf 2000, see also chapter 11). The presence of the pollen grains of cereals at the Hazendonk is indeed correlated with the presence of waste, the size of the refuse layers and human impact on the vegetation, and can be interpreted as a waste product instead of an indication of arable farming.

A third argument in favour of local cultivation is that the material consisted of rich concentrations of cereals that have never been found at comparable Dutch sites. One could argue that these concentrations and quantities indicate that it concerns a producer site. The attested number of cereals is however not large enough to exclude the import of cereals, and there are no indications of the storage of surplus production. Comparable quantities of cereals may also have been present at other sites, and the unique preservation of the cereal concentrations from phase Haz 1 indeed indicate that deposition processes and preservation may explain this exceptional find. Botanical find assemblages of indisputable producer sites from the Swifterbant culture and Hazendonk group are not known and it is therefore not possible to compare the assemblage of the Hazendonk with material of such a site.

A fourth argument is that the underdevelopment of the emmer wheat found at the Hazendonk could be explained by the suboptimal environmental conditions at the Hazendonk. Underdevelopment could however have had a variety of causes that could have occurred everywhere.

A fifth argument that supports local crop cultivation during phase Haz 1 is that the pollen diagrams provide relative strong indications of deforestation in the pollen diagrams during this phase, especially expressed in the dryland herb vegetation. The strength of the signal of human impact corresponds with the relatively large surface of the dune, which would have made the dune most suitable for local crop cultivation during phase Haz 1. The indications of deforestation during phase Haz 1 may however possibly be overrepresented since the dryland herb vegetation is dominated by *Allium* sp., which may represent a shade tolerating *Allium* species.

An important argument against local crop cultivation during phase Haz 1 is the presence of large quantities of *B. secalinus*-type. Although it could have grown at the Hazendonk, the absence of this species at older sites in the central river area and its almost complete absence (except for half a grain) during later phases at the Hazendonk indicate that this taxon did not grow at the Hazendonk but was imported from elsewhere. Large numbers of *Bromus* sp. are moreover not reported for any of the other Early and Middle Neolithic Dutch wetland sites.

The material from the phases later than Haz 1 give much weaker indications of local crop cultivation since indications of human impact in the pollen diagrams are smaller, since the quantities of both grains and chaff remains are smaller, since there is no comparable evidence of the presence of complete ears, and since there are less chaff remains of naked barley. The difference can be seen as an argument that the samples from phase Haz 1 indicate local crop cultivation and the samples from later phases in contrast do not. The difference can alternatively be explained by the differences between the type of finds (concentrations are available from phase Haz 1 only), reflecting differential depositional processes.

The archaeological information sources, such as site function, features indicative of tillage, querns and sickles do hardly provide more information than the botanical remains. The analysis of seasonality and site function do not give indications to exclude local cultivation and theoretically allow local cultivation, since the site was visited during various seasons during most phases and since the site function may have been a base camp (although this is not precisely clear). The excavation did not reveal features that are characteristic of soil tillage. The presence of fields however cannot be excluded since the top of the dune was bioturbated and eroded. There are some finds of quern stones at the Hazendonk, but these only indicate consumption and do not demonstrate local crop cultivation. Stones identified as querns that could be assigned to a single occupation phase by stratigraphy are known from phases Haz 3, VL 1a and VL 1b (N = 9). It is not known whether querns were absent during phases Haz 1 and 2 or not, since a group of 14 stones could not be assigned to a single occupation phase (pers. comm. Wansleeben 2007). The information on querns at the Hazendonk is based on the analysis of archive information only. The stone assemblage should be investigated again by modern standards (use-wear analysis and residue analysis) in order to obtain final interpretations.

Analysis of all flint finds from the Hazendonk except for those from unit C has not resulted in the positive identification of flint artefacts with use-wear with gloss in a longitudinal direction indicative of cereal cutting, *i.e.* sickles that are as convincing as the evidence from the Middle Neolithic sites Schipluiden and Ypenburg in the coastal area (Van Gijn *et al.* 2006, 154; pers. comm. Van Gijn, 2007). There are however some pieces of flint that show use-wear traces that could possibly represent cereal working (dating to phases Haz 2 and 3)[38], and as a result the use-wear analysis does not exclude local crop cultivation either. The absence of flint artefacts that convincingly show cereal gloss is furthermore not necessarily indicative of the absence of local cultivation since the crop may have been harvested in another way. Alternatively, sickles may have been deposited at off-site locations. The assumption of harvesting without sickles is however in contrast to the tentative indications of sickle harvesting from the cereal remains.

In conclusion, the available evidence does not uniformly support or reject crop cultivation at the Hazendonk. The presence of *Bromus* sp. in the material of phase Haz 1 indicates import during this phase, implying the transportation of emmer and naked barley in the ear. Local cultivation during phase Haz 3 is supported but not demonstrated by the finds of possible sickles. The indications of local crop cultivation during the Vlaardingen phases are less strong than the indications from the earlier phases.

III.5 Acknowledgements

I would like to thank A. Louwe Kooijmans-Bouhuijs, W.J. Kuijper, L.P. Louwe Kooijmans, L.B.M. Verhart and C.C. Bakels for putting available the results and for discussion, A. Louwe Kooijmans-Bouhuijs and W.J. Kuijper for analysis, J.P. Pals, C.C. Bakels, R.T.J. Cappers, B. van Geel and A. Aptroot for advice on identifications, A.J. Kalis for help with the nomenclature of pollen identifications, A.L. van Gijn for analysis of use-wear analysis of the flint, M. Wansleeben for information on querns, P.C. Anderson for discussion on harvesting methods and J. van der Plicht for information on the ^{14}C dates.

38 The flint artefacts 24.243 (Haz 2), 37.686, 37.622 and 37.202 (three fragments of a single artefact, Haz 3), 17.715 (Haz 3) and 29.402 (Haz 3) show use-wear traces that could possibly represent relevant cereal working.

phase	Haz 1							
sample	39.154	39.184	39.185	M157	M160	M163	M164	M167
unit	C	C	C	C	C	C	C	C
square	57	57	57	39	57	57	57	57
mesh width	1.5	0.25	0.25	1.5	1.5	1.5?	1.5	?
volume	0.25 l	1 l	1.5 l	10 l	0.25 l	0.25 l	0.25 l	?
sediment	peat	peat	peat	peat	?	peat	peat	peat
context	refuse	refuse	refuse	refuse	pit	refuse	refuse	refuse
taxon								
Group 1								
Tilia platyphyllos	-	-	-	2 c	-	-	-	-
Tilia sp.	-	-	-	-	-	-	2 c	-
Acer campestre	-	-	-	-	-	-	-	-
Quercus sp., cupulae	-	-	-	-	-	-	-	-
Quercus sp., cupulae with content	-	-	-	-	-	-	-	-
Quercus sp.	-	-	-	1 c	-	-	-	-
Malus sylvestris	-	1 c	-	-	2 c	-	-	2, 1 c
Malus sylvestris, parenchyma	-	-	-	-	-	-	-	-
Viburnum opulus	-	-	-	2 c	-	-	-	-
Corylus avellana	1 c	-	-	6 c	7, 6 c	-	5, 4 c	45, 40 c
Prunus padus	-	-	-	-	-	-	-	-
Prunus spinosa	-	-	-	-	-	-	-	-
Cornus sanguinea	-	-	-	16, 9c	1 c	-	2 c	11, 2 c
Sambucus nigra	-	-	-	1	-	-	-	-
Crataegus monogyna	-	-	-	4 c	-	-	-	7 c
Rubus caesius	-	-	-	-	-	-	-	-
Rubus fruticosus	-	-	-	2	-	-	-	-
Ajuga reptans	-	-	-	-	-	-	-	-
Anthriscus sylvestris	-	-	-	-	-	-	-	-
Carex remota	-	-	-	-	-	-	-	-
Chaerophyllum temulum	-	-	-	-	-	-	1 c	-
Galium aparine	-	-	-	-	-	-	-	-
Galium odoratum	-	-	-	-	-	-	-	-
Glechoma hederacea	-	-	-	-	-	-	-	-
Lamium album	-	-	-	1	-	-	-	-
Ranunculus ficaria, tubers	-	-	-	-	-	-	-	1 c
Urtica dioica	-	+	++	3	1 c	-	-	-

Table III.11 part 1a.

phase	Haz 1							
sample	39.154	39.184	39.185	M157	M160	M163	M164	M167
Group 2								
Aethusa cynapium	-	-	-	-	-	-	-	-
Brassica rapa	-	-	-	-	-	-	-	-
Bromus secalinus-type	48 c	0.5 c	68 c	12 c	3 c	149 c	5 c	1 c
Capsella bursa-pastoris	-	-	1 c	-	-	-	-	-
Carduus crispus	-	-	-	-	-	-	-	-
Chenopodium album	1 c	2 c	0.5 c	-	-	-	-	-
Chenopodium ficifolium	-	-	-	-	-	-	-	-
Elytrigia repens	-	-	1 c	-	-	-	-	-
Fallopia convolvulus	-	1 c	1 c	3, 1c	-	2 c	1 c	-
Galium spurium	-	-	-	1	-	-	-	-
Persicaria lapathifolia	-	-	-	-	-	-	-	-
Persicaria maculosa	4.5 c	6 c	33 c	5 c	-	-	2 c	-
Silene latifolia ssp. alba	-	-	-	-	-	-	-	-
Solanum nigrum	-	39 c	13 c	-	-	9 c	-	-
Stellaria media	-	-	-	-	-	-	-	-
Veronica hederifolia	-	-	-	-	-	-	-	-
Vicia cf. tetrasperma	-	-	-	-	-	-	-	-
Group 3								
Hordeum sp./Triticum sp.	-	-	-	-	-	-	-	-
Hordeum vulgare var. nudum	+ c	2 c	-	200 c	56 c	+ c	394 c	29 c
Hordeum vulgare, internodia	-	-	4 c	37 c	-	-	678 c nudum	-
Hordeum vulgare, chaff remains	-	-	-	-	34 c	-	-	-
Triticum dicoccon	++++ c	58c	+++ c	515 c	10c	*+ c	710 c	16 c
Triticum dicoccon, spikelet forks	++++ c	881 c	+++ c	-	96 c	*+ c	448 c	-
Triticum dicoccon, rachis segments	125 c	22 c	+++++ c	320 c	-	*+ c	-	-
Triticum sp.	-	-	-	-	5 c	-	-	35 c
Triticum sp., rachis segments	-	-	-	3 c	-	-	-	-
Triticum sp., spikelet forks	-	-	-	-	-	-	-	-
Triticum sp., glume bases	-	-	-	-	-	-	-	-
Group 4								
Alnus glutinosa	-	3 c	4 c	2	-	-	1 c	-
Alnus glutinosa, cones	-	-	-	1 c	1 c	-	-	1

