PALAEOBOTANICAL STUDIES OF SETTLEMENT SITES IN THE COASTAL AREA OF THE NETHERLANDS

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CONTENTS

1. INTRODUCTION

In this paper the results will be discussed of the examination of plant macrofossils, mainly seeds and fruits, which were recovered from Iron Age and Medieval settlement sites in the coastal area of the Netherlands.

The most conspicuous vestiges of earlier settlement sites in the coastal area are the habitation mounds (*terps*) which are found in the north of the Netherlands and in the northwest of Germany. Other habitation sites, which are covered by marine clay deposits, come to light only in the course of digging operations on behalf of the construction of roads, houses, and so on. In these coastal sites the conditions for the preservation of plant remains are often good. Not infrequently, thick layers of vegetal debris (manure, dung) are met with. The good state of preservation of subfossil plant material in the sites concerned is due to the fact that in a moist environment these remains are sealed off from the air.

The first mention of plant remains in coastal settlement sites in the Netherlands is by Acker Stratingh (1849, p. 217), who reports on seeds of celtic bean and flax met with during systematic excavations of the Warffumer Wierde (Warffum) and the Kloosterwierde near Usquert, in the north of the province of Groningen. Westerhoff (1871) found celtic bean, linseed, and oats in the Wadwerder Wierde near Usquert. The first systematic study of plant remains in habitation mounds was carried out by Beijerinck (1929-1931). This author studied fruits, seeds, diatoms, pollen grains, and other macrofossil and microfossil plant remains from 17 *terps* in the provinces of Groningen and Friesland. Beijerinck identified the seeds and fruits of 65 species, three of which are crop plants. It is regrettable that a somewhat accurate archaeological dating of most of the samples examined by Beijerinck is not possible.

After Beijerinck's investigations more than 20 years passed by until the palaeobotanical examination of habitation mounds was resumed. This time the thread of Beijerinck's investigations was taken up in the Niedersächsisches Landesinstitut für Marschen- und Wurtenforschung at Wilhelmshaven, West Germany. Scheer (1955) examined the seeds and fruits from the habitation mound of Tofting, in Schleswig-Holstein. A brilliant palaeobotanical examination was carried out by Körber-Grohne (1967) of the Feddersen Wierde, north of Bremerhaven, which was excavated by Haarnagel and collaborators in 1955-1963 (Haarnagel 1956, 1957, 1961, 1963). This site lent itself extremely well for a palaeobotanical examination because of its richness in organic remains. Körber-Grohne's study included the examination of wood, seeds, fruits, and other plant macrofossils as well as pollen and diatom analysis. This author arrived at detailed reconstructions of the vegetation types in the vicinity of

Fig. 1 Map of the Netherlands showing the location of the sites referred to in this paper.

the Feddersen Wierde, while much information was also obtained on the crop plants and on plant cultivation in the unprotected salt marsh.

Since 1959, in the Biologisch-Archaeologisch Instituut (B.A.I.) palaeobotanical studies are being made of sites in the coastal area, be it with many interruptions. The information which has been obtained so far, will be reviewed here. A few sites, the palaeobotanical examination of which has not yet been completed, will not be included in the discussion. On the crop plants, which are represented in the coastal settlement sites, has already been reported in an earlier paper (Van Zeist (1968) 1970).

The location of the Dutch sites mentioned in this paper is indicated in fig. 1.

Acknowledgements

This study would never have been possible without the cooperation of many people. Collaboration in the field and/or information on the sites was received from Mr. G. Elzinga, Professor W. A. van Es, the late Professor A. E. van Giffen, Professor P. J. R. Modderman, Ir. J. A. Trimpe Burger, and Professor H. T. Waterbolk. A larger number of samples was collected by Dr. W. A. Casparie. In the laboratory the present author was assisted by Mrs. L. van Duinen, Mrs. A. M. Boekschoten-van Helsdingen, Mrs. I. W. J. Wolters-van Otterloo, Mrs. H. J. Steur-van de Graaf, Mrs. R. M. Palfenier-Vegter, Mrs. G. F. Oosterveld-Boers, Mr. Y. Jongema, and Mr. H. Woldring. The typing was carried out by Miss A. Oostwouder.

Mr. H. J. During identified the moss remains. Ir. H. Toxopeus provided information on *Brassica*. The identification of some seeds and fruits was discussed with Dr. U. Körber-Grohne. The photographs were made by Dr. W. A. Casparie, while Mr. H. R. Roelink prepared the drawings. Mr. H. Praamstra checked up on the stratigraphical position of various samples. Dr. P. A. Tallantire advised on the description of the methods (chapter 2). The English text was corrected by Dr. J. J. Butler.

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2. MATERIAL, METHODS, AND RESULTS

2.1. *THE SITES*

2.1.1. PADDEPOEL-GRONINGEN

In the Paddepoel area, now a residential quarter in the northwestern part of the city of Groningen, three small and low habitation mounds (Paddepoel I, II and III) were excavated by the Biologisch-Archaeologisch Instituut (Van Es (1968) 1970). For a description of the geographical situation of the Paddepoel area and its vicinity the reader is referred to 4.2.2.1. The sites, which were founded on clay deposits of the Pre-Roman transgression, were sealed off by marine clay.

Each *terp* started as a house site on the flat surface (*Flachsiedlung*). Later on, the houses were built on sod platforms which in the course of time reached a height of about one metre. The platforms were surrounded by ditches. On the basis of the pottery finds and on the radiocarbon evidence the habitation can be dated from about 200 B.C. to about 250 A.D. Three periods of habitation are distinguished, but an accurate dating of each period cannot be given.

Paddepoel III was the most extensively excavated site and the majority of the botanical samples is from that site. Vegetal debris (dung) had only been preserved in former ditches and pits which had always lain below the ground water table. The samples that were examined (table 1) are listed below. The plans and the squares refer to Van Es (1968) 1970.

IIA: Paddepoel II, plan X, square X-63, fill of ditch, period 1.
124: Paddepoel I, plan IV, square G-5, fill of round pit, period 1.
224: Paddepoel III, plan XX, section H1, square Ag, fill of ditch, period 1 or beginning of period 2.
246: Paddepoel III, plan XVIII, square Z-17, fill of ditch, beginning of period 2.
248: Paddepoel III, plan XVIII, square Ad-10, fill of pit, period 2.
327: Paddepoel III, plan XVIII, square Ad-5, fill of pit, period 2.
272: Paddepoel III, plan XVIII, square Z-11, fil of ditch, beginning of period 3.
274: Paddepoel III, plan XVIII, square Z-11, fill of ditch, beginning of period 3.
299: Paddepoel III, plan XVIII, square Aa-23, fill of ditch, beginning of period 3.
300: Paddepoel III, plan XVIII, square Aa-23 fill of ditch, beginning of period 3.

2.1.2. EZINGE

Systematic excavations of the *terp* of Ezinge were executed under the direction of the late Professor A. E. van Giffen in 1931-1934 (Van Giffen 1936, 1940). This investigation, which became a model for later *terp* excavations, brought to light successive stages of habitation, each with large farm-houses. For the later stages of habitation a radially orientated settlement pattern could be established. Organic remains were very well preserved at Ezinge. Beijerinck (1929, table III) examined a series samples from Ezinge for seeds, fruits, and flowers.

In October 1964 a small re-examination took place on the northern side of the *terp* remnant. During this investigation two samples were secured for botanical examination (table 2):

Ezinge A, dung layer from period 2, ca. 300 B.C.
Ezinge B, dung layer from period 3, ca. 100 B.C.

2.1.3. TZUMMARUM-MONNIKENTERP

In 1961, a section through the Monnikenterp, ca. 1 km west of Tzummarum (Gem. Barradeel), and a trench in front of the section were examined. The habitation started at about 600 A.D., while the youngest phase of the mound, which is up to 3 m high, is dated to about 1000 A.D. Altogether 7 to 8 accumulation layers could be distinguished (Elzinga 1961). Six samples from this terp were examined for plant remains (table 3):

nr. 77, section, old turf line at the base of the *terp*, period 1.
66, trench, surface of level 5, "grass", period 1.
70, section, dung layer, period 1 or 2.
80, section, dung layer, period 2.
46, trench, surface of level 3, "grass", period 3.
79, section, dung layer in ditch, period 3.

2.1.4. LEEUWARDEN

In 1965, during building operations in the grounds of the Coöperatieve Condensfabriek "Friesland" at Leeuwarden, a layer of organic debris was discovered underneath about 2.5 m of marine sediments (Elzinga 1966). In this dung layer, which was up to 25 cm thick, animal bones and pottery sherds were present. The pottery dates these remains of human habitation to 600-400 B.C. (Zeijen Culture, cf. Waterbolk 1962). No excavations were carried out, but a few samples were taken for palaeobotanical examination, two of which were studied (table 4):

Leeuwarden I, from the lower part of the dung layer.
Leeuwarden II, from the upper part of the dung layer.

2.1.5. TRITSUM

A part of the habitation mound of Tritsum (Gem. Franekeradeel), ca. 6 km south of Franeker, was excavated by the Biologisch-Archaeologisch Instituut in 1958-1961 (Waterbolk 1961). A great number of storage pits, wells, and dwelling pits was found but no larger farm-houses. Eight major periods of habitation, dating from ca. 500 B.C. to ca. 200 A.D., could be established. Unfortunately, only very little vegetal debris was present. It is likely that the inhabitants of the site used the dung as fuel. Because of the great distance from the higher land, timber would have been a scarce commodity. In consequence of the scarcity of vegetal debris the palaeobotanical investigation could not assume the proportion that had been visualized (table 5).

Tritsum 3266: trench 6, level 11, square g-7, ditch, period 1.
2998: trench 5, level 9, square d-10, ditch, period 1.
2763: trench 6, level 9, square e-8, ditch, period 1.
3234: trench 5, level 10, square e-5, ditch, period 2.
3013: trench 3, level 9, square B-10, ditch, period 2.
2981: trench 3, level 8, square B-9, surface, period 3.
2986: trench 3, level 8, square D-8, surface, period 3.
2988: trench 3, level 8, square D-9, surface, period 3.
2994: trench 3, level 8, square C-9, pit, period 3.
3094: trench 3, level 10, square G-10, ditch, period 3.
3280: trench 6, level 10, square f-9, well, period 3 or younger.
2984: trench 3, level 8, square E-10, surface, period 4.
1141: trench 4, level 5, square E, F-13, dwelling pit H 25, period 7.
1264: trench 1, level 8, square E-1, ditch, period 7.
2762: trench 3, level 7a, square G-11, pit, period 7 or 8.
1541: trench 1, level 11, square F-2, pit, period 8.

2.1.6. SNEEK

In the grounds of the Nieuwe Jachthaven (New Yacht-haven), northeast of the town of Sneek, traces of habitation were found under marine clay. The habitation had taken place on peat, on which a ca. 10 cm thick clay layer had been deposited. It is likely that the peat landscape was dissected by creeks which had encroached upon the area probably during the Pre-Roman transgression phase. Pottery dates the habitation to the first centuries A.D.

An excavation, carried out by the Biologisch-Archaeologisch Instituut in 1961, provided evidence for a platform of peat sods covered by clay. On one side the platform was bordered by a pit, which was 6 m broad, 1 m deep, and at least 20 m long. This pit was filled with dung. In the creek on the other side of the platform dung layers were also observed (Elzinga 1962). Four samples from this site were examined (table 6). The sections refer to Elzinga (1962, figs. 1 and 2).

Sneek 1: section F, middle sample from dung pit.
2: section E, upper sample from dung pit.
3: section E, lower sample from dung pit.
4: section C, lower dung layer in creek.

2.1.7. DEN HELDER-HET TORP

The habitation mound "Het Torp" was situated southeast of Den Helder. Before this *terp* was sacrificed to an extension scheme of Den Helder a small part of it could be excavated (Van Es in press). This excavation brought to light individual house sites (nuclear *terps*) which in a later stage fused into one large *terp*. The interior of the houses, of the three-aisled type, was about 15 m long and more than 5 m wide. The thick house walls were built of clay sods. The beginning of the habitation is dated to the 10th century A.D., while the accumulation would have continued up to the 14th century.

Six samples were examined for seeds and fruits (table 7). The trench number and the sections refer to Van Es (in press).

Den Helder 488: trench 22, humic fill of ditch.
865: trench 22, east section, middle part, from outside house of sample 866.
866: trench 22, east section, floor layer in house.
867: trench 22, east section, northern part, ditch belonging to house of sample 866.
919: trench 22, south section, humic fill of ditch.
920: trench 22, level 13, humic fill of ditch.

These samples, which originate from the early phases of habitation, can be dated to the 10th to 12th century A.D.

Table 7 shows a few differences from the one published elsewhere (Van Zeist in press). A few identifications have been revised, while in the mean time the moss remains have been identified.

2.1.8. VLAARDINGEN-BROEKPOLDER

In the Broekpolder, northwest of the town of Vlaardingen, a house site was found on peat. The floor consisted of a 10 to 15 cm thick layer of reed stems. Of many posts the lower part was still preserved and remains of wicker-work walls could also be observed (Sonneveld & Verhagen 1958). For this site a radiocarbon date of 370± 70 B.C. (GrN-1951) has been obtained. This house site was covered by marine clay.

From a similar site in the Broekpolder a deposit of organic debris, about

0.75 m thick, was submitted for botanical examination by Mr. H. J. Verhagen (now at Zwolle). From this deposit a series of 7 successive samples was analysed (table 8).

2.1.9. SCHIEDAM-KETHEL

About one kilometre south of the original village of Kethel (from a rural village Kethel has developed into a suburban residential quarter) a small group of farm-houses was excavated by the Rijksdienst voor het Oudheidkundig Bodemonderzoek in 1961 (Halbertsma 1961, Halbertsma & Modderman 1961, Halbertsma & Van Duijn 1961, Modderman 1961). The walls of these houses, which were about 5 m wide and from 6.5 to more than 9 m long, consisted of wicker-work. The houses were at least in part surrounded by wicker-work fences. On the ground of the pottery finds the habitation can be dated from about 100 to 250 A.D. This hamlet was situated near a (narrow) creek in a peat landscape. Before the habitation started a thin layer of clay had been deposited on top of the peat. The settlement remains were sealed off by marine clay.

Four samples from layers of organic refuse were examined (table 9):

Schiedam 119: no data on origin of sample.
178: trench 2, "grass".
191: trench 2, dung from pit in northern part of house.
203: trench 2, level 5.

2.1.10. OUDDORP-DE OUDE OOSTDIJK

In the polder "De Oude Oostdijk", Gem. Ouddorp, about 0.5 km north of the town of Goedereede, part of a Roman civil settlement was excavated by the Rijksdienst voor het Oudheidkundig Bodemonderzoek in 1958 and 1959 (Trimpe Burger 1960-1961). This site, which was situated alongside a creek, had been constructed on clay deposits from the Pre-Roman transgression (see also 4.2.2.5.). The settlement remains were covered by marine sediments of 0.40 to more than 1 m thickness. The habitation can be dated from about 75 A.D. to the third century A.D.

The analyses of six samples from the site proper and of one sample from the lower layer of the fill of the creek (sample g) are shown in table 10. The other samples from the fill of the creek are left out of consideration; sample f, also from the lower layer of the fill, is poor in seeds, while samples a to e cannot be dated.

Ouddorp 1: 1959-Oudp-147, trench XIVb, well lined with a barrel of staves, 75-125 A.D.
Ouddorp 2: 1959-Oudp, trench XVIIe, from bottom of well, 75-125 A.D.
Ouddorp 3: 1959-Oudp-232, trench XVIIa, deep pit or ditch, 75-125 A.D.

Ouddorp 4: 1959-Oudp-220, trench XVII, ca. 0.5 m deep ditch or pit.
Ouddorp 5: 1959-Oudp-212, trench XV, "cesspool" (deep pit with casing of planks), middle of 2nd century A.D.
Ouddorp 6: 1959-Oudp, trench XV, ditch, 2nd century A.D.
Ouddorp 7: lower layer of fill of creek (sample g), second half of 2nd century to first half of 3rd century A.D.

The numbers of samples which were examined for each site differ considerably, and for none of the sites was a really large number of samples available. The choice of the samples was limited by the small size of the excavations and/or by the circumstance that not much plant material was present in the layers concerned. In the sites of Paddepoel, Tritsum, Den Helder, and Ouddorp, where fairly large-scale excavations have taken place, layers of vegetal debris did not occur over larger areas, but were confined to ditches, pits, and so on. For that reason no samples could be selected for specific purposes as was done for the Feddersen Wierde by Körber-Grohne (1967). It is self-evident that only two samples per site, as is the case for Ezinge and Leuwarden, is too little. However, as the results obtained for these sites compare well with those for other sites included in this study, a reconstruction of the vegetation in the vicinity of Ezinge and Leeuwarden was nevertheless possible.

2.2. METHODS

Prior to investigation, the samples of vegetal debris were kept moist in plastic bags. In order to prevent mould attack a little formalin was added. Before examination, the samples were soaked in a weak nitric acid solution (3-5%) for a few days to a few weeks, as a result of which the fairly compact material disintegrated. Thereupon, the samples were washed through three sieves, with meshes of 2.0, 0.5 and 0.2 mm respectively, placed one on top of the other. In this way three fractions (coarse, middle, fine) were obtained.

Each fraction, or part of it, was examined for seeds, fruits, and other macrofossil plant remains under a WILD M-4 binocular stereo-microscope. The identification of the majority of the seeds and fruits was carried out using the same microscope, at magnifications of 6 x to 50 x. *Juncus* seeds and a few other small seed types were identified under a high-power microscope, using transmitted light, at magnifications of 250 x or greater. The seeds and fruits which were recovered are preserved in small vials, in water to which some formalin has been added. Plant remains which have been kept in this way for more than 10 years still show no visible signs of deterioration. The fluid in the vials, which are closed with a rubber bung, is renewed every three to four years.

Of the three fractions of a sample, the coarse one generally yielded only small numbers of seeds and fruits. Larger numbers and the greatest variety of seeds and fruits were recovered from the middle fraction. The fine fraction was always poor in seed types, but one or a few of them could be very numerous, e.g. *Juncus gerardii*. The whole of the coarse fraction was usually examined, but only seldom was the whole of the middle fraction analysed, while of the fine fraction only a part, usually a minor part, was studied. The total numbers of seeds and fruits shown in tables 1 to 10 were obtained by adding together the results from each of the three separate fractions. In this connection the following fact should be noted. The obvious procedure would have been to have converted the numbers of seeds and fruits found in a subsample of a fraction to obtain the total numbers for that fraction, before adding the results of the three fractions of one sample together. However, for practical reasons a somewhat different procedure was applied, starting from the fact that the greatest variety of seeds and fruits was found in the middle fraction. If only a subsample of the middle fraction had been examined, in general 1/2 to 1/20, the numbers of seeds and fruits recovered from that subsample were not multiplied. The numbers of seeds and fruits met with in the corresponding fine fraction subsample were converted to give a total corresponding to the subsample size for the equivalent middle fraction subsample of that particular sample. For example, if a subsample of 1/50 of the fine fraction had been examined and 1/5 of the middle fraction, the numbers of seeds recovered from the fine fraction were multiplied by 10. In general a larger part of the coarse fraction was examined than that of the middle fraction; in most cases the whole of the coarse fraction was examined. For that reason the numbers of seeds and fruits recovered from the coarse fraction, or part of it, should be divided by a factor 2 or more. This has not been done, in particular because only seldom were somewhat larger numbers of seeds and fruits found in that fraction. It is true that this implies a relative over-representation of the seed and fruit types found in the coarse fraction, but in practice this is of no importance.

From the above it will be clear that the numbers of seeds and fruits shown in the tables are often higher than the numbers which were actually found. Thus, it is possible that in the text it is mentioned that a particular species is represented by only one or a few seeds, whereas in the table concerned a much larger number is shown. For mosses, calyces, petals, and some other plant remains no numbers are given. Their presence is simply indicated by a plus sign.

It should also be mentioned that for the samples from Tritsum, Vlaardingen, and Ouddorp no estimates of the subsample sizes of the fractions analysed were made. In these cases a satisfactory number of seeds and fruits was picked out from each fraction, and subsequently the numbers recovered from the three individual fractions of one sample were added together. In consequence of this, the seeds and fruits from the fine fraction of the samples mentioned above are under-represented compared to the samples which were studied later. Thus, in the samples from Tritsum and Ouddorp the total numbers given for *Juncus gerardii* seeds are much smaller than in those from Tzummarum, Paddepoel, and some of the other sites.

Another inconsistency exists in the case of the mosses. In the initial stages of the investigation insufficient attention was paid to moss remains. The absence of mosses in Vlaardingen (table 8) must be ascribed to this circumstance. For Tritsum and Ouddorp (tables 5 and 10), both sites from a brackish environment, it cannot be entirely excluded that mosses were absent. As no material from these sites was left, it was impossible to check whether or not any moss remains had been overlooked. On the other hand, an additional examination of four of the six samples from Tzummarum (table 3), a site from a similar environment as Tritsum and Ouddorp, brought no moss remains to light.

In addition to the total numbers of seeds and fruits, the percentage representations have also been calculated. These percentages are not shown in tables 1 to 10, but they were necessary for the calculation of the mean percentages (see 4.1.). Since *Juncus gerardii* seeds are often present in extraordinarily large numbers in the samples from the sites from a brackish environment, this seed type has been excluded from the sum on which the percentages of the other seeds and fruits are based. On the other hand, the *Juncus gerardii* values are expressed as percentages of the sum of *all* seeds and fruits. As an example the numbers, as well as the percentages, of the plant remains in the sample Paddepoel 124 are given below.

Agrostis spec.	56	3.8%
Alisma plantago-aquatica	2	0.1
Alopecurus geniculatus	8	0.5
Atriplex hastata/patula	316	21.5
Carex acuta-type	20	1.4
Carex disticha	13	0.9
Carex otrubae	10	0.7
Carex serotina-type	1	0.1
Centunculus minimus	35	2.4
Chenopodium album	1	0.1
Chenopodium ficifolium	10	0.7
Cirsium arvense	1	0.1
Eleocharis uniglumis/palustris	125	8.5
Erica tetralix (leaves)	+	

Erysimum cheiranthoides	1	0.1	
Glaux maritima	3	0.2	
Hippuris vulgaris	4	0.3	
Hordeum vulgare (carbonized)	1	0.1	
Juncus articulatus	341	23.2	
Juncus bufonius	103	6.9	
Juncus gerardii	5060	77.5	(sum 6532)
Leontodon autumnalis	66	4.5	
Linum usitatissimum	½	0.1	
Matricaria maritima ssp. inodora	20	1.4	
Mentha aquatica/arvensis	1	0.1	
Odontites verna/litoralis	16	1.4	
Oenanthe lachenalii	1	0.1	
Plantago major	26	1.8	
Poa pratensis/trivialis	26	1.8	
Polygonum aviculare	8	0.5	
Polygonum lapathifolium	8	0.5	
Polygonum persicaria	7	0.5	
Potentilla anserina	12	0.8	
Prunella vulgaris	2	0.1	
Ranunculus sceleratus	1	0.1	
Rumex crispus	2	0.1	
Sagina spec.	25	1.7	
Scirpus lacustris ssp. glaucus	8	0.5	
Scirpus maritimus	23	1.6	
Sonchus asper	20	1.4	
Sparganium erectum	1	0.1	
Spergularia marina-type	5	0.3	
Stellaria media	4	0.3	
Triglochin maritima	138	9.4	
Sum (excl. Juncus gerardii)	1472		

For the identification of the subfossil plant remains much use was made of the seed atlases of Beijerinck (1947) and Brouwer & Stählin (1965). Is is self-evident that a seed reference collection is indispensable for the identification of subfossil seeds and fruits. For the identification of the caryopses of Gramineae and of the seeds of the genus *Juncus* Körber-Grohne's (1964) key for the identification of these seed and fruit types proved extremely useful. Moreover, artificially fossilized fruits and seeds of these taxa had been prepared for comparison. The dimensions were determined with the help of an ocular-micrometer.

2.3. *RESULTS*

The results of the analyses of the samples enumerated in 2.1. are shown in tables 1 to 10.

3. DISCUSSION OF THE PLANT REMAINS

In this chapter the plant remains which were recovered in this study, mainly seeds and fruits, will be discussed briefly. It should be emphasized that it has not been attempted to give detailed descriptions of the plant remains concerned. On the other hand, features which proved to be useful for the identification have been stressed. In case of difficulties in distinguishing between species a more lengthy discussion was sometimes necessary. Remarks on the habitats or on the vegetation types in which the species concerned are usually found have been kept very concise. For the syntaxonomic units (plant associations, etc.) mentioned below the reader is referred to Westhoff & Den Held (1969).

3.1. *MUSCI*

The following mosses have been identified by Mr. H. J. During (Laboratory for Plant Taxonomy, University, Groningen). The data concerning the ecology of the mosses are mainly after Dixon (1924) and Landwehr (1966).

Amblystegium serpens (Hedw.) Schimp.
On the ground, on stones, and on decaying wood in moist, shady places. This moss was found in two samples from Paddepoel.

Antitrichia curtipendula (Hedw.) Brid.
On old beech and oak trunks in shaded forests. This species was recovered from Ezinge B.

Aulacomnium androgynum (Hedw.) Schwaegr.
On tree trunks, on decaying wood, and on the ground in acid, deciduous forests. Only from Ezinge B.

Aulacomnium palustre (Hedw.) Schwaegr.
In raised bogs and in oligothrophic marsh vegetations. This moss species is represented in Leeuwarden, Den Helder, and Schiedam.