Table III.11 part 1b.

phase	Haz 1							
sample	39.154	39.184	39.185	M157	M160	M163	M164	M167
Group 4 (cont.)								
Alnus glutinosa,								
fragments of male catkins	-	-	-	-	-	-	-	-
Humulus lupulus	-	-	-	-	-	-	-	-
Group 5								
Alisma plantago-aquatica	-	-	-	-	-	-	-	-
Berula erecta	-	1 c cf.	-	-	-	-	-	-
Caltha palustris	-	-	-	-	-	-	-	-
Carex acutiformis	-	-	-	-	-	-	-	-
Carex elata	-	-	-	-	-	-	-	-
Carex pseudocyperus	-	-	-	-	-	-	-	-
Carex riparia	-	-	-	-	-	-	-	-
cf. Phragmites australis,								
stem fragments	-	-	-	-	3 c	-	-	-
Cladium mariscus	-	-	-	-	-	-	-	-
Eupatorium cannabinum	-	-	-	-	-	-	-	-
Euphorbia palustris	-	-	-	-	-	1c cf.	-	-
Hypericum cf. tetrapterum	-	-	-	-	-	-	-	-
Iris pseudacorus	-	-	-	-	-	-	-	-
Lythrum salicaria	-	-	-	-	-	-	-	-
Mentha aquatica	-	-	-	-	-	-	-	-
Menyanthes trifoliata	-	-	-	-	-	-	-	-
Oenanthe aquatica	-	-	-	1 c	-	-	-	-
Phragmites australis	-	-	-	-	-	-	-	-
Rumex hydrolapathum	-	-	-	-	-	-	-	-
Sagittaria sagittifolia	-	-	-	-	-	-	-	-
Schoenoplectus lacustris	-	-	1 c	11	-	-	-	-
Sium latifolium	-	-	-	-	-	-	-	-
Solanum dulcamara	-	+	++	5	-	-	-	-
Sparganium erectum	-	-	-	1 c	-	-	1 c	-
Sparganium erectum spp. erectum	-	-	-	-	-	-	-	-
Stachys palustris	-	-	-	1	-	-	-	-
Thalictrum flavum	-	-	-	-	-	-	-	-
Valeriana officinalis	-	-	-	-	-	-	-	-
Veronica beccabunga-type	-	-	-	-	-	-	-	-

Table III.11 part 1c.

phase	Haz 1							
sample	39.154	39.184	39.185	M157	M160	M163	M164	M167
Group 6								
Persicaria hydropiper	-	-	-	-	-	-	-	-
Ranunculus repens	-	-	-	1	-	-	-	-
Ranunculus sceleratus	-	-	-	-	-	-	-	-
Rumex cf. crispus	-	-	-	-	1 c	-	-	-
Group 7								
Nymphaea alba	-	-	3 c	4 c	3, 2 c	16 c	-	-
Nuphar lutea	-	-	-	-	-	-	-	-
Ranunculus cf. fluitans	-	-	-	-	-	-	-	-
Potamogeton alpinus	-	-	-	-	-	-	-	-
Potamogeton natans/perfoliatus	-	-	-	1	-	-	-	-
Trapa natans, spines	-	-	-	-	-	-	-	-
Trapa natans, bristles	-	-	-	-	-	-	-	-
Group 8								
Alopecurus myosuroides/pratensis	-	-	-	-	-	-	-	-
Anthoxanthum odoratum	-	-	-	-	-	-	-	-
Apiaceae	-	-	-	-	-	-	-	-
Carex sp.	-	-	-	-	-	-	-	-
cf. Holcus sp.	-	-	-	-	-	-	-	-
Mentha aquatica/arvensis	-	-	-	-	-	-	-	-
Phleum sp./Poa annua	-	-	-	-	-	1 c	-	-
Poa pratensis/trivialis	-	-	-	-	-	-	-	-
Poaceae	-	-	-	-	-	-	-	-
Potentilla sp.	-	-	-	-	-	-	-	-
Rosaceae	-	-	-	1 c	-	-	-	-
Rumex sp.	-	1 c	-	-	-	-	-	-
Scrophularia sp./Verbascum sp.	-	-	-	-	-	-	-	-
Stellaria sp.	-	-	-	-	-	-	-	-
Veronica austriaca/chamaedrys	-	1 c	-	-	-	-	-	-
Lathyrus palustris/Vicia cracca	-	-	-	-	-	-	-	-
Viola sp.	-	-	-	-	-	-	-	-
Indet.	-	-	-	1 c	-	-	-	-

Table III.11 part 1d.

phase	Haz 1							
sample	39.154	39.184	39.185	M157	M160	M163	M164	M167
Group 9								
Sand	+	-	-	-	-	-	-	-
Buds	-	-	+	8, 8 c	-	-	-	-
Bud scales	-	-	-	-	-	-	-	-
Leaf remains	-	-	-	-	-	-	-	-
Moss remains	-	-	-	-	-	-	-	-
Fragments of catkins indet.	-	-	-	-	-	1 c	-	-
Charcoal	-	+	+	+	-	-	+	-
Bone/fish remains *	+	+	+	+	++	-	+	-
Pottery remains	-	+	-	-	-	-	+	-
Flint fragments	-	-	-	-	-	-	-	-
Bark remains	-	+	-	-	-	-	-	-
Insect remains	-	-	-	-	-	-	-	-
Faecal pellets	-	-	-	-	-	-	-	-
Lophopus cristallinus, statoblasts	-	-	-	-	-	-	-	-
Daphnia sp., ephippia	-	-	-	-	-	-	-	-
Cocoons	-	-	+	12, 11 c	-	-	-	-
Cenococcum geophilum, sclerotia	-	+++ c	+++ c	+++ c	-	+	-	+
Trichoptera, cases of larvae	-	-	-	-	-	-	-	-
cf. Hypoxylon sp./Ustulina sp.	-	-	-	-	-	-	-	-
Valvata piscinalis	-	-	-	-	-	-	-	-
Bithynia tentaculata, opercula	-	-	-	-	-	-	-	-
Anodonta sp./Unio sp.,								
fragment tissue	-	-	-	-	-	-	-	-

Haz = Hazendonk
VL = Vlaardingen
VL 2b* = younger phase of VL 2b (based on stratigraphy)
l = litre, g = gram, refuse = refuse layer, / = or
* = bone and fish remains were found in a carbonised and waterlogged state

-	= not present	++++	= some hundreds (100-499)
+	= few (1-10)	*+	= some thousands (1000-5000)
++	= some tens (10-49)	+++++	= many hundreds (500-999)
+++	= many tens (50-99)	*+*+	= many thousands (>5000)

c = carbonised
x, yc = x macroremains including y carbonised macroremains
j = juvenile

Table III.11 The Hazendonk, macroremains that were collected during the excavation by active search for concentrations and by analysis of sieve residues, part 1e.

phase	Haz 1/ 2		Haz 2	Haz 2/3	Haz 3		
sample	?	M156	M150	M133	M25	M74B	M75A
unit	C	C	C	D	A	B	B
square	39	39	53	9	3	26	26
mesh width	0.25	5?	1.5 / 5	?	5	5	5
volume	1 l	?	2 l	?	?	?	?
sediment	peaty sand	peaty sand	peat	peaty sand	peat	peat	peat
context	colluvium	colluvium	refuse	colluvium	refuse	refuse	refuse
taxon							
Group 1							
Tilia platyphyllos	-	-	1	-	1	16, 2 c	1
Tilia sp.	-	-	-	-	8	-	-
Acer campestre	-	-	-	-	-	-	-
Quercus sp., cupulae	-	-	-	-	-	5	3
Quercus sp., cupulae with content	-	-	-	-	-	10, 9 j	-
Quercus sp.	-	-	-	-	-	4	1
Malus sylvestris	-	-	-	-	4	16, 7 c	-
Malus sylvestris, parenchyma	-	-	-	-	-	2, 1 c	-
Viburnum opulus	-	-	-	-	3	5, 4 c	-
Corylus avellana	-	3 c	1 c	-	1	24, 14 c, 1 j	4, 1 c
Prunus padus	-	-	-	-	-	-	-
Prunus spinosa	-	-	-	1 c	-	1 c	-
Cornus sanguinea	1	1	8, 4 c	-	3	87, 4 c	5
Sambucus nigra	-	-	-	8	2	83	-
Crataegus monogyna	-	-	2 c	-	-	-	-
Rubus caesius	-	-	-	-	4	-	-
Rubus fruticosus	-	-	2	1	77	65, 1 c	-
Ajuga reptans	-	-	-	-	7	11, 2 c	-
Anthriscus sylvestris	-	-	-	-	-	2	-
Carex remota	-	-	-	-	-	-	-
Chaerophyllum temulum	-	-	-	-	-	-	-
Galium aparine	-	-	11 c	1 c	1 c	22, 13 c	-
Galium odoratum	-	-	1 c	-	-	-	-
Glechoma hederacea	-	-	-	1	-	1	-
Lamium album	-	-	-	-	-	1	-
Ranunculus ficaria, tubers	-	-	2 c	-	-	3 c	-
Urtica dioica	130	-	-	-	15	15	-