TABLE 1. PADDEPOEL-GRONINGEN

Sample number	*IIA*	*124*	*224*	*246*	*248*	*327*	*272*	*274*	*299*	*300*
Agrostis spec.	74	56	1283	90	803	22	1567	676	50	1081
Alisma plantago-aquatica	—	2	—	—	—	—	—	—	3	2
Alopecurus geniculatus	14	8	37	6	15	22	513	308	354	67
Althaea officinalis	—	—	—	—	—	—	—	—	1	—
Aster tripolium	1	—	6	—	1	56	—	—	—	—
Atriplex hastata/patula	15	316	401	99	270	9585	46	135	448	90
Atriplex littoralis-type	—	—	—	1	4	—	—	1	—	—
Avena spec. (carbonized)	—	—	3	1	—	—	—	—	1	—
Bidens tripartitus	—	—	1/2	—	1/2	263	2	2	14	3
Brassica campestris	1/2	—	—	—	—	—	—	—	3	—
Bromus mollis/secalinus	2	—	—	1	7	—	—	1	17	3
Camelina sativa	—	—	—	—	1	—	2 1/2	100	—	—
Capsella bursa-pastoris	—	—	4	—	—	—	—	—	1	—
Carduus crispus	—	—	—	—	—	—	—	—	1	2
Carex acuta-type	2	20	—	3	50	—	13	89	24	3
Carex disticha	—	13	—	—	—	—	6	19	3	46
Carex otrubae	1	10	15	143	—	—	33	16	23	20
Carex rostrata/vesicaria	—	—	2	2	—	—	1	—	16	5
Carex serotina-type	3	1	—	—	5	—	7	52	29	2
Caryophyllaceae indet.	—	—	—	—	1	—	—	—	—	—
Centaurium spec.	2	—	—	—	—	—	—	—	—	—
Centunculus minimus	2	35	—	—	—	—	—	50	—	—
Cerastium holosteoides	—	—	—	—	1	—	64	4	—	105
Chenopodium album	1/2	1	103	1	2	7	—	3	557	5
Chenopodium ficifolium	3 1/2	10	747	14	11	15	14	22	393	17
Chenopodium polyspermum	—	—	—	—	—	—	3	7	4	—
Chenopodium rubrum/glaucum	1 1/2	—	105	3	34	—	—	13	16	4
Cirsium arvense	—	1	—	1	1	—	3	1	23	24
Cochlearia danica	—	—	—	—	—	—	—	—	1	—
Daucus carota	3	—	—	—	—	—	—	—	8	41
Echinochloa crus-galli	—	—	—	1	—	—	—	—	—	—
Eleocharis uniglumis/palustris	129	125	12	741	130	—	1530	900	815	28
Elytrigia repens/pungens	—	—	—	14	8	—	—	3	—	—
Erica tetralix (leaves)	—	+	—	—	+	—	+	+	+	—
Erysimum cheiranthoides	—	1	—	—	—	—	—	7	18	—
Euphorbia helioscopia	—	—	—	—	—	—	—	—	—	1
Festuca rubra	1	—	—	1	5	—	—	28	—	—
Galeopsis tetrahit/speciosa	—	—	6	—	—	—	—	1/2	1165	1
Galium palustre	2	—	—	—	—	—	—	2	—	1
Glaux maritima	+	3	1	7	29	—	62	10	1	—
Gramineae indet.	—	4	—	—	2	—	2	3	7	3
Hippuris vulgaris	—	—	—	—	—	—	—	1	—	—
Hordeum spec. (subfossil)	1	—	13	5	10	—	—	4	31	—
Hordeum vulgare (carbonized)	1	1	10	—	1	—	—	—	6	—
Juncus articulatus	7	341	—	16	150	7	1867	159	8	23
Juncus bufonius	2	103	3	6	501	107	4032	453	17	61
Juncus gerardii	3825	5060	11222	3325	55206	949	156605	19545	1145	2043
Juncus spec.	3	—	—	—	—	—	—	—	—	—

TABLE 1. PADDEPOEL-GRONINGEN (cont'd)

Sample number	*IIA*	*124*	*224*	*246*	*248*	*327*	*272*	*274*	*299*	*300*
Lamium purpureum	—	—	4	—	—	—	—	—	8	2
Leontodon autumnalis	164	66	8	297	195	—	13	57	88	114
Linum catharticum	1	—	—	—	—	—	—	—	—	5
Linum usitatissimum	2	1/2	—	2 1/2	12	—	2	12	2	1
Lolium perenne	6	—	—	2	3	—	—	1	123	—
Lychnis flos-cuculi	3	—	—	1	—	—	1	4	—	—
Lycopus europaeus	—	—	—	—	—	—	—	1	—	—
Lythrum salicaria	1	—	—	1	25	—	—	—	2	—
Matricaria maritima ssp. inodora	4	20	2	2	100	36	16	195	68	55
Medicago lupulina	—	—	—	—	2	—	—	—	3	—
Mentha aquatica/arvensis	—	1	—	—	1	—	1	—	1	—
Myrica gale	—	—	—	—	1	—	—	—	—	—
Myriophyllum cf. spicatum	—	—	—	—	—	—	+	—	—	—
Odontites verna/litoralis	134	16	74	7	230	—	1	28	22	120
Oenanthe lachenalii	3	1	4	10	1/2	—	1	—	16	—
Phragmites australis	—	—	6	—	—	—	—	—	—	—
Plantago major	101	26	599	202	680	169	1183	376	58	85
Plantago maritima (seeds)	—	—	—	—	7	—	1	1	—	—
(capsule lids)	1	—	—	—	9	—	—	5	—	—
Poa annua	—	—	—	—	5	—	2	5	91	15
Poa pratensis/trivialis	60	26	286	56	50	—	600	815	380	172
Polygonum aviculare	1	8	39	1 1/2	7	—	4	2 1/2	93	8
Polygonum lapathifolium	—	8	55	3 1/2	2	100	—	5	102	4 1/2
Polygonum persicaria	—	7	—	2	1 1/2	—	4	7 1/2	109	3
Potamogeton cf. pectinatus	—	—	—	—	—	—	—	—	1	—
Potamogeton pusillus	—	—	—	—	—	—	—	—	—	2
Potentilla anserina	17	12	15	41	60	—	131	153	100	607
Potentilla erecta	—	—	—	—	1 1/2	—	—	—	—	—
Prunella vulgaris	1	2	—	1	2	—	—	7	28	3
Puccinellia distans	—	—	27	2	8	1575	62	1	3	1
Ranunculus repens	1	—	2	—	—	—	290	29	26	14
Ranunculus sardous	—	—	1	—	—	—	1/2	—	6	1
Ranunculus sceleratus	—	1	4	—	1	—	—	—	1	102
Rhinanthus spec.	—	—	—	—	3	—	3	19	1	16
Rumex acetosella	—	—	—	—	—	—	—	1	—	—
Rumex crispus	—	2	4	2	1	—	11	14	10	1
Rumex maritimus	—	1	7	—	—	—	—	—	—	7
Rumex spec.	1	—	4	—	—	—	—	—	3	—
Ruppia maritima	—	—	—	—	—	—	1	—	—	—
Sagina spec.	48	25	—	—	225	—	1204	100	68	611
Scirpus lacustris ssp. glaucus	—	8	2	—	4	7	—	—	8	3
Scirpus maritimus	13	23	132	454	66	8	3 1/2	3	118	9
Solanum nigrum	1	—	48	—	3	14	2 1/2	—	705	1/2
Sonchus arvensis	—	—	2	—	—	—	—	1	—	2
Sonchus asper	3	20	335	4	30	214	32	90	355	7
Sonchus oleraceus	—	—	263	—	—	15	—	2	108	4
Sparganium erectum	—	1	—	—	—	—	—	—	—	—
Spergularia marina-type	—	5	2014	10	153	1054	180	29	—	—

TABLE 1. PADDEPOEL-GRONINGEN (cont'd)

Sample number	*IIA*	*124*	*224*	*246*	*248*	*327*	*272*	*274*	*299*	*300*
Spergularia media-type	—	—	—	—	4	—	—	—	—	—
Stachys arvensis	—	—	—	—	—	—	—	—	3	—
Stellaria media	2	4	10	1	12	—	25	$6^1/_2$	200	7
Suaeda maritima	—	—	—	1	—	—	—	—	—	—
Taraxacum spec.	1	—	—	—	—	—	1	1	1	+
Thlaspi arvense	—	—	—	—	1	—	—	1	15	—
Trifolium repens (calyces)	—	—	—	—	—	—	—	—	19	46
(petals)	+	—	+	+	+	—	+	+	—	—
Triglochin maritima	7	138	34	130	236	—	79	700	211	91
Triglochin palustris	—	—	—	16	—	—	—	—	—	—
Triticum dicoccum (carbonized)	—	—	2	—	—	—	—	—	—	1
Urtica dioica	—	—	4	—	—	—	2	1	—	—
Urtica urens	—	—	—	—	7	—	—	—	1638	—
Vicia faba var. minor	—	—	1	—	—	—	—	—	—	—
Zannichellia palustris ssp. pedicellata	—	—	6	—	1	—	1	—	—	—
Amblystegium serpens	+	—	—	—	—	—	—	+	—	—
Brachythecium spec.	—	—	—	—	—	—	—	+	—	—
Bryum argenteum	—	—	—	—	—	—	—	—	—	+
Bryum marratii	+	—	—	—	—	—	—	—	—	—
Bryum spec.	+	—	—	—	—	—	—	—	—	—
Calliergonella cuspidata	—	+	—	—	+	—	—	+	+	+
Campylium stellatum	—	—	—	—	—	—	—	+	—	—
Drepanocladus aduncus	—	—	—	—	+	—	—	—	+	—
Drepanocladus uncinatus	—	—	—	—	—	—	—	+	—	—
Eurhynchium praelongum	+	+	—	—	+	—	+	+	—	+
Hypnum cupressiforme	—	—	—	—	—	—	+	+	+	—
Leptodictyum kochii	—	—	—	—	—	—	—	—	+	—
Leptodictyum riparium	+	+	+	+	+	—	+	+	+	+
Pohlia nutans	—	+	—	—	+	—	—	—	—	—
Rhytidiadelphus squarrosus	—	—	—	—	—	—	—	+	—	+
Sphagnum compactum	—	—	—	—	—	—	—	+	—	—
Sphagnum imbricatum	—	+	—	—	—	—	—	—	—	—
Sphagnum palustre	—	+	—	—	—	—	+	—	—	—
Sphagnum papillosum	—	—	—	—	—	—	—	—	+	—
Sphagnum sect. subsecundum	—	—	—	—	+	—	—	—	—	—
Ulota spec.	—	—	—	—	+	—	+	—	—	+

TABLE 2. EZINGE

Sample number	*A*	*B*
Agrostis spec.	180	109
Althaea officinalis	47	—
Apium graveolens	—	10
Aster tripolium	3	—
Atriplex hastata/patula	365	250
Atriplex littoralis-type	5	—
Brassica campestris	3	$^1/_2$
Bromus mollis/secalinus	—	1
Calluna vulgaris (leaves)	—	+
Camelina sativa	$4^1/_2$	—
Carduus crispus	2	6
Carex rostrata/vesicaria	3	—
Chenopodium ficifolium	8	$4^1/_2$
Chenopodium rubrum/glaucum	9	—
Cruciferae indet.	7	3
Elytrigia repens/pungens	10	60
Festuca rubra	3	—
Glaux maritima	32	—
Hordeum spec. (subfossil)	—	22
Iris pseudacorus	1	—
Juncus gerardii	15030	22950
Limonium vulgare	316	10
Linum usitatissimum	7	42
Matricaria maritima ssp. inodora	21	3
Odontites verna/litoralis	16	7
Oenanthe lachenalii	$19^1/_2$	4
Phragmites australis	—	2
Plantago major	150	19
Plantago maritima (seeds)	$12^1/_2$	—
(capsule lids)	20	$^1/_2$
Polygonum aviculare	6	1
Polygonum lapathifolium	—	$^1/_2$
Polygonum persicaria	—	$1^1/_2$
Potamogeton cf. pectinatus	2	—
Potentilla erecta	—	1
Puccinellia distans	—	3
Ranunculus sceleratus	4	1
Rumex crispus	—	6
Rumex maritimus	—	1
Salicornia europaea	16	15
Scirpus maritimus	9	—
Solanum dulcamara	—	1
Sonchus asper	—	4
Sonchus palustris	—	1
Spergularia marina-type	18	15
Spergularia media-type	2	2
Suaeda maritima	35	1
Triglochin maritima	13	9

TABLE 2. EZINGE (cont'd)

Sample number	*A*	*B*
Urtica dioica	—	90
Antitrichia curtipendula	—	+
Aulacomnium androgynum	—	+
Brachythecium spec.	+	—
Homalothecium sericeum	+	—
Hypnum cupressiforme	+	—
Isothecium myosuroides	+	+
Neckera complanata	+	+
Neckera crispa	+	—
Thamnobryum alopecurum	+	—

TABLE 3. TZUMMARUM

Sample number	*77*	*66*	*70*	*80*	*46*	*79*
Agrostis spec.	160	10	169	492	30	27
Anagallis arvensis	1	—	—	5	—	—
Armeria maritima	—	2	7	7	—	6
Aster tripolium	3	—	3	16	—	7
Atriplex hastata/patula	106	352	320	6840	14	6647
Atriplex littoralis-type	—	2	7	—	—	—
Brassica campestris	1	—	1	16	—	2
Bromus mollis/secalinus	2	—	—	1	—	—
Carex rostrata/vesicaria	2	—	—	2	—	—
Carex spec.	1	—	—	—	—	—
Centaurium spec.	24	10	35	204	910	12
Chenopodium album	15	—	1	2	—	—
Chenopodium ficifolium	—	2	14	110	—	295
Chenopodium rubrum/glaucum	—	—	3	5	—	1
Cirsium arvense	—	—	—	6	—	1
Cruciferae indet.	—	—	—	1	—	—
Elytrigia repens/pungens	—	—	1	1	—	—
Euphorbia helioscopia	—	—	—	1	—	—
Festuca rubra	—	—	4	1	—	—
Glaux maritima	11	—	23	91	4	13
Gramineae indet.	—	—	3	6	—	6
Hordeum vulgare (carbonized)	3	—	3	2	—	8
Juncus bufonius	—	—	15	—	220	—
Juncus gerardii	5749	236	15030	38406	27250	1115
Leontodon autumnalis	50	3	29	99	—	6
Limonium vulgare	—	15	—	2	—	1
Matricaria maritima ssp. inodora	2	—	—	4	—	1
Mentha aquatica/arvensis	—	—	—	—	1	—
Odontites verna/litoralis	11	—	1	397	—	26
Oenanthe lachenalii	2	—	11	32	—	2
Parapholis strigosa	—	—	—	2	—	—
Phragmites australis	—	—	—	1	—	—
Plantago major	33	—	3	75	41	15
Plantago maritima (seeds)	2	1	3	88	—	5
(capsule lids)	10	2	9	26	—	—
Poa annua	8	—	3	—	—	—
Poa pratensis/trivialis	5	—	17	2	—	—
Polygonum aviculare	5	—	14	38	—	11
Potentilla anserina	4	—	4	1	—	3
Potentilla spec.	1/2	—	—	—	—	—
Puccinellia distans	19	—	14	6	—	—
Ranunculus sardous	5	—	9	9	1	—
Rumex crispus	—	—	—	1	—	—
Sagina spec.	2	—	—	41	—	—
Salicornia europaea	1	130	22	111	111	—
Scirpus maritimus	1	1	—	9	—	1
Sinapis arvensis	1 1/2	2	—	7	—	—

TABLE 3. TZUMMARUM (cont'd)

Sample number	*77*	*66*	*70*	*80*	*46*	*79*
Sium erectum	—	—	—	2	—	—
Sonchus arvensis	—	—	—	3	—	—
Sonchus asper	8	5	2	32	—	55
Spergularia marina-type	39	5	41	49	10	2
Spergularia media-type	6	5	11	116	—	—
Stellaria media	2	—	—	—	—	—
Suaeda maritima	4	32	28	259	—	1
Trifolium repens (calyx)	—	—	—	—	—	1
Triglochin maritima	56	12	253	365	145	4c