Table III.11 part 2a.

phase	Haz 1/ 2		Haz 2	Haz 2/3	Haz 3		
sample	?	M156	M150	M133	M25	M74B	M75A
Group 2							
Aethusa cynapium	-	-	-	-	-	-	-
Brassica rapa	-	-	-	-	-	2 c	-
Bromus secalinus-type	-	-	1 c cf.	-	-	-	-
Capsella bursa-pastoris	-	-	-	-	-	-	-
Carduus crispus	-	-	-	-	-	-	-
Chenopodium album	4	-	6	-	-	1	-
Chenopodium ficifolium	-	-	-	1	1	-	-
Elytrigia repens	-	-	-	-	-	-	-
Fallopia convolvulus	1 c	-	6 c	-	-	-	-
Galium spurium	-	-	-	-	-	-	-
Persicaria lapathifolia	-	-	-	-	-	-	-
Persicaria maculosa	-	-	-	1	-	2	-
Silene latifolia ssp. alba	-	-	2	-	1	-	-
Solanum nigrum	2 c	-	-	-	-	-	-
Stellaria media	1	-	-	-	-	-	-
Veronica hederifolia	-	-	-	-	-	1 c	-
Vicia cf. tetrasperma	-	-	-	-	-	-	-
Group 3							
Hordeum sp./Triticum sp.	-	-	-	1 c	-	-	-
Hordeum vulgare var. nudum	-	-	-	-	-	16 c	-
Hordeum vulgare, internodia	-	-	-	-	-	-	-
Hordeum vulgare, chaff remains	-	-	-	-	-	-	-
Triticum dicoccon	-	-	3 c	-	-	67 c	-
Triticum dicoccon, spikelet forks	-	-	-	-	-	4 c	-
Triticum dicoccon, rachis segments	-	-	-	-	-	-	-
Triticum sp.	-	-	-	-	-	-	-
Triticum sp., rachis segments	-	-	-	-	-	-	-
Triticum sp., spikelet forks	8 c	-	-	-	-	-	-
Triticum sp., glume bases	-	-	-	-	-	-	-
Group 4							
Alnus glutinosa	1 c	-	2	-	29	52	-
Alnus glutinosa, cones	-	-	3	-	4	49	1

Table III.11 part 2b.

phase	Haz 1/ 2		Haz 2	Haz 2/3	Haz 3		
sample	?	M156	M150	M133	M25	M74B	M75A
Group 4 (cont.)							
Alnus glutinosa,							
fragments of male catkins	-	-	-	-	5	10	-
Humulus lupulus	-	-	-	-	-	-	-
Group 5							
Alisma plantago-aquatica	1	-	-	-	1	-	-
Berula erecta	-	-	-	-	-	-	-
Caltha palustris	-	-	-	-	1	-	-
Carex acutiformis	-	-	-	-	4	3	-
Carex elata	-	-	-	-	-	-	-
Carex pseudocyperus	-	-	1	-	-	1	-
Carex riparia	-	-	-	-	1	4	-
cf. Phragmites australis,							
stem fragments	-	-	-	-	-	-	-
Cladium mariscus	-	-	-	-	1	2	-
Eupatorium cannabinum	-	-	-	-	1	-	-
Euphorbia palustris	-	-	-	-	-	-	-
Hypericum cf. tetrapterum	-	-	-	-	-	-	-
Iris pseudacorus	-	-	-	-	1 c	1	-
Lythrum salicaria	2	-	-	-	-	-	-
Mentha aquatica	-	-	-	-	-	-	-
Menyanthes trifoliata	-	-	-	-	-	1 c	-
Oenanthe aquatica	-	-	-	-	-	-	-
Phragmites australis	-	-	-	-	-	-	-
Rumex hydrolapathum	-	-	-	-	-	-	-
Sagittaria sagittifolia	-	-	-	-	-	-	-
Schoenoplectus lacustris	-	-	22	-	5	4	-
Sium latifolium	-	-	-	-	-	-	-
Solanum dulcamara	1	-	7	-	4	3	-
Sparganium erectum	-	-	3, 1 c	-	1	1	-
Sparganium erectum spp. erectum	-	-	-	-	-	6	-
Stachys palustris	-	-	1	-	1	2	-
Thalictrum flavum	-	-	-	-	-	-	-
Valeriana officinalis	-	-	-	-	1	1	-
Veronica beccabunga-type	-	-	-	-	-	-	-

Table III.11 part 2c.

phase	Haz 1/ 2		Haz 2	Haz 2/3	Haz 3		
sample	?	M156	M150	M133	M25	M74B	M75A
Group 6							
Persicaria hydropiper	-	-	-	-	-	1	-
Ranunculus repens	-	-	-	1	-	12	-
Ranunculus sceleratus	-	-	-	-	-	-	-
Rumex cf. crispus	-	-	-	-	-	-	-
Group 7							
Nymphaea alba	-	-	-	-	-	-	-
Nuphar lutea	-	-	-	-	-	-	-
Ranunculus cf. fluitans	-	-	-	-	-	-	-
Potamogeton alpinus	-	-	-	-	-	-	-
Potamogeton natans/perfoliatus	-	-	1	-	1	-	-
Trapa natans, spines	-	-	-	-	-	2 cf. c	-
Trapa natans, bristles	-	-	-	-	1 c	1 c	-
Group 8							
Alopecurus myosuroides/pratensis	-	-	-	-	-	1	-
Anthoxanthum odoratum	-	-	-	-	-	1 cf.	-
Apiaceae	-	-	-	-	-	1	-
Carex sp.	-	-	-	-	1	-	-
cf. Holcus sp.	-	-	-	-	-	-	-
Mentha aquatica/arvensis	-	-	-	-	-	-	-
Phleum sp./Poa annua	-	-	-	-	-	-	-
Poa pratensis/trivialis	-	-	-	-	-	-	-
Poaceae	-	-	-	-	-	4	-
Potentilla sp.	-	-	-	-	-	-	-
Rosaceae	-	-	-	-	-	-	-
Rumex sp.	-	-	1	-	-	-	-
Scrophularia sp./Verbascum sp.	-	-	-	-	-	-	-
Stellaria sp.	-	-	-	-	-	-	-
Veronica austriaca/chamaedrys	-	-	-	-	-	-	-
Lathyrus palustris/Vicia cracca	-	-	-	-	-	1 c	-
Viola sp.	-	-	-	-	-	-	-
Indet.	-	-	-	-	-	-	-

Table III.11 part 2d.

phase	Haz 1/ 2		Haz 2	Haz 2/3	Haz 3		
sample	?	M156	M150	M133	M25	M74B	M75A
Group 9							
Sand	+++++	-	-	-	-	-	-
Buds	-	-	-	-	18	180, 1 c	3
Bud scales	-	-	-	-	-	-	-
Leaf remains	-	-	-	-	-	-	-
Moss remains	-	-	-	-	+	-	-
Fragments of catkins indet.	-	-	-	-	5	-	-
Charcoal	-	-	++	-	++	-	-
Bone/fish remains *	+	-	++	-	++	-	-
Pottery remains	-	-	-	-	+	-	-
Flint fragments	-	-	-	-	-	-	-
Bark remains	-	-	-	-	-	-	-
Insect remains	-	-	-	-	++	-	-
Faecal pellets	-	-	-	-	-	-	-
Lophopus cristallinus, statoblasts	-	-	-	-	-	-	-
Daphnia sp., ephippia	-	-	-	-	-	-	-
Cocoons	-	-	-	-	-	-	-
Cenococcum geophilum, sclerotia	++++ c	-	++	-	++	-	-
Trichoptera, cases of larvae	-	-	-	-	-	-	-
cf. Hypoxylon sp./Ustulina sp.	-	-	1	-	-	-	-
Valvata piscinalis	-	-	-	-	-	-	-
Bithynia tentaculata, opercula	-	-	-	-	-	-	-
Anodonta sp./ Unio sp., fragment tissue	-	-	-	-	-	-	-

Haz = Hazendonk
VL = Vlaardingen
VL 2b* = younger phase of VL 2b (based on stratigraphy)
l = litre, g = gram, refuse = refuse layer, / = or
* = bone and fish remains were found in a carbonised and waterlogged state

-	= not present	++++	= some hundreds (100-499)
+	= few (1-10)	*+	= some thousands (1000-5000)
++	= some tens (10-49)	+++++	= many hundreds (500-999)
+++	= many tens (50-99)	*+*+	= many thousands (>5000)

c = carbonised
x, yc = x macroremains including y carbonised macroremains
j = juvenile

Table III.11 The Hazendonk, macroremains that were collected during the excavation by active search for concentrations and by analysis of sieve residues, part 2e.

phase	Haz 3 (cont.)					
sample	M75C	M77B2	M84	M88	M154	?
unit	B	B	B	B	C	C
square	26	26	26	26	39	39
mesh width	5	5	0.25	0.25	5	?
volume	?	?	?	?	?	?
sediment	peat	peat	peat	sand	peat	peat
context	refuse	refuse	refuse	colluvium	refuse	refuse
taxon						
Group 1						
Tilia platyphyllos	-	-	-	-	-	-
Tilia sp.	-	-	-	-	-	-
Acer campestre	-	-	-	-	-	-
Quercus sp., cupulae	-	1	-	-	-	-
Quercus sp., cupulae with content	4	4 j	-	-	-	-
Quercus sp.	-	1	-	-	-	-
Malus sylvestris	4 c	3 c	-	-	-	-
Malus sylvestris, parenchyma	2 c	-	-	-	-	-
Viburnum opulus	-	2 c	-	-	-	-
Corylus avellana	7, 4 c	11, 8 c	-	1 c	2, 1 c	1
Prunus padus	-	-	-	-	-	-
Prunus spinosa	1	1	-	-	-	-
Cornus sanguinea	11, 1 c	54	-	1	12, 2 c	-
Sambucus nigra	-	-	-	3	-	-
Crataegus monogyna	-	1 c	-	-	-	-
Rubus caesius	-	-	-	-	-	-
Rubus fruticosus	-	-	-	13	-	-
Ajuga reptans	-	-	-	1	-	-
Anthriscus sylvestris	-	-	-	-	-	-
Carex remota	-	-	-	1	-	-
Chaerophyllum temulum	-	-	-	-	-	-
Galium aparine	-	-	-	-	-	-
Galium odoratum	-	-	-	-	-	-
Glechoma hederacea	-	-	-	-	-	-
Lamium album	-	-	-	-	-	-
Ranunculus ficaria, tubers	-	-	-	-	-	-
Urtica dioica	-	-	6	9	-	-

Table III.11 part 3a.

phase	Haz 3 (cont.)					
sample	M75C	M77B2	M84	M88	M154	?
Group 2						
Aethusa cynapium	-	-	-	-	-	-
Brassica rapa	-	-	-	-	-	-
Bromus secalinus-type	-	-	-	-	-	-
Capsella bursa-pastoris	-	-	-	-	-	-
Carduus crispus	-	-	-	-	-	-
Chenopodium album	-	-	1	-	-	-
Chenopodium ficifolium	-	-	-	-	-	-
Elytrigia repens	-	-	-	-	-	-
Fallopia convolvulus	-	-	-	-	-	-
Galium spurium	-	-	-	-	-	-
Persicaria lapathifolia	-	-	-	-	-	-
Persicaria maculosa	-	-	-	-	-	-
Silene latifolia ssp. alba	-	-	-	-	-	-
Solanum nigrum	-	-	-	-	-	-
Stellaria media	-	-	-	-	-	-
Veronica hederifolia	-	-	-	-	-	-
Vicia cf. tetrasperma	-	-	-	-	-	-
Group 3						
Hordeum sp./Triticum sp.	-	-	-	-	-	-
Hordeum vulgare var. nudum	-	7 c	-	-	-	-
Hordeum vulgare, internodia	-	-	-	-	-	-
Hordeum vulgare, chaff remains	-	-	-	-	-	-
Triticum dicoccon	7 c	2 c	-	-	1 c	-
Triticum dicoccon, spikelet forks	-	-	-	-	-	-
Triticum dicoccon, rachis segments	-	-	-	-	-	-
Triticum sp.	-	-	-	-	-	-
Triticum sp., rachis segments	-	-	-	-	-	-
Triticum sp., spikelet forks	-	-	-	-	-	-
Triticum sp., glume bases	-	-	-	-	-	-
Group 4						
Alnus glutinosa	-	-	-	-	-	-
Alnus glutinosa, cones	4	8	-	-	32	-

Table III.11 part 3b.

phase	Haz 3 (cont.)					
sample	M75C	M77B2	M84	M88	M154	?
Group 4 (cont.)						
Alnus glutinosa,						
fragments of male catkins	-	-	-	-	-	-
Humulus lupulus	-	-	-	-	-	-
Group 5						
Alisma plantago-aquatica	-	-	-	1	-	-
Berula erecta	-	-	-	-	-	-
Caltha palustris	-	-	-	-	-	-
Carex acutiformis	-	-	-	-	-	-
Carex elata	-	-	-	-	-	-
Carex pseudocyperus	-	-	-	-	-	-
Carex riparia	-	-	-	-	-	-
cf. Phragmites australis,						
stem fragments	-	-	-	-	-	-
Cladium mariscus	-	-	-	-	-	-
Eupatorium cannabinum	-	-	-	-	-	-
Euphorbia palustris	-	-	-	-	-	-
Hypericum cf. tetrapterum	-	-	-	-	-	-
Iris pseudacorus	-	-	-	-	-	-
Lythrum salicaria	-	-	-	-	-	-
Mentha aquatica	-	-	-	1	-	-
Menyanthes trifoliata	-	-	-	-	-	-
Oenanthe aquatica	-	-	-	-	-	-
Phragmites australis	-	-	-	-	-	-
Rumex hydrolapathum	-	-	-	-	-	-
Sagittaria sagittifolia	-	-	-	-	-	-
Schoenoplectus lacustris	-	-	-	-	-	-
Sium latifolium	-	-	-	-	-	-
Solanum dulcamara	-	-	-	1	-	-
Sparganium erectum	-	1	-	-	-	-
Sparganium erectum spp. erectum	-	-	-	-	-	-
Stachys palustris	-	-	-	-	-	-
Thalictrum flavum	-	-	-	-	-	-
Valeriana officinalis	-	-	-	-	-	-
Veronica beccabunga-type	-	-	-	-	-	-

Table III.11 part 3c.

phase	Haz 3 (cont.)					
sample	M75C	M77B2	M84	M88	M154	?
Group 6						
Persicaria hydropiper	-	-	-	-	-	-
Ranunculus repens	-	-	-	-	-	-
Ranunculus sceleratus	-	-	-	-	-	-
Rumex cf. crispus	-	-	-	-	-	-
Group 7						
Nymphaea alba	-	-	-	-	-	-
Nuphar lutea	-	-	-	-	-	-
Ranunculus cf. fluitans	-	-	-	-	-	-
Potamogeton alpinus	-	-	-	-	-	-
Potamogeton natans/perfoliatus	-	-	-	-	-	-
Trapa natans, spines	-	-	-	-	-	-
Trapa natans, bristles	-	-	-	-	-	-
Group 8						
Alopecurus myosuroides/pratensis	-	-	-	-	-	-
Anthoxanthum odoratum	-	-	-	-	-	-
Apiaceae	-	-	-	-	-	-
Carex sp.	-	-	-	-	-	-
cf. Holcus sp.	-	-	-	-	-	-
Mentha aquatica/arvensis	-	-	-	-	-	-
Phleum sp./Poa annua	-	-	-	-	-	-
Poa pratensis/trivialis	-	-	-	-	-	-
Poaceae	-	-	-	-	-	-
Potentilla sp.	-	-	-	-	-	-
Rosaceae	-	-	-	-	-	-
Rumex sp.	-	-	-	-	-	-
Scrophularia sp./Verbascum sp.	-	-	-	-	-	-
Stellaria sp.	-	-	-	-	-	-
Veronica austriaca/chamaedrys	-	-	-	-	-	-
Lathyrus palustris/Vicia cracca	-	-	-	-	-	-
Viola sp.	-	-	-	-	-	-
Indet.	-	3	-	1	-	-

Table III.11 part 3d.

phase	Haz 3 (cont.)					
sample	M75C	M77B2	M84	M88	M154	?
Group 9						
Sand	-	-	-	++++	-	-
Buds	3	50	-	-	-	-
Bud scales	-	-	-	-	-	-
Leaf remains	-	-	-	-	-	-
Moss remains	-	-	-	-	-	-
Fragments of catkins indet.	-	-	-	-	-	-
Charcoal	-	-	-	+	-	-
Bone/fish remains *	-	-	++	+	-	-
Pottery remains	-	-	-	-	-	-
Flint fragments	-	-	-	-	-	-
Bark remains	-	-	-	-	-	-
Insect remains	-	-	-	-	-	-
Faecal pellets	-	-	-	-	-	-
Lophopus cristallinus, statoblasts	-	-	-	-	-	-
Daphnia sp., ephippia	-	-	-	-	-	-
Cocoons	-	-	-	-	-	-
Cenococcum geophilum, sclerotia	-	-	-	+++	-	-
Trichoptera, cases of larvae	-	-	-	-	-	-
cf. Hypoxylon sp./Ustulina sp.	-	-	-	-	-	1
Valvata piscinalis	-	-	-	-	-	-
Bithynia tentaculata, opercula	-	-	1	-	-	-
Anodonta sp./Unio sp.,						
fragment tissue	-	-	-	-	-	-

Haz = Hazendonk
VL = Vlaardingen
VL 2b* = younger phase of VL 2b (based on stratigraphy),
l = litre, g = gram, refuse = refuse layer, / = or
* = bone and fish remains were found in a carbonised and waterlogged state

-	= not present	++++	= some hundreds (100-499)
+	= few (1-10)	*+	= some thousands (1000-5000)
++	= some tens (10-49)	+++++	= many hundreds (500-999)
+++	= many tens (50-99)	*+*+	= many thousands (>5000)

c = carbonised
x, yc = x macroremains including y carbonised macroremains
j = juvenile

Table III.11 The Hazendonk, macroremains that were collected during the excavation by active search for concentrations and by analysis of sieve residues, part 3e.

phase	Haz 3/VL 1b						
sample	M13a	M73A	M76A2	M110	M112	M102	M113
unit	B	B	B	C	C	D	D
square	5	26	26	36	35	31	31
mesh width	1.5	1.5	1.5	1.5	5	5	5
volume	?	?	?	?	?	?	?
sediment	peaty sand	peaty sand	peaty sand	peaty sand	peaty sand	peaty sand	peaty sand
context	all colluvium						
taxon							
Group 1							
Tilia platyphyllos	-	-	-	-	-	-	-
Tilia sp.	-	-	-	-	-	-	-
Acer campestre	-	-	-	-	-	-	-
Quercus sp., cupulae	-	2	3	-	-	-	-
Quercus sp., cupulae with content	-	1 j	2 j	-	-	-	-
Quercus sp.	-	-	-	-	-	-	-
Malus sylvestris	1 cf.	2, 1 c	-	-	-	1 c	-
Malus sylvestris, parenchyma	-	-	5 c	-	-	-	-
Viburnum opulus	-	-	1 c	-	-	-	-
Corylus avellana	-	4, 2 c	19, 6 c	1 c	1 c	-	-
Prunus padus	-	-	-	-	-	-	-
Prunus spinosa	-	-	4 c	-	-	-	2 c
Cornus sanguinea	-	6	29, 3 c	1 c	-	-	-
Sambucus nigra	14	16	-	-	-	-	-
Crataegus monogyna	-	-	-	-	-	-	1 c
Rubus caesius	-	-	-	-	-	-	-
Rubus fruticosus	17	25	-	-	-	-	-
Ajuga reptans	36	77	-	-	-	-	-
Anthriscus sylvestris	-	-	-	-	-	-	-
Carex remota	-	-	-	-	-	-	-
Chaerophyllum temulum	-	-	-	-	-	-	-
Galium aparine	-	1 c	-	-	-	-	-
Galium odoratum	-	-	-	-	-	-	-
Glechoma hederacea	1	1	-	-	-	-	-
Lamium album	-	-	-	-	-	-	-
Ranunculus ficaria, tubers	-	-	-	-	-	-	-
Urtica dioica	44	17	-	-	-	-	-