TABLE 4. LEEUWARDEN

Sample number	*I*	*II*
Agrostis spec.	175	704
Alopecurus geniculatus	—	2
Althaea officinalis	19	1
Apium graveolens	2	1
Aster tripolium	1	1
Atriplex hastata/patula	81	31
Atriplex littoralis-type	2	—
Bromus mollis/secalinus	—	1
Calluna vulgaris	5	—
Camelina sativa	1 1/2	1/2
Carex otrubae	—	2
Carex rostrata/vesicaria	4	16
Centaurium spec.	—	56
Cerastium holosteoides	—	1
Chenopodium album	2	—
Chenopodium ficifolium	16	—
Chenopodium rubrum/glaucum	125	14
Cirsium arvense	2	—
Cladium mariscus	2	2 1/2
Eleocharis uniglumis/palustris	—	1
Elytrigia repens/pungens	4	2
Erica tetralix	10	—
Eupatorium cannabinum	—	1
Festuca rubra	4 1/2	—
Galium palustre	3	4
Glaux maritima	13	50
Gramineae indet.	—	2
Hordeum spec. (subfossil)	1	2
Hydrocotyle vulgaris	3	6
Hypericum spec.	10	—
Juncus articulatus	—	28
Juncus bufonius	981	423
Juncus effusus-type	—	42
Juncus gerardii	3736	28392
Juncus subnodulosus	85	330
Limonium vulgare	140	22
Linum usitatissimum	4	13
Lychnis flos-cuculi	3	6
Lycopus europaeus	9	13
Lythrum salicaria	41	198
Matricaria maritima ssp. inodora	1	1
Medicago lupulina	—	1
Mentha aquatica/arvensis	5	18
Moehringia trinervia	4	—
Odontites verna/litoralis	1	6
Oenanthe lachenalii	4	55
Phragmites australis	13	—

TABLE 4. LEEUWARDEN (cont'd)

Sample number	*I*	*II*
Plantago major	—	68
Plantago maritima (seeds)	2	9
(capsule lids)	17	10
Poa pratensis/trivialis	19	54
Polygonum aviculare	4	—
Potentilla anserina	1	4
Potentilla erecta	1	—
Puccinellia distans	10	6
Puccinellia maritima	1	1
Ranunculus repens	—	1
Ranunculus sceleratus	57	7
Rumex acetosella	1	—
Rumex crispus	14	2
Rumex maritimus	61	—
Sagina spec.	5	56
Salicornia europaea	131	333
Scirpus lacustris ssp. glaucus	4	1
Scirpus maritimus	75	18
Scutellaria galericulata	—	1
Solanum nigrum	2	—
Sonchus arvensis	2	2
Spergularia marina-type	15	100
Spergularia media-type	3	26
Suaeda maritima	31	12
Triglochin maritima	5	44
Aulacomnium palustre	+	—
Brachythecium spec.	+	—
Bryum spec	+	+
Calliergonella cuspidata	+	—
Drepanocladus lycopodioides	+	—
Drepanocladus vernicosus	+	—
Eurhynchium praelongum	+	+
Leptodictyum riparium	+	+
Mnium hornum	+	—
Sphagnum cuspidatum	—	+
Sphagnum fallax	—	+
Sphagnum imbricatum	—	+
Sphagnum palustre	—	+

TABLE 5. TRITSUM

Sample number	*3266*	*2998*	*2763*	*3234*	*3013*
Aethusa cynapium					
Agrostis spec.	3	6	16	48	21
Alisma plantago-aquatica	—	—	—	—	—
Alopecurus geniculatus	—	—	—	—	1
Anagallis arvensis	—	—	—	—	—
Armeria maritima	—	—	—	—	—
Aster tripolium	—	1	—	7	18
Atriplex hastata/patula	89	423	67	24	128
Atriplex littoralis-type	—	2	—	—	2
Brassica campestris	—	—	1	—	5
Bromus mollis/secalinus	—	—	—	—	—
Camelina sativa	—	1	—	1	—
Capsella bursa-pastoris	—	5	—	—	2
Carduus crispus	—	—	—	—	1
Carex otrubae	—	—	—	—	3
Carex pseudocyperus	—	—	—	—	—
Carex rostrata/vesicaria	—	1	—	—	—
Cerastium holosteoides	—	—	—	1	—
Chenopodium album	—	—	—	—	—
Chenopodium ficifolium	—	3	—	1	3
Chenopodium polyspermum	—	—	—	—	—
Chenopodium rubrum/glaucum	1	4	2	2	—
Cirsium arvense	—	—	3	—	—
Cirsium palustre	—	—	—	—	—
Cirsium vulgare	—	—	—	—	—
Cruciferae indet.	—	—	—	—	—
Daucus carota	1	—	—	—	—
Eleocharis uniglumis/palustris	—	—	—	—	—
Elytrigia repens/pungens	—	—	—	—	—
Epilobium spec.	—	—	—	—	—
Erysimum cheiranthoides	—	23	—	—	3
Festuca rubra	—	—	—	—	2
Galeopsis tetrahit/speciosa	—	—	—	—	—
Galium aparine	—	—	—	—	—
Galium palustre	—	—	—	—	—
Galium spec.	—	—	—	—	—
Glaux maritima	—	3	12	148	33
Gramineae indet.	3	—	—	1	—
Hippuris vulgaris	—	—	—	—	—
Holcus lanatus	—	—	—	—	—
Hordeum spec. (subfossil)	—	—	—	—	—
Hordeum vulgare (carbonized)	—	1	1	—	—
Juncus bufonius	—	—	—	—	—
Juncus gerardii	657	240	591	901	211
Leontodon autumnalis	—	—	1	1	24
Limonium vulgare	1	—	35	—	6
Linum usitatissimum	7	2	4	2	20
Lolium perenne	—	1	2	—	2
Lycopus europaeus	—	—	—	—	—
Matricaria maritima ssp. inodora	—	—	—	3	10
Medicago lupulina	—	—	—	—	1
Mentha aquatica/arvensis	—	—	1	—	—
Odontites verna/litoralis	1	1	—	2	28

2981	*2986*	*2988*	*2994*	*3094*	*3280*	*2984*	*1141*	*1264*	*2762*	*1541*
—	—	—	—	—	—	—	3	—	—	—
2	11	25	—	—	15	9	224	83	58	1
—	—	—	—	—	—	—	—	—	—	1
—	5	—	—	—	—	—	—	—	—	3
—	—	—	—	—	1	—	—	—	—	—
—	—	—	—	—	8	—	—	3	—	—
4	—	1	1	2	—	—	7	—	—	1
283	2	223	17	220	220	23	330	—	82	5
19	—	4	—	5	3	—	6	—	—	—
21	—	3	—	6	70	—	—	—	—	—
1	—	2	—	26	—	—	25	—	4	1
3	—	25	—	15	—	—	—	—	—	—
1	—	1	—	—	—	—	2	—	—	—
—	—	—	—	—	13	—	—	—	—	—
—	—	—	—	—	—	—	108	—	34	12
—	—	—	—	—	—	—	—	—	1	—
—	—	1	—	—	1	—	1	—	5	—
—	—	—	—	—	—	—	61	—	—	—
3	—	—	—	2	31	—	102	—	47	11
44	—	19	—	15	1	—	507	—	32	—
—	—	—	—	—	—	—	16	—	1	—
18	—	5	—	1	—	—	223	—	26	—
2	—	1	—	—	11	—	1	—	—	—
—	—	—	—	—	2	—	—	—	—	—
—	—	—	—	—	2	—	1	—	1	—
—	—	—	—	—	—	—	1	—	—	—
1	6	—	115	17	—	2	—	—	—	—
—	—	—	—	—	—	—	—	—	—	1
1	—	1	—	4	71	4	1	—	1	—
—	—	—	—	—	—	—	6	—	—	—
1	—	2	—	—	—	—	—	—	—	—
1	—	—	—	3	—	—	1	7	—	—
1	—	—	—	—	—	—	8	—	—	—
—	—	—	—	—	2	—	—	—	—	—
—	—	—	—	—	—	—	1	—	—	—
—	—	—	—	—	—	—	1	—	—	—
37	3	5	5	2	3	1	—	—	—	—
2	—	—	—	—	1	1	2	—	—	—
—	—	—	—	—	—	—	—	—	—	1
—	—	—	—	—	—	—	—	—	1	—
—	—	—	—	1	—	—	9	—	10	—
—	—	—	—	—	1	—	11	—	—	—
—	—	—	—	—	—	—	—	—	2	—
460	880	431	129	48	178	377	165	419	190	—
16	—	22	2	110	—	4	—	5	—	1
4	—	—	—	—	—	—	—	—	—	—
4	—	20	1	—	—	2	4	—	21	—
2	—	2	—	26	—	3	—	—	—	—
—	—	—	—	—	—	—	5	—	4	—
6	—	2	—	1	3	—	52	3	2	—
2	—	56	—	32	1	—	—	—	1	—
—	—	—	—	—	1	—	—	—	—	1
11	9	10	4	47	2	1	65	7	7	—

TABLE 5. TRITSUM (cont'd)

Sample number	*3266*	*2998*	*2763*	*3234*	*3013*
Oenanthe aquatica	—	—	—	—	—
Oenanthe fistulosa	—	—	—	—	—
Oenanthe lachenalii	6	—	1	1	7
Parapholis strigosa	—	—	—	—	—
Phragmites australis	—	1	—	—	—
Plantago major	74	53	12	9	98
Plantago maritima (seeds)	1	1	3	11	—
(capsule lids)	—	—	—	1	—
Poa annua	—	—	—	—	—
Poa pratensis/trivialis	—	—	4	—	33
Polygonum aviculare	2	—	1	2	5
Polygonum convolvulus	—	—	—	—	—
Polygonum lapathifolium	—	—	—	—	—
Polygonum persicaria	—	1	—	—	—
Potamogeton spec.	—	—	—	—	—
Potentilla anserina	—	—	8	—	10
Prunella vulgaris	—	—	—	—	—
Puccinellia distans	83	12	4	3	68
Puccinellia maritima	2	—	—	—	1
Raunuculus repens	—	—	—	—	—
Ranunculus sardous	—	1	—	—	—
Ranunculus sceleratus	—	—	—	1	—
Ranunculus spec.	—	—	—	—	—
Rhinanthus spec.	—	—	—	—	—
Rubus spec.	—	—	—	—	—
Rumex crispus	—	1	—	—	—
Rumex maritimus	—	—	—	—	—
Sagina spec.	—	—	—	—	—
Salicornia europaea	—	5	6	6	25
Scirpus lacustris ssp. glaucus	—	—	—	—	—
Scirpus maritimus	1	3	16	—	1
Sinapis arvensis	—	—	—	—	—
Sium erectum	—	—	—	—	—
Solanum dulcamara	—	—	—	—	—
Solanum nigrum	—	—	—	—	1
Sonchus arvensis	—	—	—	—	1 1/2
Sonchus asper	—	—	—	—	1
Sonchus oleraceus	3	—	—	—	5
Spergularia marina-type	—	—	1	1	2
Spergularia media-type	—	—	1	1	—
Stachys arvensis	—	—	—	—	—
Stellaria media	2	97	6	1	45
Suaeda maritima	—	10	—	1	—
Taraxacum spec.	—	—	—	—	—
Thalictrum flavum	—	—	—	—	—
Thlaspi arvense	—	—	—	—	—
Trifolium campestre (flowers, pods)	—	—	—	—	—
Trifolium pratense (calyces)	—	—	—	—	—
Trifolium repens (calyces)	—	—	—	—	—
Triglochin maritima	—	2	1	5	15
Urtica dioica	—	—	—	—	—
Urtica urens	—	—	—	—	—

	2981	*2986*	*2988*	*2994*	*3094*	*3280*	*2984*	*1141*	*1264*	*2762*	*1541*
	—	—	—	—	—	—	—	—	—	—	1
	—	—	—	—	—	—	—	—	—	—	1
	1	5	4	4	—	—	9	14	—	—	—
	—	—	—	—	—	—	1	—	—	—	—
	—	—	4	1	—	—	—	—	—	4	2
	31	49	21	6	12	—	108	375	1	34	—
	2	—	3	—	11	—	10	—	3	—	—
	—	—	—	—	1	—	1	—	—	—	—
	—	—	—	—	—	—	—	5	—	5	—
	5	87	38	19	2	—	11	30	50	22	2
	220	5	2	—	35	47	—	9	—	2	1
	—	—	—	—	—	—	—	5	—	1	—
	—	—	—	—	2	—	—	22	—	—	—
	—	—	—	—	2	—	—	4	—	—	—
	—	—	—	—	—	1	—	—	—	—	—
	12	1	2	3	28	19	—	3	1	—	—
	—	—	—	—	—	—	—	7	—	—	—
	17	5	9	1	1	2	13	4	—	—	—
	—	—	2	—	—	1	1	—	—	—	—
	—	—	1	—	—	—	—	6	—	—	—
	—	—	1	—	—	6	—	268	—	13	2
	1	1	2	1	—	1	—	46	—	3	—
	—	—	—	—	—	—	—	—	—	1	—
	—	—	—	—	—	—	—	19	—	—	—
	—	—	—	—	—	1	—	—	—	—	—
	—	—	—	—	1	3	—	23	—	3	11
	—	—	—	—	—	—	—	85	—	4	1
	—	—	—	—	—	—	—	1	—	—	—
	—	—	—	—	—	—	—	1	—	—	—
	—	1	—	—	2	—	11	—	—	—	—
	2	—	13	1	6	13	1	78	—	—	34
	—	—	—	—	—	14	—	—	—	—	1
	—	—	—	—	—	—	—	—	—	10	—
	—	—	—	—	—	—	—	—	—	1	—
	1	—	—	—	1	—	—	—	—	—	—
	—	—	1	—	—	—	—	5	—	—	—
	4	—	1	—	8	—	—	278	—	8	—
	1	—	1	—	4	4	—	64	—	4	—
	—	—	1	—	—	—	—	1	—	—	—
	—	—	1	—	—	—	—	—	—	—	—
	—	—	—	—	1	2	—	6	—	—	—
	50	4	39	9	17	112	—	148	—	4	6
	23	—	—	—	—	70	—	11	—	—	—
	—	—	—	—	1	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	1	—	—
	—	—	—	—	—	—	—	73	—	—	—
	—	—	—	—	—	—	—	340	—	—	—
	—	—	—	—	22	—	—	23	—	—	—
	—	—	—	—	—	—	—	—	38	—	—
	26	80	18	7	188	63	9	—	27	—	—
	—	—	—	—	—	—	—	2	—	—	—
	1	—	—	—	—	28	—	—	—	1	6