Table III.11 part 4a.

phase	Haz 3/VL 1b						
sample	M13a	M73A	M76A2	M110	M112	M102	M113
Group 2							
Aethusa cynapium	-	-	-	-	-	-	-
Brassica rapa	-	-	-	-	-	-	-
Bromus secalinus-type	-	-	-	-	-	-	-
Capsella bursa-pastoris	-	-	-	-	-	-	-
Carduus crispus	-	-	-	-	-	-	-
Chenopodium album	-	-	-	-	-	-	-
Chenopodium ficifolium	-	-	-	-	-	-	-
Elytrigia repens	-	-	-	-	-	-	-
Fallopia convolvulus	-	-	-	-	-	-	-
Galium spurium	-	-	-	-	-	-	-
Persicaria lapathifolia	-	-	-	-	-	-	-
Persicaria maculosa	-	-	-	-	-	-	-
Silene latifolia ssp. alba	-	-	-	-	-	-	-
Solanum nigrum	-	2	-	-	-	-	-
Stellaria media	3	1	-	-	-	-	-
Veronica hederifolia	-	-	-	-	-	-	-
Vicia cf. tetrasperma	-	-	-	-	-	-	-
Group 3							
Hordeum sp./Triticum sp.	-	-	-	-	-	-	-
Hordeum vulgare var. nudum	-	1 c	-	-	-	-	-
Hordeum vulgare, internodia	-	-	-	-	-	-	-
Hordeum vulgare, chaff remains	-	-	-	-	-	-	-
Triticum dicoccon	-	-	8 c	-	-	-	-
Triticum dicoccon, spikelet forks	-	-	-	-	-	-	-
Triticum dicoccon, rachis segments	-	-	-	-	-	-	-
Triticum sp.	-	-	-	-	-	-	-
Triticum sp., rachis segments	-	-	-	-	-	-	-
Triticum sp., spikelet forks	-	-	-	-	-	-	-
Triticum sp., glume bases	-	-	-	-	-	-	-
Group 4							
Alnus glutinosa	-	4	-	-	-	-	-
Alnus glutinosa, cones	-	-	2	1	-	-	-

Table III.11 part 4b.

phase	Haz 3/VL 1b						
sample	M13a	M73A	M76A2	M110	M112	M102	M113
Group 4 (cont.)							
Alnus glutinosa,							
fragments of male catkins	-	-	-	-	-	-	-
Humulus lupulus	-	-	-	-	-	-	-
Group 5							
Alisma plantago-aquatica	-	-	-	-	-	-	-
Berula erecta	-	-	-	-	-	-	-
Caltha palustris	-	-	-	-	-	-	-
Carex acutiformis	-	2	-	-	-	-	-
Carex elata	-	1	-	-	-	-	-
Carex pseudocyperus	-	5	-	-	-	-	-
Carex riparia	-	1	-	-	-	-	-
cf. Phragmites australis,							
stem fragments	-	-	-	-	-	-	-
Cladium mariscus	-	-	-	-	-	-	-
Eupatorium cannabinum	-	-	-	-	-	-	-
Euphorbia palustris	-	-	-	-	-	-	-
Hypericum cf. tetrapterum	-	-	-	-	-	-	-
Iris pseudacorus	-	-	-	-	-	-	-
Lythrum salicaria	-	1	-	-	-	-	-
Mentha aquatica	-	-	-	-	-	-	-
Menyanthes trifoliata	-	-	-	-	-	-	-
Oenanthe aquatica	-	-	-	-	-	-	-
Phragmites australis	-	-	-	-	-	-	-
Rumex hydrolapathum	-	1	-	-	-	-	-
Sagittaria sagittifolia	-	-	-	-	-	-	-
Schoenoplectus lacustris	-	-	-	-	-	-	-
Sium latifolium	-	-	-	-	-	-	-
Solanum dulcamara	-	-	-	-	-	-	-
Sparganium erectum	-	-	-	-	-	-	-
Sparganium erectum spp. erectum	3	6	-	-	-	-	-
Stachys palustris	-	1	-	-	-	-	-
Thalictrum flavum	-	-	-	-	-	-	-
Valeriana officinalis	-	-	-	-	-	-	-
Veronica beccabunga-type	-	-	-	-	-	-	-

Table III.11 part 4c.

phase	Haz 3/VL 1b						
sample	M13a	M73A	M76A2	M110	M112	M102	M113
Group 6							
Persicaria hydropiper	-	-	-	-	-	-	-
Ranunculus repens	1	4	-	-	-	-	-
Ranunculus sceleratus	-	-	-	-	-	-	-
Rumex cf. crispus	-	-	-	-	-	-	-
Group 7							
Nymphaea alba	-	-	-	-	-	-	-
Nuphar lutea	-	-	-	-	-	-	-
Ranunculus cf. fluitans	-	-	-	-	-	-	-
Potamogeton alpinus	-	-	-	-	-	-	-
Potamogeton natans/perfoliatus	-	-	-	-	-	-	-
Trapa natans, spines	-	-	-	-	-	-	-
Trapa natans, bristles	-	-	-	-	-	-	-
Group 8							
Alopecurus myosuroides/pratensis	-	-	-	-	-	-	-
Anthoxanthum odoratum	1	-	-	-	-	-	-
Apiaceae	-	-	-	-	-	-	-
Carex sp.	-	-	-	-	-	-	-
cf. Holcus sp.	3	-	-	-	-	-	-
Mentha aquatica/arvensis	-	-	-	-	-	-	-
Phleum sp./Poa annua	-	-	-	-	-	-	-
Poa pratensis/trivialis	-	-	-	-	-	-	-
Poaceae	-	-	-	-	-	-	-
Potentilla sp.	2, 1 c cf.	-	-	-	-	-	-
Rosaceae	-	-	-	-	-	-	-
Rumex sp.	1	-	-	-	-	-	-
Scrophularia sp./Verbascum sp.	-	-	-	-	-	-	-
Stellaria sp.	-	-	-	-	-	-	-
Veronica austriaca/chamaedrys	-	-	-	-	-	-	-
Lathyrus palustris/Vicia cracca	-	-	-	-	-	-	-
Viola sp.	-	-	-	-	-	-	-
Indet.	-	-	-	-	-	-	-

Table III.11 part 4d.

phase	Haz 3/VL 1b						
sample	M13a	M73A	M76A2	M110	M112	M102	M113
Group 9							
Sand	-	-	-	-	-	-	-
Buds	11	12	20	-	-	-	-
Bud scales	-	-	-	-	-	-	-
Leaf remains	-	-	-	-	-	-	-
Moss remains	-	-	-	-	-	-	-
Fragments of catkins indet.	-	-	-	-	-	-	-
Charcoal	-	+	-	-	-	-	-
Bone/fish remains *	-	+	-	-	-	-	-
Pottery remains	-	+	-	-	-	-	-
Flint fragments	-	+	-	-	-	-	-
Bark remains	-	+	-	-	-	-	-
Insect remains	+	++	-	-	-	-	-
Faecal pellets	-	-	-	-	-	-	-
Lophopus cristallinus, statoblasts	3	-	-	-	-	-	-
Daphnia sp., ephippia	-	-	-	-	-	-	-
Cocoons	+	++	-	-	-	-	-
Cenococcum geophilum, sclerotia	++++	+	-	-	-	-	-
Trichoptera, cases of larvae	-	+	-	-	-	-	-
cf. Hypoxylon sp./Ustulina sp.	-	-	-	-	-	-	-
Valvata piscinalis	-	-	-	-	-	-	-
Bithynia tentaculata, opercula	-	-	-	-	-	-	-
Anodonta sp./Unio sp.,							
fragment tissue	-	-	-	-	-	-	-

Haz = Hazendonk
VL = Vlaardingen
VL 2b* = younger phase of VL 2b (based on stratigraphy)
l = litre, g = gram, refuse = refuse layer, / = or
* = bone and fish remains were found in a carbonised and waterlogged state

-	= not present	++++	= some hundreds (100-499)
+	= few (1-10)	*+	= some thousands (1000-5000)
++	= some tens (10-49)	+++++	= many hundreds (500-999)
+++	= many tens (50-99)	*+*+	= many thousands (>5000)

c = carbonised
x, yc = x macroremains including y carbonised macroremains
j = juvenile

Table III.11 The Hazendonk, macroremains that were collected during the excavation by active search for concentrations and by analysis of sieve residues, part 4e.

phase	VL 1b							
sample	M49	M100	M116-117	M118	M187	M101	M103	M108
unit	B	C	C	C	C	D	D	D
square	25	36	8	8	42	31	9	9
mesh width	1.5	5	1.5?	1.5?	5	1.5	5	5
volume	?	?	?	?	?	?	?	?
sediment	peat	peat	peat	peat	peat	peat	peat	peat
context	refuse	refuse	refuse	refuse	refuse	refuse	refuse	refuse
taxon								
Group 1								
Tilia platyphyllos	-	-	-	-	-	-	-	-
Tilia sp.	-	-	-	-	-	-	-	-
Acer campestre	-	-	-	-	-	-	-	-
Quercus sp., cupulae	20	-	-	-	-	-	-	-
Quercus sp., cupulae with content	17	-	-	-	-	-	-	-
Quercus sp.	3, 2 j	-	-	-	-	-	-	-
Malus sylvestris	-	-	-	-	-	-	-	-
Malus sylvestris, parenchyma	-	-	-	-	-	-	-	-
Viburnum opulus	-	-	-	-	-	-	-	-
Corylus avellana	-	-	1	1 c	1	1 c	1 c	-
Prunus padus	-	-	-	-	-	-	-	-
Prunus spinosa	1	1 c	1	-	-	-	-	3 c
Cornus sanguinea	4	-	-	-	-	-	-	-
Sambucus nigra	-	-	1	1	-	-	-	-
Crataegus monogyna	-	-	-	-	-	-	1 c	-
Rubus caesius	-	-	-	-	-	-	-	-
Rubus fruticosus	3	-	++, ++ cf.	-	-	-	-	-
Ajuga reptans	-	-	-	-	-	-	-	-
Anthriscus sylvestris	-	-	-	-	-	-	-	-
Carex remota	-	-	-	-	-	-	-	-
Chaerophyllum temulum	-	-	-	-	-	-	-	-
Galium aparine	-	-	3, 1 c	4 c	-	-	-	-
Galium odoratum	-	-	-	-	-	-	-	-
Glechoma hederacea	-	-	-	-	-	-	-	-
Lamium album	-	-	-	-	-	-	-	-
Ranunculus ficaria, tubers	-	-	-	-	-	-	-	-
Urtica dioica	7	-	++++	++	-	-	-	-

Table III.11 part 5a.

phase	VL 1b							
sample	M49	M100	M116-117	M118	M187	M101	M103	M108
Group 2								
Aethusa cynapium	-	-	-	-	-	-	-	-
Brassica rapa	-	-	-	-	-	-	-	-
Bromus secalinus-type	-	-	-	-	-	-	-	-
Capsella bursa-pastoris	-	-	-	-	-	-	-	-
Carduus crispus	-	-	-	-	-	-	-	-
Chenopodium album	1	-	++++, + c	+++	-	-	-	-
Chenopodium ficifolium	-	-	++	+++	-	-	-	-
Elytrigia repens	-	-	-	-	-	-	-	-
Fallopia convolvulus	-	-	3 c	1 c	-	-	-	-
Galium spurium	-	-	-	-	-	-	-	-
Persicaria lapathifolia	-	-	+++	++	-	-	-	-
Persicaria maculosa	3	-	+++	-	-	-	-	-
Silene latifolia ssp. alba	1	-	-	-	-	-	-	-
Solanum nigrum	59, 1 c	-	++	+	-	-	-	-
Stellaria media	4	-	++	-	-	-	-	-
Veronica hederifolia	-	-	-	-	-	-	-	-
Vicia cf. tetrasperma	-	-	-	-	-	-	-	-
Group 3								
Hordeum sp./Triticum sp.	-	-	1 c	-	-	-	-	-
Hordeum vulgare var. nudum	-	-	-	1 c	-	-	-	7 c
Hordeum vulgare, internodia	-	-	2 c	-	-	-	-	-
Hordeum vulgare, chaff remains	-	-	-	-	-	-	-	-
Triticum dicoccon	-	-	-	-	-	-	-	-
Triticum dicoccon, spikelet forks	-	-	-	-	-	-	-	-
Triticum dicoccon, rachis segments	-	-	-	-	-	-	-	-
Triticum sp.	-	-	-	-	-	-	-	-
Triticum sp., rachis segments	-	-	-	-	-	-	-	-
Triticum sp., spikelet forks	-	-	1 c	-	-	-	-	-
Triticum sp., glume bases	-	-	-	1 c	-	-	-	-
Group 4								
Alnus glutinosa	19	-	++	-	-	-	-	-
Alnus glutinosa, cones	21	-	++	-	-	-	-	-

Table III.11 part 5b.

phase	VL 1b							
sample	M49	M100	M116-117	M118	M187	M101	M103	M108
Group 4 (cont.)								
Alnus glutinosa,								
fragments of male catkins	2	-	-	-	-	-	-	-
Humulus lupulus	-	-	-	-	-	-	-	-
Group 5								
Alisma plantago-aquatica	2	-	++	-	-	-	-	-
Berula erecta	-	-	-	-	-	-	-	-
Caltha palustris	-	-	-	-	-	-	-	-
Carex acutiformis	4	-	2	-	-	-	-	-
Carex elata	-	-	-	-	-	-	-	-
Carex pseudocyperus	-	-	++	-	-	-	-	-
Carex riparia	31	-	3	-	-	-	-	-
cf. Phragmites australis,								
stem fragments	-	-	-	-	-	-	-	-
Cladium mariscus	-	-	-	-	-	-	-	-
Eupatorium cannabinum	-	-	-	-	-	-	-	-
Euphorbia palustris	-	-	-	-	1	-	-	-
Hypericum cf. tetrapterum	1	-	-	-	-	-	-	-
Iris pseudacorus	-	-	-	-	-	-	-	-
Lythrum salicaria	-	-	++	-	-	-	-	-
Mentha aquatica	-	-	-	-	-	-	-	-
Menyanthes trifoliata	-	-	-	-	-	-	-	-
Oenanthe aquatica	2	-	-	-	-	-	-	-
Phragmites australis	-	-	-	-	-	-	-	-
Rumex hydrolapathum	-	-	-	-	-	-	-	-
Sagittaria sagittifolia	-	-	-	-	-	-	-	-
Schoenoplectus lacustris	-	-	1	-	-	-	-	-
Sium latifolium	-	-	1	-	-	-	-	-
Solanum dulcamara	6	-	++	+	-	-	-	-
Sparganium erectum	-	-	++	1	-	-	-	-
Sparganium erectum spp. erectum	18	-	-	-	-	-	-	-
Stachys palustris	8	-	++	-	-	-	-	-
Thalictrum flavum	-	-	-	-	-	-	-	-
Valeriana officinalis	-	-	1	-	-	-	-	-
Veronica beccabunga-type	-	-	++	-	-	-	-	-

Table III.11 part 5c.

phase	VL 1b							
sample	M49	M100	M116-117	M118	M187	M101	M103	M108
Group 6								
Persicaria hydropiper	2	-	++	-	-	-	-	-
Ranunculus repens	24	-	++	-	-	-	-	-
Ranunculus sceleratus	1	-	1	-	-	-	-	-
Rumex cf. crispus	-	-	-	-	-	-	-	-
Group 7								
Nymphaea alba	2	-	++, 2 c	3, 2 c	-	-	-	-
Nuphar lutea	-	-	-	-	-	-	-	-
Ranunculus cf. fluitans	-	-	-	-	-	-	-	-
Potamogeton alpinus	-	-	-	-	-	-	-	-
Potamogeton natans/perfoliatus	-	-	-	-	-	-	-	-
Trapa natans, spines	-	-	-	-	-	-	-	-
Trapa natans, bristles	-	-	-	-	-	-	-	-
Group 8								
Alopecurus myosuroides/pratensis	-	-	-	-	-	-	-	-
Anthoxanthum odoratum	-	-	-	-	-	-	-	-
Apiaceae	-	-	-	-	-	-	-	-
Carex sp.	-	-	-	+	-	-	-	-
cf. Holcus sp.	-	-	-	-	-	-	-	-
Mentha aquatica/arvensis	6	-	-	-	-	-	-	-
Phleum sp./Poa annua	-	-	-	-	-	-	-	-
Poa pratensis/trivialis	-	-	-	-	-	-	-	-
Poaceae	-	-	-	-	-	-	-	-
Potentilla sp.	-	-	-	-	-	-	-	-
Rosaceae	-	-	-	-	-	-	-	-
Rumex sp.	-	-	1	-	-	-	-	-
Scrophularia sp./Verbascum sp.	-	-	1 c	-	-	-	-	-
Stellaria sp.	-	-	-	+	-	-	-	-
Veronica austriaca/chamaedrys	-	-	-	-	-	-	-	-
Lathyrus palustris/Vicia cracca	-	-	-	-	-	-	-	-
Viola sp.	-	-	-	-	-	-	-	-
Indet.	-	-	1	-	-	-	-	-

Table III.11 part 5d.

phase	VL 1b							
sample	M49	M100	M116-117	M118	M187	M101	M103	M108
Group 9								
Sand	-	-	-	-	-	-	-	-
Buds	72	-	-	-	-	-	-	-
Bud scales	-	-	-	-	-	-	-	-
Leaf remains	-	-	-	-	-	-	-	-
Moss remains	+	-	-	-	-	-	-	-
Fragments of catkins indet.	-	-	-	-	-	-	-	-
Charcoal	+	-	+++++	+	-	-	-	-
Bone/fish remains *	+	-	*+*+	+	-	-	-	++
Pottery remains	+	-	+	-	-	-	-	-
Flint fragments	-	-	-	-	-	-	-	-
Bark remains	-	-	-	-	-	-	-	-
Insect remains	++	-	-	-	-	-	-	-
Faecal pellets	-	-	-	-	-	-	-	-
Lophopus cristallinus, statoblasts	-	-	-	-	-	-	-	-
Daphnia sp., ephippia	-	-	-	-	-	-	-	-
Cocoons	++	-	-	-	-	-	-	-
Cenococcum geophilum, sclerotia	-	-	+ c	+	-	-	-	-
Trichoptera, cases of larvae	+	-	-	-	-	-	-	-
cf. Hypoxylon sp./Ustulina sp.	-	-	-	-	-	-	-	-
Valvata piscinalis	-	-	-	-	-	-	-	-
Bithynia tentaculata, opercula	-	-	-	-	-	-	-	-
Anodonta sp./Unio sp., fragment tissue	-	-	-	-	-	-	-	-

Haz = Hazendonk
VL = Vlaardingen
VL 2b* = younger phase of VL 2b (based on stratigraphy)
l = litre, g = gram, refuse = refuse layer, / = or
* = bone and fish remains were found in a carbonised and waterlogged state