TABLE 6. SNEEK

Sample number	*1*	*2*	*3*	*4*
Agrostis spec.	406	163	62	564
Alopecurus geniculatus	—	—	—	10
Althaea officinalis	—	—	—	1
Aster tripolium	1	—	21	344
Atriplex hastata/patula	165	17	210	564
Atriplex littoralis-type	2	—	1	18
Bidens tripartitus	—	—	—	1
Calluna vulgaris (leaves)	—	—	—	+
Capsella bursa-pastoris	1	—	8	—
Carex acuta-type	—	—	—	1
Carex otrubae	7	2	1	1
Cerastium holosteoides	—	1	—	—
Chenopodium album	8	—	14	10
Chenopodum ficifolium	55	16	4	15
Chenopodium rubrum/glaucum	105	5	29	440
Cirsium arvense	—	—	—	3
Cladium mariscus	—	—	1	45
Eleocharis uniglumis/palustris	1	2	7	11
Elytrigia repens/pungens	—	—	—	2
Erica tetralix	—	—	—	20
Festuca rubra	1	3	—	20
Gramineae indet.	—	1	1	—
Hordeum spec. (subfossil)	—	1	—	—
Hordeum vulgare (carbonized)	1	—	—	—
Juncus articulatus	3	16	4	10
Juncus bufonius	12	10	58	140
Juncus gerardii	2359	391	1510	7911
Leontodon autumnalis	—	1	—	2
Matricaria maritima ssp. inodora	—	—	3	11
Mentha aquatica/arvensis	1	—	—	—
Odontites verna/litoralis	4	2	—	10
Oenanthe lachenalii	11	2	3	25
Phragmites australis	—	2	24	160
Plantago major	83	7	9	61
Poa annua	1	1	—	—
Poa pratensis/trivialis	10	2	39	61
Polygonum aviculare	—	—	—	1
Potamogeton pusillus	—	—	2	—
Potentilla anserina	1	1	3	4 1/2
Potentilla erecta	—	—	—	1
Puccinellia distans	3	—	—	—
Ranunculus sceleratus	1	—	3 1/2	35
Ranunculus spec.	—	—	—	1/2
Rumex crispus	1	—	9	2
Rumex spec.	—	—	1	—
Salicornia europaea	—	—	1	10
Scirpus lacustris ssp. glaucus	—	—	—	3

TABLE 6. SNEEK (cont'd)

Sample number	*1*	*2*	*3*	*4*
Scirpus maritimus	2	2	17	41
Sonchus arvensis	—	—	1	—
Sonchus asper	4	3	1	32
Sonchus oleraceus	2	—	4	94
Spergularia marina-type	2	—	16	50
Spergularia media-type	—	—	—	20
Stellaria media	2	—	16	—
Suaeda maritima	1	—	1	—
Trifolium spec. (petals)	—	+	—	—
Triglochin maritima	4	2	8	57
Typha latifolia	—	2	—	—
Urtica dioica	3	—	12	—
Urtica urens	5	—	—	—
Bryum spec.	—	—	+	—
Ceratodon purpureus	—	—	+	—
Leptodictyum kochii	—	+	—	—
Leptodictyum riparium	+	—	+	—
Sphagnum palustre	+	—	+	+
Sphagnum papillosum	—	—	—	+
Sphagnum sect. subsecundum	—	—	—	+

TABLE 7. DEN HELDER-HET TORP

Sample number	*488*	*865*	*866*	*867*	*919*	*920*
Agrostemma githago	—	—	—	—	1	—
Agrostis spec.	381	63	130	85	64	71
Armeria maritima	15	—	29	3	16	7
Aster tripolium	1	—	1	—	4	—
Atriplex hastata/patula	70	622	70	80	24	27
Betula spec.	—	—	—	—	—	1
Brassica campestris	—	1	—	—	—	—
Bromus mollis/secalinus	—	—	—	1/2	1	—
Calluna vulgaris (leaves)	—	—	—	—	—	+
Capsella bursa-pastoris	1	—	—	—	—	—
Carex acuta-type	2	—	3	—	—	5
Carex rostrata/vesicaria	4	—	—	—	4	1 1/2
Carex serotina-type	—	1	—	—	—	—
Carex spec.	3	—	1	—	—	—
Centaurium spec.	—	—	—	—	5	—
Cerastium holosteoides	—	—	—	—	—	1
Chenopodium album	5	—	4	1	5	2
Chenopodium rubrum/glaucum	2	—	—	—	—	—
Cladium mariscus	—	—	3	—	1	—
Eleocharis uniglumis/palustris	1	—	1	—	—	—
Erica tetralix (leaves)	—	—	+	—	—	+
Festuca rubra	11	2	17	1/2	9	18
Galeopsis tetrahit/speciosa	1	—	—	—	—	—
Glaux maritima	3	—	3	2	5	1
Gramineae indet.	6	—	—	—	—	—
Hordeum spec. (subfossil)	2	1	2 1/2	—	2	1
Hordeum vulgare (carbonized)	—	—	—	1	3	—
Juncus articulatus	41	—	—	—	33	—
Juncus bufonius	—	—	11	—	9	40
Juncus gerardii	7301	336	3596	13784	3254	1698
Juncus subnodulosus	—	4	—	—	—	—
Lapsana communis	1	—	—	—	2	—
Leontodon autumnalis	—	—	—	—	1	1
Limonium vulgare	4	1	4	—	47	98
Lychnis flos-cuculi	2	—	2	—	—	—
Lycopus europaeus	—	—	2	—	—	1
Menyanthes trifoliata	1 1/2	—	2 1/2	—	—	—
Oenanthe lachenalii	1	—	—	—	—	—
Parapholis strigosa	2	—	—	—	—	—
Phragmites australis	—	1	—	—	—	1
Plantago major	—	—	1	—	4	—
Plantago maritima (seeds)	75	—	104	6	49	55
(capsule lids)	65	—	182	1	182	101
Poa pratensis/trivialis	11	3	4	—	5	—
Polygonum aviculare	—	8	2	17	3	1
Polygonum convolvulus	—	—	—	—	1	—
Polygonum lapathifolium	2	—	1/2	38	2	1

TABLE 7. DEN HELDER-HET TORP (cont'd)

Sample number	*488*	*865*	*866*	*867*	*919*	*920*
Polygonum persicaria	—	—	—	9	—	—
Potentilla palustris	—	—	1	—	—	—
Prunella vulgaris	1	—	—	—	1	—
Puccinellia distans	38	—	3	2	26	8
Puccinellia maritima	42	—	18	2	49	20
Ranunculus flammula	1	—	—	—	—	—
Ranunculus spec.	—	—	—	—	—	1
Raphanus raphanistrum	—	—	—	2	—	—
Rosa pimpinellifolia	1	—	2	1	5	—
Rumex acetosella	—	—	—	—	1	—
Sagina spec.	—	—	30	—	15	1
Salicornia europaea	31	—	120	30	113	18
Scirpus lacustris ssp. glaucus	—	—	—	1	1 1/2	1
Scirpus maritimus	1	3	—	—	1/2	1
Scirpus planifolius	—	—	—	—	—	1
Senecio cf. vulgaris	1	—	4	—	—	—
Sinapis arvensis	—	—	—	—	2	5
Sonchus oleraceus	—	49	4	1	—	1
Spergula arvensis	5	—	—	—	—	1
Spergularia marina-type	182	4	242	97	389	32
Spergularia media-type	228	1	174	8	367	97
Stellaria media	1/2	5	4	—	1	5
Suaeda maritima	36	25	16	3	23	5
Thlaspi arvense	—	—	—	—	1	—
Triglochin maritima	109	—	81	85	164	82
Urtica urens	6	69	32	19	2	2
Vicia sativa ssp. obovata	—	—	—	—	1	—
Aulacomnium palustre	+	—	—	—	—	+
Calliergon stramineum	+	—	+	—	—	—
Calliergonella cuspidata	—	—	—	—	+	—
Dicranum scoparium	—	—	—	—	+	—
Drepanocladus vernicosus	—	—	+	—	—	—
Hypnum cupressiforme	+	—	—	—	—	—
Pohlia nutans	—	—	+	—	—	—
Sphagnum imbricatum	+	—	—	—	+	+
Sphagnum sect. subsecundum	+	—	—	—	—	—
Sphagnum tenellum	—	—	—	—	—	+
Tomenthypnum nitens	+	—	+	—	+	+

TABLE 8. VLAARDINGEN-BROEKPOLDER

Sample number	*I*	*II/III*	*IV*	*V*	*VI*	*VII*	*VIII*
Agrostis spec.	7	35	40	16	35	6	—
Alnus glutinosa	—	—	—	—	1	1	—
Alopecurus geniculatus	8	17	1	—	—	3	—
Atriplex hastata/patula	96	181	21	8	41	87	27
Bidens tripartitus	8	75	—	8	28	16	—
Brassica campestris	1	—	—	—	1	3	—
Bromus mollis/secalinus	—	1	—	—	—	—	—
Calluna vulgaris	1	2	—	7	7	2	—
Camelina sativa	50	189	25	1	—	18	2
Capsella bursa-pastoris	—	23	6	—	—	—	—
Carex otrubae	8	15	9	15	16	5	1
Carex rostrata/vesicaria	—	—	—	—	—	1	1
Carex serotina-type	—	6	1	1	3	—	—
Cerastium holosteoides	2	11	2	—	3	4	4
Chenopodium album	—	—	1	—	3	1	—
Chenopodum ficifolium	14	262	3	1	2	8	—
Chenopodium rubrum/glaucum	15	392	32	3	27	1	—
Cirsium vulgare	1	—	—	—	—	—	—
Echinochloa crus-galli	—	3	—	—	2	1	—
Eleocharis palustris/uniglumis	30	84	54	76	46	65	22
Epilobium palustre	2	4	—	—	2	—	—
Epilobium spec.	1	1	—	—	—	—	—
Erica tetralix (leaves)	—	+	+	+	+	+	—
Erysimum cheiranthoides	—	1	—	—	—	—	—
Eupatorium cannabinum	—	—	1	—	—	—	—
Fagus sylvatica	—	6	—	—	2	—	—
Filipendula ulmaria	1	—	—	—	2	—	—
Galium palustre	1	2	—	1	1	—	—
Galium uliginosum	1	1	—	—	2	—	—
Glyceria maxima	—	—	—	—	2	—	—
Hordeum vulgare (carbonized)	—	1	—	—	—	—	—
Hydrocotyle vulgaris	—	—	1	1	2	—	—
Iris pseudacorus	2	6	—	11	1	—	—
Juncus articulatus	20	—	9	8	23	14	—
Juncus bufonius	166	25	43	23	178	36	—
Juncus effusus-type	—	—	1	1	—	—	—
Juncus gerardii	2	—	—	2	—	—	—
Juncus subnodulosus	—	1	8	5	31	9	—
Linum usitatissimum	36	125	1	2	10	37	85
Lychnis flos-cuculi	—	2	2	1	5	6	4
Lycopus europaeus	8	17	2	8	16	—	1
Lythrum salicaria	4	2	1	—	3	1	2
Matricaria maritima ssp. inodora	7	16	1	1	3	2	1
Mentha aquatica/arvensis	1	2	1	2	12	1	—
Molinia coerulea	2	—	—	—	3	—	—
Myosotis cf. scorpioides	1	—	4	1	1	—	—
Myrica gale	—	7	21	5	2	1	1

TABLE 8. VLAARDINGEN-BROEKPOLDER (cont'd)

Sample number	*I*	*II/III*	*IV*	*V*	*VI*	*VII*	*VIII*
Odontites verna/litoralis	3	24	8	1	3	16	21
Oenanthe fistulosa	1	11	18	10	14	42	—
Panicum miliaceum	—	1	1	—	1	—	—
Pedicularis palustris	—	2	2	4	—	1	—
Peucedanum palustre	—	2	—	—	—	—	—
Phragmites australis	—	1	—	—	—	—	—
Plantago major	18	45	6	22	79	115	64
Poa annua	5	11	1	—	1	1	—
Poa pratensis/trivialis	26	73	14	9	17	6	—
Polygonum aviculare	6	21	—	—	1	1	2
Polygonum hydropiper	—	8	—	—	—	—	—
Polygonum lapathifolium	36	165	3	11	33	58	7
Polygonum minus	1	2	—	—	1	—	—
Polygonum persicaria	7	58	—	4	13	9	—
Potentilla anserina	—	4	—	2	3	6	4
Potentilla erecta	—	1	—	—	—	—	—
Prunella vulgaris	—	8	6	16	15	—	2
Puccinellia distans	—	—	28	—	—	—	—
Quercus spec.	—	1	—	—	—	—	—
Ranunculus lingua	—	—	—	—	—	2	—
Ranunculus repens	—	—	—	—	3	—	—
Ranunculus sceleratus	10	16	3	1	4	2	—
Ranunculus spec.	—	—	—	—	—	2	—
Rhinanthus spec.	—	2	—	—	—	—	—
Rorippa islandica	6	14	—	—	1	2	—
Rumex crispus	1	—	—	—	—	—	—
Rumex hydrolapathum	—	1	2	5	7	—	—
Rumex maritimus	4	23	2	—	1	6	—
Rumex obtusifolius	—	—	—	—	1	2	1
Scirpus lacustris ssp. glaucus	3	8	—	3	7	3	2
Scirpus maritimus	—	1	—	1	—	—	—
Scutellaria galericulata	—	2	—	2	2	—	—
Sium erectum	—	3	2	1	—	—	1
Solanum nigrum	2	2	—	—	15	—	—
Sonchus arvensis	—	—	—	—	1	—	—
Sonchus asper	1	7	2	—	23	10	4
Sonchus oleraceus	—	1	1	—	1	—	—
Stachys palustris	1	—	1	—	—	1	—
Stellaria media	12	56	14	5	20	20	30
Thalictrum flavum	—	2	1	—	—	—	—
Triglochin palustris	—	8	—	1	5	—	—
Urtica dioica	—	1	—	—	—	—	—
Valeriana officinalis	—	1	—	—	—	—	—

TABLE 9. SCHIEDAM-KETHEL

Sample number	*119*	*178*	*191*	*203*
Agrostis spec.	1	—	100	263
Alisma plantago-aquatica	1	—	—	—
Alnus glutinosa	2	—	—	—
Alopecurus geniculatus	45	—	86	112
Arctium cf. pubens	—	79	—	—
Atriplex hastata/patula	28	49	186	53
Atriplex littoralis-type	—	4	2	—
Bidens tripartitus	14	1	13	29
Brassica campestris	—	515	—	—
Bromus mollis/secalinus	—	1/2	—	7
Calluna vulgaris	115	—	—	—
Capsella bursa-pastoris	3	—	—	3
Carex disticha	3	—	—	—
Carex otrubae	6	—	8	—
Carex paniculata	4	—	—	—
Carex rostrata/vesicaria	1	—	—	—
Carex serotina-type	12	—	15	10
Carex spec.	13	—	—	—
Chenopodium album	—	1	—	—
Chenopodium ficifolium	5	3	184	—
Chenopodium rubrum/glaucum	1	—	185	—
Cirsium spec.	—	—	10	37
Cirsium vulgare	—	78	—	—
Cruciferae indet.	—	—	4	—
Echinochloa crus-galli	3	—	—	—
Eleocharis palustris/uniglumis	3	1	214	47
Elytrigia repens/pungens	—	—	—	20
Epilobium spec.	2	—	—	—
Erica tetralix (leaves)	+	—	—	—
Erysimum cheiranthoides	—	—	—	49
Fagus sylvatica	—	—	—	2
Filipendula ulmaria	1	—	—	—
Galium aparine	—	2	—	—
Gramineae indet.	5	—	26	17
Hordeum spec. (subfossil)	3	4	—	1
Hordeum vulgare (carbonized)	—	—	1	—
Hydrocotyle vulgaris	3	—	—	—
Iris pseudacorus	—	—	—	1
Juncus articulatus	560	—	608	937
Juncus bufonius	2370	32	4212	442
Juncus effusus-type	170	—	55	12
Juncus gerardii	50	160	205	6
Juncus subnodulosus	50	—	27	—
Leontodon autumnalis	—	1	2	2
Linum usitatissimum	1	—	54	48
Lychnis flos-cuculi	—	—	2	—
Lycopus europaeus	33	—	—	8
Lythrum salicaria	22	—	16	10
Matricaria maritima ssp. inodora	—	—	4	195

TABLE 9. SCHIEDAM-KETHEL (cont'd)

Sample number	*119*	*178*	*191*	*203*
Medicago lupulina	—	—	—	1
Mentha aquatica/arvensis	1	—	—	—
Myosotis cf. scorpioides	3	—	—	—
Odontites verna/litoralis	—	—	12	126
Phalaris arundinacea	2	—	—	—
Plantago major	512	8	1016	7211
Poa annua	1	—	—	—
Poa pratensis/trivialis	4	—	41	38
Polygonum aviculare	1	—	12	—
Polygonum hydropiper	4	—	—	—
Polygonum lapathifolium	16	7	13	1
Polygonum minus	11	—	—	—
Polygonum persicaria	6	—	2	—
Potentilla anserina	10	2	19	—
Potentilla erecta	—	—	—	5
Prunella vulgaris	7	—	2	—
Ranunculus flammula	—	—	8	—
Ranunculus repens	9	—	2	8
Ranunculus sceleratus	16	—	9	—
Rhinanthus spec.	—	—	—	31
Rorippa islandica	7	—	6	5
Rumex crispus	—	4	—	3
Rumex hydrolapathum	1	—	—	—
Rumex maritimus	2	—	5006	4
Rumex obtusifolius	136	—	8	15
Sagina spec.	20	—	6	36
Scirpus maritimus	—	—	1	—
Sium erectum	—	—	2	—
Solanum dulcamara	2	—	—	—
Sonchus arvensis	1	—	2	45
Sonchus asper	11	8	82	192
Sonchus oleraceus	—	1	44	66
Spergularia marina-type	—	—	4	—
Stachys palustris	—	—	—	11
Stellaria media	97	1	31	665
Trifolium pratense (calyx)	—	—	—	1
Trifolium repens (petals)	—	—	—	+
Triglochin palustris	—	—	3	—
Umbelliferae indet.	—	—	2	—
Urtica dioica	6	—	1	—
Aulacomnium palustre	+	—	—	—
Calliergonella cuspidata	+	—	—	—
Climacium dendroides	+	—	—	—
Eurhynchium praelongum	+	—	—	—
Hypnum cupressiforme	—	—	+	—
Isothecium spec.	—	—	+	—
Leptodictyum riparium	—	—	+	—
Sphagnum palustre	—	—	+	—

TABLE 10. OUDDORP

Sample number	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Agrostemma githago	—	—	—	—	—	—	1 1/2
Agrostis spec.	6	—	—	1	—	1	8
Alisma plantago-aquatica	—	—	—	—	—	1	—
Alnus glutinosa	—	—	—	—	—	2	—
Aleopecurus geniculatus	6	—	—	1	1	—	—
Anagallis arvensis	3	—	—	1	—	—	2
Arctium cf. pubens	—	—	—	—	2	—	1
Arenaria serpyllifolia	2	—	—	—	—	2	—
Aster tripolium	1	—	—	—	5	6	8
Atriplex hastata/patula	3	1	2	12	10	28	14
Betula spec.	—	—	—	—	—	—	4
Brassica campestris	—	—	—	—	—	1 1/2	—
Bromus mollis/secalinus	1	—	—	—	—	—	—
Calluna vulgaris	—	—	—	—	—	—	1
Camelina sativa	—	—	—	—	—	—	2 1/2
Capsella bursa-pastoris	—	—	—	—	—	—	1
Carex acuta-type	—	—	—	—	1	10	2
Carex disticha	11	—	1	—	—	1	—
Carex otrubae	3	—	—	—	—	5	1
Carex rostrata/vesicaria	1	—	1	—	—	6	1
Carex serotina-type	—	—	—	—	—	5	—
Cerastium holosteoides	—	—	1	—	—	—	—
Chenopodium album	—	—	—	—	—	—	2
Chenopodium ficifolium	3	—	—	—	—	4	3
Chenopodium rubrum/glaucum	1	—	—	—	—	7	1
Cirsium vulgare	—	—	—	—	—	2	—
Conium maculatum	—	2	1/2	—	—	—	—
Cruciferae indet.	—	—	—	—	1	—	—
Daucus carota	—	1	—	—	—	—	1
Eleocharis uniglumis/palustris	3	3	30	10	3	19	7
Erica tetralix	—	—	—	—	—	1	—
Erysimum cheiranthoides	—	1	—	—	—	—	1
Glaux maritima	—	2	—	—	—	2	2
Gramineae indet.	—	1	—	—	—	—	1
Hippuris vulgaris	—	—	—	1	—	1	—
Hydrocotyle vulgaris	—	—	—	—	1	—	1
Juncus articulatus	18	—	8	6	6	13	10
Juncus bufonius	28	2	3	6	262	25	20
Juncus gerardii	420	180	200	170	415	900	525
Leontodon autumnalis	—	—	—	1	2	4	2
Linum catharticum	1	—	—	—	—	—	—
Lychnis flos-cuculi	—	—	—	—	—	1	—
Lycopus europaeus	1	—	—	—	—	—	1
Lythrum salicaria	—	—	—	—	—	2	—
Matricaria maritima ssp. inodora	—	—	—	—	10	—	—
Mentha aquatica/arvensis	—	—	—	—	—	3	2
Molinia coerulea	—	—	—	—	—	—	1
Odontites verna/litoralis	3	—	—	3	3	—	—

TABLE 10. OUDDORP (cont'd)

Sample number	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Oenanthe fistulosa	—	1	—	—	—	—	—
Oenanthe lachenalii	1	—	—	—	1	2	—
Papaver somniferum	—	—	—	—	1	—	—
Phragmites australis	—	—	46	—	7	—	3
Plantago major	—	2	—	—	9	1	18
Poa annua	9	—	—	—	—	—	—
Poa pratensis/trivialis	7	—	3	3	1	—	3
Polygonum aviculare	—	—	1	—	10	64	2
Polygonum lapathifolium	—	—	—	—	—	3	1
Potamogeton spec.	—	—	—	—	—	2	—
Potentilla anserina	1	—	—	—	5	20	3
Potentilla reptans	—	—	—	—	—	10	1
Prunella vulgaris	1	—	—	—	—	3	1
Puccinellia distans	—	—	—	—	4	24	—
Ranunculus flammula	1	1	—	—	—	—	1
Ranunculus repens	3	—	—	—	—	6	2
Ranunculus sardous	1	1	1	5	1	15	1
Ranunculus seceleratus	1	—	1	—	4	52	—
Ranunculus spec.	—	—	—	—	—	—	1
Rosaceae indet.	—	—	—	—	—	2	—
Rumex acetosella	—	—	—	—	—	5	1
Rumex crispus	—	—	—	—	—	—	2
Rumex obtusifolius	1	—	2	—	—	1	—
Rumex spec.	—	—	—	—	—	—	1
Ruppia maritima	—	—	—	—	—	1	—
Salicornia europaea	—	—	—	—	2	—	1
Sambucus nigra	—	—	—	—	—	1	—
Scirpus lacustris ssp. glaucus	1	—	1	2	3	27	5
Scirpus maritimus	5	—	1	8	5	52	12
Solanum nigrum	1	—	—	—	—	—	1
Sonchus asper	1	1	—	1	19	1	5
Sonchus oleraceus	—	—	—	1	3	3	—
Spergularia marina-type	1	—	—	—	83	14	—
Stellaria media	2	—	3	1	2	4	3
Suaeda maritima	—	—	—	1	—	4	2
Taraxacum spec.	—	—	—	—	—	1/4	—
Triglochin maritima	2	2	—	16	12	8	42
Triticum aestivum (carbonized)	1	—	—	—	—	1	—
Umbelliferae indet.	—	—	—	—	—	—	1
Urtica dioica	—	—	16	—	1	2	4
Urtica urens	6	1	—	49	—	1	4
Zannichellia palustris ssp. pedicellata	—	—	—	1	3	4	5

Bryum argenteum Hedw.
On walls, between paving-stones, on the ground, on roofs. This species was only once met with (Paddepoel 300).

Bryum marratii Wils.
In eutrophic marsh vegetations (Carcion davallianae), also on brackish sandy soils. This species is reported by Gillner (1960) for the Juncetum gerardii. Only in Paddepoel IIA.

Calliergon stramineum (Brid.) Lindb.
In raised bogs and in marsh vegetations. This moss was found in Den Helder.

Calliergonella cuspidata (Hedw.) Loeske
This moss species occurs in a great variety of moist habitats. It was quite common in moist Juncetum gerardii vegetations near the Feddersen Wierde (Körber-Grohne 1967, p. 86). In Paddepoel, Leeuwarden, Den Helder, and Schiedam.

Campylium stellatum (Hedw.) C. Jens.
In eutrophic marsh vegetations and in young, moist dune valleys. In Paddepoel 274.

Ceratodon purpureus (Hedw.) Brid.
A very variable species which is found on sandy and peaty soils, on walls and roofs. Only in Sneek 3.

Climacium dendroides (Hedw.) Web. & Mohr
In moist grasslands, in marshes, and in dune valleys. Only in Schiedam 119.

Dicranum scoparium Hedw.
In many habitats: heaths, woods, tree trunks, roofs. This species was recovered from Den Helder 919.

Drepanocladus aduncus (Hedw.) Warnst.
In eutrophic to mesothrophic marsh vegetations. This species occurs also on moist, slightly saline soils. In Paddepoel 248 and 299.

Drepanocladus lycopodioides (Schwaegr.) Warnst.
In eutrophic to mesotrophic marsh vegetations (Caricion davallianae). In Leeuwarden I.

Drepanocladus uncinatus (Hedw.) Warnst.
On acid, sandy soils. The var. *plumulosus* (B.S.G.) Warnst. grows on oak and willow trunks. In Paddepoel 274.

Drepanocladus vernicosus (Lindb.) Warnst.
Same habitats as *D. lycopodioides.* This species is represented in Den Helder and Leeuwarden.

Eurhynchium praelongum (Hedw.) Schimp.
On stumps of trees, on decaying wood, on the ground, particularly on clayey soil. This species occurs also in a brackish environment (Juncetum gerardii). In Ezinge, Leeuwarden and Schiedam.

Homalothecium sericeum (Hedw.) Schimp.
On trunks of trees. This species was found in Ezinge A.

Hypnum cupressiforme Hedw.
This species is extremely variable and is found in many habitats, but not on saline soil. Various varieties occur on tree trunks. This species is represented in Paddepoel, Ezinge, Den Helder, and Schiedam.

Isothecium myosuroides Brid.
On trunks of trees (oak, beech). In both samples from Ezinge.