-	= not present	++++	= some hundreds (100-499)
+	= few (1-10)	*+	= some thousands (1000-5000)
++	= some tens (10-49)	+++++	= many hundreds (500-999)
+++	= many tens (50-99)	*+*+	= many thousands (>5000)

c = carbonised
x, yc = x macroremains including y carbonised macroremains
j = juvenile

Table III.11 The Hazendonk, macroremains that were collected during the excavation by active search for concentrations and by analysis of sieve residues, part 5e.

phase	VL 1b (cont.)				VL 2b	
sample	M109	M35	M8	M40	M20	M130
unit	D	-	-	-	-	E
square	9	10	11	11	12	24
mesh width	5	1.5	5	1.5	1.5	1.5
volume	?	?	?	?	?	?
sediment	peat	peat	peaty sand	peat	clay	clay
context	refuse	refuse	colluvium	refuse	channel fill	channel fill
taxon						
Group 1						
Tilia platyphyllos	-	-	-	-	-	-
Tilia sp.	-	-	-	-	-	-
Acer campestre	-	-	-	-	-	-
Quercus sp., cupulae	-	-	-	-	-	-
Quercus sp., cupulae with content	-	1 c	-	-	-	-
Quercus sp.	-	-	-	4, 2 c	-	-
Malus sylvestris	-	-	-	-	-	-
Malus sylvestris, parenchyma	-	-	-	-	-	-
Viburnum opulus	-	-	-	-	-	-
Corylus avellana	1 c	7, 5 c	-	1 c	-	1 c
Prunus padus	-	-	-	-	-	-
Prunus spinosa	2 c	2 c	-	2 c	-	-
Cornus sanguinea	3, 2 c	2	-	-	-	-
Sambucus nigra	-	-	-	-	1	3
Crataegus monogyna	3 c	-	-	-	-	-
Rubus caesius	-	-	-	-	-	-
Rubus fruticosus	-	10	-	1	7	-
Ajuga reptans	-	-	-	-	-	-
Anthriscus sylvestris	-	-	-	-	-	-
Carex remota	-	-	-	-	-	-
Chaerophyllum temulum	-	-	-	-	-	-
Galium aparine	-	-	-	3 c	1 c	-
Galium odoratum	-	-	-	-	-	-
Glechoma hederacea	-	-	-	1	-	-
Lamium album	-	-	-	-	1	-
Ranunculus ficaria, tubers	-	-	-	-	-	-
Urtica dioica	-	5	1	17	2	1

Table III.11 part 6a.

phase	VL 1b (cont.)				VL 2b	
sample	M109	M35	M8	M40	M20	M130
Group 2						
Aethusa cynapium	-	-	-	-	-	-
Brassica rapa	-	-	-	-	-	-
Bromus secalinus-type	-	-	-	-	-	-
Capsella bursa-pastoris	-	-	-	-	-	-
Carduus crispus	-	-	-	-	-	-
Chenopodium album	-	-	-	10	-	-
Chenopodium ficifolium	-	-	-	4	1	-
Elytrigia repens	-	-	-	-	-	-
Fallopia convolvulus	-	-	-	-	-	-
Galium spurium	-	-	-	-	-	-
Persicaria lapathifolia	-	3	1 c	-	-	-
Persicaria maculosa	-	-	-	-	-	-
Silene latifolia ssp. alba	-	-	-	-	-	-
Solanum nigrum	-	-	-	23	-	-
Stellaria media	-	-	-	-	-	2
Veronica hederifolia	-	-	-	-	-	-
Vicia cf. tetrasperma	-	-	-	-	-	-
Group 3						
Hordeum sp./Triticum sp.	-	1 c	-	1 c	-	-
Hordeum vulgare var. nudum	9 c	2 c	-	-	3c	-
Hordeum vulgare, internodia	-	-	-	-	-	-
Hordeum vulgare, chaff remains	-	-	-	-	-	-
Triticum dicoccon	-	4 c	-	-	-	-
Triticum dicoccon, spikelet forks	-	-	-	-	-	-
Triticum dicoccon, rachis segments	-	-	-	-	-	-
Triticum sp.	-	-	-	1 c	-	-
Triticum sp., rachis segments	-	-	-	-	-	-
Triticum sp., spikelet forks	-	-	-	-	-	-
Triticum sp., glume bases	-	-	-	-	-	-
Group 4						
Alnus glutinosa	-	8	-	-	2	32
Alnus glutinosa, cones	2	18	-	-	1	+

Table III.11 part 6b.

phase	VL 1b (cont.)				VL 2b	
sample	M109	M35	M8	M40	M20	M130
Group 4 (cont.)						
Alnus glutinosa,						
fragments of male catkins	-	14	-	-	-	-
Humulus lupulus	-	3	-	-	-	-
Group 5						
Alisma plantago-aquatica	-	-	-	-	-	1
Berula erecta	-	-	-	-	-	-
Caltha palustris	-	-	-	-	-	1
Carex acutiformis	-	2	-	-	-	-
Carex elata	-	-	-	-	-	-
Carex pseudocyperus	-	-	-	-	-	-
Carex riparia	-	2	-	-	3	1
cf. Phragmites australis,						
stem fragments	-	-	-	-	-	-
Cladium mariscus	-	-	-	-	-	-
Eupatorium cannabinum	-	-	-	-	-	-
Euphorbia palustris	-	4	-	-	-	-
Hypericum cf. tetrapterum	-	-	-	-	-	-
Iris pseudacorus	1 c	-	-	-	-	-
Lythrum salicaria	-	2	-	1	-	-
Mentha aquatica	-	-	-	-	-	-
Menyanthes trifoliata	-	-	-	-	-	-
Oenanthe aquatica	-	-	-	-	-	-
Phragmites australis	-	-	-	-	-	1
Rumex hydrolapathum	-	-	-	-	-	-
Sagittaria sagittifolia	-	-	-	-	-	-
Schoenoplectus lacustris	-	1	-	-	-	-
Sium latifolium	-	-	-	-	-	-
Solanum dulcamara	-	14	-	2	4	2
Sparganium erectum	-	-	-	-	-	1
Sparganium erectum spp. erectum	-	2	-	-	1	-
Stachys palustris	-	-	-	-	1	2
Thalictrum flavum	-	-	-	-	-	-
Valeriana officinalis	-	-	-	-	-	-
Veronica beccabunga-type	-	-	-	-	-	-

Table III.11 part 6c.

phase	VL 1b (cont.)				VL 2b	
sample	M109	M35	M8	M40	M20	M130
Group 6						
Persicaria hydropiper	-	-	-	-	-	1
Ranunculus repens	-	10	-	-	7	2
Ranunculus sceleratus	-	-	-	3	-	1
Rumex cf. crispus	-	-	-	-	-	-
Group 7						
Nymphaea alba	-	3 c	-	2 c	1 c	-
Nuphar lutea	-	-	-	-	-	-
Ranunculus cf. fluitans	-	-	-	-	-	2
Potamogeton alpinus	-	-	-	-	-	1
Potamogeton natans/perfoliatus	-	-	-	-	1	-
Trapa natans, spines	-	-	-	-	-	-
Trapa natans, bristles	-	-	-	-	-	-
Group 8						
Alopecurus myosuroides/pratensis	-	-	-	-	13	-
Anthoxanthum odoratum	-	-	-	-	3	-
Apiaceae	-	-	-	-	-	-
Carex sp.	-	-	-	-	-	-
cf. Holcus sp.	-	1	-	-	-	-
Mentha aquatica/arvensis	-	-	-	-	-	-
Phleum sp./Poa annua	-	-	-	-	-	-
Poa pratensis/trivialis	-	-	-	-	-	2
Poaceae	-	-	-	4	-	-
Potentilla sp.	-	-	-	-	-	-
Rosaceae	-	-	-	-	-	-
Rumex sp.	-	-	-	-	-	1
Scrophularia sp./Verbascum sp.	-	-	-	-	-	-
Stellaria sp.	-	-	-	-	-	-
Veronica austriaca/chamaedrys	-	-	-	-	-	-
Lathyrus palustris/Vicia cracca	-	-	-	-	-	-
Viola sp.	-	-	-	-	-	-
Indet.	-	+, + c	1	-	-	-

Table III.11 part 6d.

phase	VL 1b (cont.)				VL 2b	
sample	M109	M35	M8	M40	M20	M130
Group 9						
Sand	-	-	-	+	-	-
Buds	1	13	-	-	7	-
Bud scales	-	-	-	-	-	-
Leaf remains	-	-	-	-	-	-
Moss remains	-	+	-	-	+	-
Fragments of catkins indet.	-	-	-	-	-	-
Charcoal	-	++	-	++	+++	-
Bone/fish remains *	-	++	-	++	+++	+
Pottery remains	-	+	-	++	-	-
Flint fragments	-	+	-	+	-	-
Bark remains	-	-	-	-	-	-
Insect remains	-	-	-	-	-	-
Faecal pellets	-	-	-	-	-	-
Lophopus cristallinus, statoblasts	-	-	-	-	-	-
Daphnia sp., ephippia	-	-	-	-	-	-
Cocoons	-	++	-	+	8	++
Cenococcum geophilum, sclerotia	-	-	-	-	-	+
Trichoptera, cases of larvae	-	+	-	-	3	-
cf. Hypoxylon sp./Ustulina sp.	-	-	-	-	-	-
Valvata piscinalis	-	-	-	1	-	-
Bithynia tentaculata, opercula	-	-	-	-	3	-
Anodonta sp./Unio sp.,						
fragment tissue	-	+	-	-	-	1

Haz = Hazendonk
VL = Vlaardingen
VL 2b* = younger phase of VL 2b (based on stratigraphy)
l = litre, g = gram, refuse = refuse layer, / = or
* = bone and fish remains were found in a carbonised and waterlogged state

-	= not present	++++	= some hundreds (100-499)
+	= few (1-10)	*+	= some thousands (1000-5000)
++	= some tens (10-49)	+++++	= many hundreds (500-999)
+++	= many tens (50-99)	*+*+	= many thousands (>5000)

c = carbonised
x, yc = x macroremains including y carbonised macroremains
j = juvenile