Leptodictyum kochii Schimp.
In marshy meadows. In Paddepoel 299 and Sneek 2.

Leptodictyum riparium (Hedw.) Warnst.
A very variable species, which is found on tree trunks and in marsh vegetations. It grows also in a brackish environment. This moss is particularly well represented in Paddepoel.

Mnium hornum Hedw.
On acid grounds in woods, at the foot of trees. In Leeuwarden I.

Neckera complanata (Hedw.) Hueb.
On trunks of trees. This moss is represented in Ezinge.

Neckera crispa Hedw.
On calcareous rocks and on old trees. Only in Ezinge A.

Pohlia nutans (Hedw.) Lindb.
On peaty and sandy soils, in heaths and acid woods, also on thatched roofs. This moss was met with in a few samples.

Rhytidiadelphus squarrosus (Hedw.) Warnst.
Grassy places on light soil. In Paddepoel 274 and 300.

Sphagnum compactum Lamk. & D.C.
In moist heaths. In Paddepoel 274.

Sphagnum cuspidatum Ehrh.
Wet places in raised bogs (hollows) and in pools. In Leeuwarden II.

Sphagnum fallax (Klinggr.) Klinggr. sensu Isoviita
In raised bogs. In Leeuwarden II.

Sphagnum imbricatum Hornsch.
In raised bogs. This species is represented in various sites.

Sphagnum palustre L.
In raised bogs. In Paddepoel, Leeuwarden, Den Helder, and Sneek.

Sphagnum papillosum Lindb.
In raised bogs. In Paddepoel 299 and Sneek 4.

Sphagnum tenellum Hoffm.
Raised bogs and moist heaths. In Den Helder 920.

Thamnobryum alopecurum (Hedw.) Nieuwl.
On trunks of trees, on the ground in shady woods. In Ezinge A.

Tomenthypnum nitens (Hedw.) Loeske
In marsh vegetations. This species was found in samples from Den Helder.

Ulota spec.
Ulota species are found on tree trunks. This type is represented in Paddepoel.

3.2. SPERMATOPHYTA

With a few exceptions the plant names are according to Heukels & Van Ooststroom (1970).

3.2.1. ALISMATACEAE

Alisma plantago-aquatica L. (fig. 13:5)

Flat, wedge-shaped fruits, obovate in outline. This species is scarcely represented; only Paddepoel yielded more than one fruit. One specimen was suitable for measuring: 2.4 x 1.2 mm. *Alisma plantago-aquatica* grows in marsh vegetations of a freshwater environment.

3.2.2. BETULACEAE

Alnus glutinosa (L.) Vill.

Flat fruits, rounded pentagonal in outline, with a blunt tip. Vlaardingen and Schiedam yielded a few alder fruits (2.1 x 1.7 and 2.5 x 2.1 mm). *Alnus glutinosa* is a tree from swamp forests.

Betula spec

Four damaged *Betula* fruits were recovered from Ouddorp 7 and one from Den Helder 920. As only fragments of the wings are preserved it cannot be established whether *B. pendula* Roth or *B. pubescens* Ehrh. is concerned here.

Corylus avellana L.

One damaged hazel-nut (ca. 2.0 x 1.4 cm) was recovered from a sample which was taken from the same layer as Ouddorp 7. This sample is not shown in table 10 because it yielded only a very small number of seeds and fruits.

3.2.3. BORAGINACEAE

Myosotis cf. *scorpioides* L. (= *M. palustris* Hill.)

The compressed fruits are ovate in outline, with domed ventral and dorsal side, and with a keeled margin. Relatively large, protruding hilum. Smooth fruit surface. In Schiedam and Vlaardingen a few fruits of this type were found, two of which were suitable for measuring: 1.5 x 1.0 and 1.4 x 1.0 mm. *Myosotis scorpioides* grows in marsh vegetations.

3.2.4. CAPRIFOLIACEAE

Sambucus nigra L.

In Ouddorp 6 one seed of *Sambucus nigra* was met with (2.9 x 1.8 mm). This seed is obovate in outline with a pointed lower end. One side is flat and the other roof-shaped. The surface shows a coarse transverse wrinkling. At present *Sambucus nigra* is a common shrub in hedges, forest borders, and in the dunes.

3.2.5. CARYOPHYLLACEAE

Agrostemma githago L. (fig. 10:7)

Ouddorp 7 and Den Helder 919 yielded 1½ and 1 corncockle seed respectively. Although the preservation is not particularly good they could easily be identified as *Agrostemma githago* because of the size (a largest diameter of 3.3 and 3.8 mm was found) and because of the rows of fairly coarse projections. This species is characteristic of the Secalietea, which class includes weed associations of winter cereals.

Arenaria serpyllifolia L.

Small, kidney-shaped seeds; on the surface a pattern of oblong domed cells. Only in Ouddorp a few seeds of *Arenaria serpyllifolia*, which grows in fields on sand and light clay, were found (0.6 x 0.5 mm).

Cerastium holosteoides Fr.

Seeds quadrangular to slightly ovate in outline, wedge-shaped (the thickest part opposite to the hilum). On the surface a pattern of oblong protuberances. In a few samples somewhat larger numbers of seeds of *Cerastium holosteoides* were met with. The largest diameter for 20 seeds from both Tritsum and Paddepoel was obtained: 0.85 (0.70-0.95) mm and 0.91 (0.80-0.95) mm. *C. holosteoides* is a grassland species.

Lychnis flos-cuculi L. (fig. 6:5)

Reniform seeds, covered with concentric rows of pointed papillae. *Lychnis flos-cuculi* is represented by small numbers of seeds. Length and breadth for 15 seeds from Vlaardingen amount to 0.91 (0.8-1.0) mm and 0.75 (0.7-0.8) mm respectively. This species grows in wet grasslands.

Moehringia trinervia (L.) Clairv.

Compressed seeds, kidney-shaped in outline. Domed upper and lower side and sharp edge. Seed surface glossy. Leeuwarden yielded four seeds of *Moehringia trinervia* which is a species from deciduous forests. It is not clear what significance should be attached to the presence of this seed type in Leeuwarden. Dimensions: 1.2 x 0.9, 1.2 x 1.0, 1.2 x 1.0, and 1.0 x 0.9 mm.

Sagina spec. (fig. 9:9)

Very small, more or less reniform seeds. On the smooth surface a pattern of slightly domed cells. A fairly large number of *Sagina* seeds was recovered from Paddepoel. Length and breadth for 26 seeds from this site vary from 0.35 to 0.45 mm (mean 0.39 mm) and from 0.25 to 0.35 mm (mean 0.30 mm) respectively. It is doubtful whether subfossil *Sagina* seeds can be identified to the species.

Spergula arvensis L.
Lenticular seeds, with a keeled margin. The surface is covered with fine warts. A few seeds of this type were found in samples from Den Helder. Only one specimen was suitable for measuring: diameter 1.4 mm, thickness 1.1 mm. *Spergula arvensis* is a weed in fields, but it is also cultivated.

Spergularia media (L.) C. Presl (= *S. marginata* (DC.) Kittel) and *Spergularia marina* (L.) Griseb. (= *S. salina* J. et C. Presl) (figs. 9:5 and 6).
Until recently the presence or absence of a seed wing was considered to be a reliable differential character of *Spergularia media* and *Spergularia marina.* The seeds of *S. media* would have a more or less well developed wing, whereas the seeds of *S. marina* would be unwinged. However, Sterk (1969a) could demonstrate that in *S. media* in addition to broadly winged seeds, unwinged specimens and all possible transitions occur. Particularly in the north of the Netherlands *S. media* populations are encountered which produce a high percentage of unwinged to rudimentary winged seeds. Unwinged *S. media* seeds in the seed reference collection in the B.A.I. can be distinguished from those of *S. marina* by the absence of fine papillae on the flat sides of the disc-shaped seeds. Unfortunately, in subfossil material the upper seed layer is often no longer preserved. The wing can also have disappeared in subfossil seeds. Further, it has been established by Sterk (1969b) that *S. marina* plants may produce broadly winged seeds, although this does not seem to be a common phenomenon. Neither is the size of the seeds a distinguishing character. Sterk (1969a, 1969b) found that in both *S. media* and *S. marina* the size of the broadly winged seeds is larger than that of the unwinged to rudimentary winged specimens.

From the above it will be clear that the seeds do not allow a reliable species determination. However, one may assume that the majority of the broadly to rudimentary winged *Spergularia* seeds found in the samples from the settlement sites originate from *S. media*, whereas most of the unwinged seeds would have been produced by *S. marina.* In order to emphasize the uncertainty in the identification the suffix "type" has been added.

S. marina-type seeds were particularly common in Paddepoel and Den Helder. The latter site yielded also large numbers of *S. media*-type seeds. The greatest diameter of the *Spergularia* seeds has been measured (table 11). In *S. media*-type seeds the wing is not included in the measurement.

Both *Spergularia* species are from a brackish environment. *S. marina* is particularly found in the Puccinellietum distantis (see 4.2.1.3.). *S. media* is common in the Puccinellietum maritimae (see 4.2.1.2.), but it occurs also in other halophytic plant communities.

TABLE 11. GREATEST DIAMETER IN MM FOR *SPERGULARIA* SEEDS

	min.	mean	max.
S. marina-type, Den Helder (N=100)	0.7	0.86	1.1
S. marina-type, Paddepoel (N=100)	0.5	0.76	0.9
S. media-type, Den Helder (N=100)	0.8	0.97	1.2

Stellaria media (L.) Vill. (fig. 17:6)
The flattened seeds are circular in outline. The surface is covered with concentric rows of warty protuberances. The seeds of *Stellaria media* occurred in many of the samples examined, suggesting that this species was common in and around the settlements. The greatest diameter for 100 seeds from Tritsum varies from 1.0 to 1.6 mm (mean 1.35 mm).

It can be difficult to separate small, poorly preserved seeds of *Stellaria media* from those of *Cerastium holosteoides*. In that case an examination of the seed wall at magnifications of 100 to 200 times in transmitted light is necessary. In *Stellaria media* the walls of the star-shaped surface cells are straight, whereas in *Cerastium holosteoides* they are wavy.

Stellaria media is one of the most common species from fields and ruderal sites.

3.2.6. CHENOPODIACEAE
Atriplex hastata L./*patula* L. and *Atriplex littoralis* L.-type.

Two types of *Atriplex* seeds were distinguished:

a. *Atriplex hastata/patula* (fig. 14:10). Seeds circular to slightly oval in outline. Seed wall black and shiny, the largest diameter generally not exceeding 1.9 mm. Körber-Grohne (1967, p. 268) claims that the seeds of *A. hastata* can be distinguished from those of *A. patula*. However, the present author does not feel able to separate satisfactorily the seeds of these *Atriplex* species. For that reason the seeds of *A. hastata* and *A. patula*, which are both common in fields and on ruderal sites, are taken together. The seeds of *A. hastata/patula* were found in all samples but one, sometimes in large numbers. For 100 seeds from both Tzummarum and Tritsum the largest diameter has been measured: Tzummarum 0.8-1.9 mm (mean 1.36 mm); Tritsum 1.0-1.9 mm (mean 1.48 mm).

b. *Atriplex littoralis*-type. This seeds of this type are larger than those of *A. hastata/patula*. The surface is brown. This type includes seeds of *A. littoralis* and *A. hastata* var. *salina*, both species from a saline environment. Moreover, on inland sites a type of *A. hastata* occurs which produces brown seeds with a diameter from 1.7 to 2.2 mm (Körber-Grohne 1967, p. 268). Consequently, *A. littoralis*-type seeds are not necessarily derived from plants from a saline environment. The diameter for 29 *A. littoralis*-type seeds from Tritsum and for 13 seeds from Sneek amounts to 2.47 (2.0-3.0) mm and 2.30 (2.0-2.7) mm respectively.

Chenopodium album L.
The lenticular seeds of *Chenopodium album* have a glossy, black surface. In the central part of one of the sides a small round scar is visible. *Ch. album* is represented in most of the sites examined, although sometimes by small numbers of seeds. For 100 seeds from Tritsum and Paddepoel the dimensions were obtained: Tritsum, diameter 1.55 (1.3-1.8) mm, thickness 0.84 (0.8-1.0) mm; Paddepoel, diameter 1.53 (1.4-1.8) mm, thickness 0.79 (0.6-0.9) mm. *Ch. album* is a very common plant in fields and in ruderal habitats.

Chenopodium ficifolium Sm. (fig. 12:9)
Compressed seeds, circular in outline, with domed upper and lower side. Diagnostic of the seeds of *Chenopodium ficifolium* is the surface sculpture. On one side a network consisting of hexagonal meshes is present, whereas on the other side long and narrow meshes are radially arranged. *Ch. ficifolium* is represented in all sites except Den Helder. For two sites 100 seeds have been measured: Vlaardingen, diameter 1.12 (0.9-1.3) mm, thickness 0.64 (0.4-0.8) mm; Tritsum, diameter 1.12 (1.0-1.3) mm, thickness 0.60 (0.5-0.8) mm.

Ch. ficifolium is characteristic of the Chenopodio-Urticetum urentis (Sisymbrietalia), a plant community of habitats which are rich in nitrates and colloids, such as dung-hills.

Chenopodium polyspermum L.
The seeds of this species resemble those of *Ch. ficifolium.* However, in *Ch. polyspermum* on either side of the seed a pattern of radially arranged, long and narrow sculpturing elements can be observed. This species is represented in a few samples from Tritsum and Paddepoel. The diameter and thickness for 11 seeds from Tritsum measure 1.16 (1.0-1.3) mm and 0.61 (0.5-0.7) mm respectively; and for 12 seeds from Paddepoel 1.10 (1.0-1.2) and 0.60 (0.5-0.7) mm respectively.