Table III.11 The Hazendonk, macroremains that were collected during the excavation by active search for concentrations and by analysis of sieve residues, part 6e.

phase	VL 2b*			?		
sample	M22	M28	M41	M19C	M48	M114
unit	A	A	B	A	B	?
square	3	3	25	17	21	?
mesh width	1.5	1.5	1.5	?	?	1.5
volume	?	?	?	?	130 g	?
sediment	clay	clay	clay	sand	sand	
context	refuse	pit	pit	pit	pit	
taxon						
Group 1						
Tilia platyphyllos	-	-	-	-	-	-
Tilia sp.	-	-	-	-	-	-
Acer campestre	-	-	25	-	-	-
Quercus sp., cupulae	2, 1 j	14, 2 j	+++, ++ j	-	-	-
Quercus sp., cupulae with content	-	-	+++, +++ j	-	-	-
Quercus sp.	-	2	21, 3 j	-	-	-
Malus sylvestris	-	-	-	-	-	-
Malus sylvestris, parenchyma	-	-	-	-	-	-
Viburnum opulus	-	-	-	-	-	-
Corylus avellana	-	-	-	-	-	-
Prunus padus	-	-	2	-	-	-
Prunus spinosa	-	-	-	-	-	1 c
Cornus sanguinea	-	-	-	-	-	-
Sambucus nigra	4	-	-	-	-	-
Crataegus monogyna	-	-	-	-	-	1 c
Rubus caesius	1	-	-	-	-	-
Rubus fruticosus	4	-	-	-	-	-
Ajuga reptans	-	-	-	-	-	-
Anthriscus sylvestris	-	-	-	-	-	-
Carex remota	-	-	-	-	-	-
Chaerophyllum temulum	-	-	-	-	-	-
Galium aparine	-	-	-	-	-	-
Galium odoratum	-	-	-	-	-	-
Glechoma hederacea	-	-	-	-	-	-
Lamium album	-	-	-	-	-	-
Ranunculus ficaria, tubers	-	-	-	-	-	-
Urtica dioica	3	-	11	-	-	-

Table III.11 part 7a.

phase	VL 2b*			?		
sample	M22	M28	M41	M19C	M48	M114
Group 2						
Aethusa cynapium	2	-	-	-	-	-
Brassica rapa	-	-	-	-	-	-
Bromus secalinus-type	-	-	-	-	-	-
Capsella bursa-pastoris	-	-	-	-	-	-
Carduus crispus	1	-	-	-	-	-
Chenopodium album	2	-	-	-	-	-
Chenopodium ficifolium	-	-	-	-	-	-
Elytrigia repens	-	-	-	-	-	-
Fallopia convolvulus	-	-	-	-	-	-
Galium spurium	-	-	-	-	-	-
Persicaria lapathifolia	2	-	-	-	-	-
Persicaria maculosa	4	-	-	-	-	-
Silene latifolia ssp. alba	-	-	-	-	-	-
Solanum nigrum	-	-	-	-	-	-
Stellaria media	-	-	1	1	-	-
Veronica hederifolia	-	-	-	-	-	-
Vicia cf. tetrasperma	-	-	-	1 c	-	-
Group 3						
Hordeum sp./Triticum sp.	-	-	-	-	-	1 c
Hordeum vulgare var. nudum	-	-	-	-	-	-
Hordeum vulgare, internodia	-	-	-	-	-	-
Hordeum vulgare, chaff remains	-	-	-	-	-	-
Triticum dicoccon	-	-	-	-	-	-
Triticum dicoccon, spikelet forks	-	-	-	-	-	-
Triticum dicoccon, rachis segments	-	-	-	-	-	-
Triticum sp.	-	-	-	-	-	-
Triticum sp., rachis segments	-	-	-	-	-	-
Triticum sp., spikelet forks	-	-	-	-	-	-
Triticum sp., glume bases	-	-	-	-	-	-
Group 4						
Alnus glutinosa	404	-	95	-	-	-
Alnus glutinosa, cones	66	-	89	-	-	1

Table III.11 part 7b.

phase	VL 2b*			?		
sample	M22	M28	M41	M19C	M48	M114
Group 4 (cont.)						
Alnus glutinosa,						
fragments of male catkins	-	-	3	-	-	-
Humulus lupulus	5	-	-	-	-	-
Group 5						
Alisma plantago-aquatica	-	-	8	-	-	-
Berula erecta	-	-	-	-	-	-
Caltha palustris	-	-	-	-	-	-
Carex acutiformis	6	-	-	-	-	-
Carex elata	6	-	4	-	-	-
Carex pseudocyperus	-	-	4	-	-	-
Carex riparia	56	-	4	-	-	-
cf. Phragmites australis,						
stem fragments	-	-	-	-	-	-
Cladium mariscus	-	-	-	-	-	-
Eupatorium cannabinum	-	-	-	-	-	-
Euphorbia palustris	1	-	-	-	-	-
Hypericum cf. tetrapterum	-	-	-	-	-	-
Iris pseudacorus	-	-	4	-	-	-
Lythrum salicaria	-	-	-	-	-	-
Mentha aquatica	-	-	-	-	-	-
Menyanthes trifoliata	-	-	-	-	-	-
Oenanthe aquatica	20	-	22	-	-	-
Phragmites australis	-	-	-	-	-	-
Rumex hydrolapathum	2	-	-	-	-	-
Sagittaria sagittifolia	4	-	-	-	-	-
Schoenoplectus lacustris	-	-	-	-	-	-
Sium latifolium	8	-	2	-	-	-
Solanum dulcamara	26	-	4	-	-	-
Sparganium erectum	-	-	-	-	-	-
Sparganium erectum spp. erectum	110	-	-	-	-	-
Stachys palustris	18	-	1	1	-	-
Thalictrum flavum	11	-	-	-	-	-
Valeriana officinalis	1	-	1	-	-	-
Veronica beccabunga-type	-	-	-	-	-	-

Table III.11 part 7c.

phase	VL 2b*			?		
sample	M22	M28	M41	M19C	M48	M114
Group 6						
Persicaria hydropiper	5	-	-	-	-	-
Ranunculus repens	38	-	5	-	-	-
Ranunculus sceleratus	-	-	-	-	-	-
Rumex cf. crispus	-	-	-	-	-	-
Group 7						
Nymphaea alba	14	-	-	-	-	-
Nuphar lutea	13	-	-	-	-	-
Ranunculus cf. fluitans	1	-	-	-	-	-
Potamogeton alpinus	29	-	-	-	-	-
Potamogeton natans/perfoliatus	-	-	-	-	-	-
Trapa natans, spines	-	-	-	-	-	-
Trapa natans, bristles	-	-	-	-	-	-
Group 8						
Alopecurus myosuroides/pratensis	-	-	-	-	-	-
Anthoxanthum odoratum	-	-	-	1	-	-
Apiaceae	11**	-	2	-	-	-
Carex sp.	-	-	-	-	-	-
cf. Holcus sp.	1	-	-	-	-	-
Mentha aquatica/arvensis	-	-	-	-	-	-
Phleum sp./Poa annua	-	-	-	-	-	-
Poa pratensis/trivialis	-	-	-	-	-	-
Poaceae	-	-	-	-	-	-
Potentilla sp.	-	-	-	-	-	-
Rosaceae	-	-	-	-	-	-
Rumex sp.	1	-	-	-	-	-
Scrophularia sp./Verbascum sp.	-	-	-	-	-	-
Stellaria sp.	3	-	-	-	-	-
Veronica austriaca/chamaedrys	-	-	-	-	-	-
Lathyrus palustris/Vicia cracca	-	-	-	-	-	-
Viola sp.	1	-	-	-	-	-
Indet.	1	-	-	-	2, 1 c	-

Table III.11 part 7d.

phase	VL 2b*			?		
sample	M22	M28	M41	M19C	M48	M114
Group 9						
Sand	-	-	-	-	-	-
Buds	37	-	+++	-	-	-
Bud scales	-	-	-	-	-	-
Leaf remains	+	-	-	-	-	-
Moss remains	++	-	+	-	-	-
Fragments of catkins indet.	13	-	+	-	-	-
Charcoal	-	-	+	-	-	-
Bone/fish remains *	+++	-	-	-	+	-
Pottery remains	-	-	+	-	-	-
Flint fragments	+	-	-	-	+	-
Bark remains	-	-	+	-	-	-
Insect remains	++	-	-	-	-	-
Faecal pellets	12	-	-	-	-	-
Lophopus cristallinus, statoblasts	-	-	-	-	-	-
Daphnia sp., ephippia	-	-	+	-	-	-
Cocoons	++	-	++	-	-	-
Cenococcum geophilum, sclerotia	-	-	-	-	-	-
Trichoptera, cases of larvae	++	-	-	-	-	-
cf. Hypoxylon sp./Ustulina sp.	-	-	-	-	-	-
Valvata piscinalis	-	-	-	-	-	-
Bithynia tentaculata, opercula	-	-	-	-	-	-
Anodonta sp./Unio sp., fragment tissue	-	-	-	-	-	-

Haz = Hazendonk
VL = Vlaardingen
VL 2b* = younger phase of VL 2b (based on stratigraphy)
l = litre, g = gram, refuse = refuse layer, / = or
* = bone and fish remains were found in a carbonised and waterlogged state
** = possibly all representing *Oenanthe aquatica*

-	= not present	++++	= some hundreds (100-499)
+	= few (1-10)	*+	= some thousands (1000-5000)
++	= some tens (10-49)	+++++	= many hundreds (500-999)
+++	= many tens (50-99)	*+*+	= many thousands (>5000)

c = carbonised
x, yc = x macroremains including y carbonised macroremains
j = juvenile

Table III.11 The Hazendonk, macroremains that were collected during the excavation by active search for concentrations and by analysis of sieve residues, part 7e.