Chenopodium rubrum L./*glaucum* L. (fig. 12:5)
Small, disk-shaped seeds with a glossy surface. The seeds of *Ch. rubrum* and *Ch. glaucum* cannot be separated satisfactorily. For that reason this type is listed as *Ch. rubrum/glaucum.* The diameter for 100 seeds of this type from Tritsum and Vlaardingen amounts to 0.89 (0.7-1.2) and 0.84 (0.7-1.1) mm respectively.

Ch. rubrum and *Ch. glaucum* occur both in fields and on sites rich in nitrates, such as muck-heaps.

Salicornia europaea L. (fig. 14:12)
U-shaped seeds with terminally curved hairs. *Salicornia europaea* is represented in most sites from a brackish environment, but only in Tzummarum, Leeuwarden, and Den Helder larger numbers of seeds were found. For Tzummarum 100 *Salicornia* seeds were measured: length 0.7-1.7 mm (mean 1.27 mm), breadth 0.5-1.2 mm (mean 0.83 mm). *S. europaea* is most common in the part of the coastal area which is flooded by the sea regularly, up to two times per day.

Suaeda maritima (L.) Dum. (fig. 12:6)
The shape of the seeds of *Suaeda maritima* shows fairly much resemblance to that of *Atriplex hastata/patula*. However, *Suaeda* seeds can be distinguished by the fine reticulate surface pattern and by the sharp edge.

S. maritima is represented in all sites from a brackish environment, although it was certainly not always a common plant in the vicinity of the settlements (Sneek, Paddepoel). The largest diameter for 38 seeds from Tritsum varies from 1.1 to 1.7 mm (mean 1.47 mm), for 50 seeds from Tzummarum from 1.3 to 1.9 mm (mean 1.55 mm). *S. maritima* is characteristic of the Suaedetum maritimae, a tidal drift community. This species is also frequently found in the Puccinellietum maritimae and the Puccinellietum distantis.

3.2.7. COMPOSITAE

Arctium cf. *pubens* Bab. (fig. 17:2)
Oblong achenes, tapering towards the base, with narrow longitudinal ribs. The mottling of the surface is often no longer present in subfossil fruits. The species could not be determined with certainty, but it is likely that *Arctium pubens* is concerned here. This type was found only in Schiedam 178 and Ouddorp. Length and breadth for 21 specimens amount to 6.55 (5.0-7.2) and 2.53 (2.0-3.0) mm respectively. *Arctium pubens* is a plant from ruderal habitats.

Aster tripolium L. (fig. 14:5)
Oblong, compressed achenes, with domed sides. In the subfossil fruits of *Aster tripolium* met with in this study the outer wall and the thickened annulus at the apex have disappeared. In this state of preservation the *Aster tripolium* fruits can be recognized by the cellular tubercle near the top of the fruit.

The fruits of *Aster tripolium* were found regularly. For fruits from two sites the dimensions have been determined: Tritsum (N = 15), length 2.84 (2.0-4.2) mm, breadth 0.89 (0.8-1.3) mm; Sneek (N = 40), length 2.94 (1.8-4.1) mm, breadth 0.81 (0.6-1.0) mm. *Aster tripolium* is a characteristic species of the Asteretea tripolii, which class includes halophytic vegetations.

Bidens tripartitus L. (fig. 17:1)
Flat achenes, trapezoidal in outline, with two to four barbed awns. This fruit type is fairly frequent in some sites (Paddepoel, Schiedam, Vlaardingen), but absent in others. Length (not including the awns) and breadth for 68 *B. tripartitus* achenes from Vlaardingen amount to 5.55 (3.8-8.6) and 2.12 (1.5-2.8) mm respectively. *B. tripartitus* is common in wet, nitrate-rich habitats.

Carduus crispus L. (fig. 14:3)
The achenes of *Carduus crispus* can be distinguished from those of *Cirsium* by the fine transverse wrinkling of the fruit wall. This type occurred only in a few samples. Four specimens from Tritsum were measured: 3.4 x 1.4, 3.3 x 1.4, 2.9 x 1.4, and 3.4 x 1.6 mm. *Carduus crispus* is a characteristic species of the Artemisietalia vulgaris, which order includes vegetations from habitats rich in nitrates.

Cirsium arvense (L.) Scop. (fig. 14:6)
Oblong, slightly curved achenes, tapering towards the base. The fruit wall is smooth. 29 specimens from Paddepoel measure: length 3.28 (2.8-3.7) mm, breadth 1.30 (1.1-1.7) mm, L:B 254 (214-307). *C. arvense* is common in fields and on waste ground.

Cirsium palustre (L.) Scop.
The achenes of *C. palustre* can be distinguished from those of *C. arvense* by the longitudinal, narrow ribs. This species could only be demonstrated for Tritsum (3.8 x 1.4 and 3.5 x 1.4 mm). *C. palustre* grows in wet habitats.

Cirsium vulgare (Savi) Ten.
The achenes of *C. vulgare* differ from those of *C. arvense* by the size and the shape, the latter type being more slender, which finds expression in the L:B index values. The fruits of *C. oleraceum* (L.) Scop. show much resemblance to those of *C. vulgare*, but in view of the present distribution of *C. oleraceum* it is not likely that the latter species is represented in the coastal settlement sites.

The achenes of *C. vulgare* were not commonly found. Only Schiedam 178 yielded a larger number of this fruit type, 77 specimens of which were measured: length 3.71 (3.2-4.3) mm, breadth 2.03 (1.7-2.3) mm, L:B 191 (167-208). *C. vulgare* is a characteristic species of the Artemisietalia vulgaris.

Eupatorium cannabinum L. (fig. 9:2)
Pillar-shaped achenes with 4 to 6 sides and a black, somewhat rough surface. From this fruit type two specimens (2.5 x 0.6 mm) were met with (Leeuwarden and Vlaardingen). *Eupatorium cannabinum* is a species from marshy and moist places.

Lapsana communis L.
Slightly curved, lanceolate achenes, with a large number of closely spaced, longitudinal ribs. The fruit is broadest above the middle. A few specimens of this fruit type were found in Den Helder (4.1 x 1.0 mm). *Lapsana communis* grows on roadsides, in fields, and along forest borders.

Leontodon autumnalis L. (fig. 14:4)
Long, cylindrical achenes. The fruit wall shows a fine, transverse wrinkling. Particularly Paddepoel yielded larger numbers of this fruit type.

The following dimensions were obtained for the fruits of *Leontodon autumnalis*: Paddepoel (N = 75), length 5.12 (3.4-7.3) mm, breadth 0.73 (0.6-1.0) mm; Tritsum (N = 69), length 4.45 (3.3-5.8) mm, breadth 0.69 (0.5-1.0) mm. *Leontodon autumnalis* is a species from grasslands and roadsides. It grows also in a brackish environment where it would be indicative of grazing (see 4.2.1.1.).

Matricaria maritima L. ssp. *inodora* (L.) Clapham (fig. 9:3)
The achenes of this species can easily be recognized, even if poorly preserved, by the presence of two oval warts (glands) in the upper part of the dorsal side. Three conspicuous, longitudinal ribs of white tissue can be observed in well preserved subfossil fruits: one on the ventral side and two lateral ones. The fruit surface shows a transverse wrinkling. This fruit type was encountered in many samples, sometimes in larger numbers. The dimensions have been determined for 39 fruits from Paddepoel: length 1.5-2.2 mm (mean 1.85 mm), breadth 0.7-1.2 mm (mean 0.97 mm).

Matricaria maritima ssp. *inodora* is a species from fields and roadsides, while the variety *salina* (Wallr.) Lange is found in tidal drift vegetations.

Senecio cf. *vulgaris* L. (fig. 9:1)
The subfossil *Senecio* fruits recovered from Den Helder 488 and 866 are completely flat, this in contrast to the modern fruits which are cylindrical in shape. The outer fruit wall had largely decayed, but the narrow longitudinal ribs (about 10 in number) and the annulus at the apex are still preserved. Four fruits were measured: 2.5 x 0.8, 2.4 x 0.6, 2.5 x 0.6, and 2.6 x 0.6 mm. *Senecio* is common in fields and ruderal places.

Sonchus arvensis L.
The oblong and flat achenes are characterized by five about equally strong ribs on both sides and by a transversally wrinkled surface. *S. arvensis* fruits from two sites have been measured: Tritsum (N = 5), 3.9 (3.4-4.4) x 1.3 (1.1-1.5) mm; Schiedam (N = 7), 3.3 (3.0-3.9) x 1.2 (1.0-1.5) mm. This species is a weed in fields.

Sonchus asper (L.) Hill (fig. 14:1)
Oblong and flat achenes, with three longitudinal ribs on both sides. The fruit surface is smooth. *S. asper* fruits were recovered from many samples, not infrequently in larger numbers. The dimensions are shown in table 12. *S. asper* is particularly found in fields and on ruderal sites.

TABLE 12. DIMENSIONS IN MM AND INDEX VALUES FOR *SONCHUS* SPECIES

		Length	Breadth	L:B
S. asper	min.	2.3	0.7	178
Tritsum	min.	2.81	1.23	231
N = 100	min.	3.3	1.6	308
S. asper	mean	2.3	0.9	204
Paddepoel	mean	2.83	1.12	255
N = 50	mean	3.4	1.4	314
S. oleraceus	max.	2.5	0.7	252
Paddepoel	max.	2.94	0.96	308
N = 72	max.	3.2	1.2	400

Sonchus oleraceus L. (fig. 14:2)
The achenes of *S. oleraceus* can be distinguished from those of *S. asper* by the fine transverse wrinkling of the surface. Moreover, the fruits of *S. oleraceus* are slightly more slender than those of *S. asper*, which finds expression in the L:B index values (see table 12). *S. oleraceus* grows in about the same habitats as *S. asper*.

Sonchus palustris L.
Ezinge yielded one achene of *S. palustris*. The lanceolate fruit (3.6 x 0.8 mm) is quadrangular in cross-section, the edges being formed by pronounced ribs. In between two strong ribs two smaller ones are present. The fruit surface is transversally wrinkled. *S. palustris* grows along lakes and water courses with fresh as well as with slightly brackish water.

Taraxacum spec. (fig. 10:6)
Even if poorly preserved the achenes of *Taraxacum* can easily be recognized by the rows of spines in the upper part of the fruit. Among the small numbers of *Taraxacum* fruits which were found in this study no specimens were suitable for measurement. *Taraxacum* species occur in grasslands and other open herbaceous vegetations.

3.2.8. CRUCIFERAE
Brassica campestris L. (*Br. rapa* L.) (fig. 14:8)
The surface of the more or less spherical seeds of *Brassica campestris* shows a distinct reticulate pattern. The largest diameter for 42 seeds from Tritsum and for 84 specimens from Schiedam amounts to 1.73 (1.3-2.1) and 1.76 (1.4-2.2) mm respectively.

The identification of *Br. campestris* caused difficulties. The reticulate surface pattern is more distinct in the subfossil seeds than in the modern seeds of *Br. campestris/rapa* present in the seed reference collection in the B.A.I. At first it was thought that the subfossil seeds show more resemblance to *Br. nigra* (L.) Koch, but on closer inspection it turned out that in the latter species the walls forming the reticulate pattern are much higher than in the subfossil *Brassica* seeds. The definite identification of the *Brassica* seeds from the Dutch coastal sites as *Br. campestris* is partly based on the good resemblance to the *Br. campestris* seeds from the Feddersen Wierde (Körber-Grohne 1967, plate 41). Körber-Grohne's (1967, pp. 183-189) identification of *Br. campestris* rests on seeds as well as on pods. The latter were not encountered in the sites examined.

For a further discussion of the species see 5.1.5.

Camelina sativa (L.) Crantz (figs. 10:4 and 17:4)
Seeds oval in outline, with polygonal epidermis cells. Not only the seeds but also the characteristic pods were found (Vlaardingen, Paddepoel). 36 seeds from Vlaardingen were measured: length 1.44 (1.1-1.8) mm, breadth 0.91 (0.6-1.2) mm. For 71 pods from Vlaardingen the following measurements were obtained: length 7.26 (5.6-9.0) mm, breadth 4.05 (3.1-5.1) mm. *Camelina* seeds from other sites could not be measured because of serious damage.

Camelina sativa is a crop plant.

Capsella bursa-pastoris (L.) Med.
The separation of the seeds of *Capsella bursa-pastoris* and *Camelina sativa* can cause some difficulties, although in general *Camelina* seeds are larger. At magnifications of at least 100 times the difference in thickness of the epidermis cell walls becomes evident. In *Camelina sativa* these walls are considerably

thicker than in *Capsella bursa-pastoris* and they show a distinct middle lamella.

The seeds of *Capsella* were found in only small numbers. Seeds from Tritsum and Vlaardingen were measured: Tritsum (N = 9), length 1.09 (0.9-1.2) mm, breadth 0.66 (0.6-0.8) mm; Vlaardingen (N = 13), length 1.10 (1.0-1.2) mm, breadth 0.68 (0.6-0.7) mm. At present *Capsella bursa-pastoris* is a very common weed of cultivated ground and roadsides.

Cochlearia danica L.

Only one seed of *Cochlearia danica* was met with (Paddepoel 299, 1.2 x 0.9 mm). The network on the surface is very coarse in relation to the size of the seed. *Cochlearia danica* occurs on the highest parts of the salt marshes as well as in the dunes.

Erysimum cheiranthoides L.

Seeds oval to ovate in outline, with more or less pointed upper end. In the subfossil seeds the small spine-like papillae on the surface can often still be observed. *Erysimum cheiranthoides* seeds were found in a few sites. Length and breadth for 15 specimens from Tritsum measure 1.54 (1.4-1.6) and 0.87 (0.8-1.0) mm respectively. *Erysimum cheiranthoides* is a plant from fields and roadsides.

Raphanus raphanistrum L. (fig. 10:2)

From Den Helder 867 one pod segment and one seed of *Raphanus raphanistrum* were recovered. The squat pod segments are characterized by the longitudinal ribs. The oval seeds show a distinct reticulate surface pattern. The somewhat damaged seed from Den Helder is 3.2 mm long. *Raphanus raphanistrum* grows in fields on sandy soils.

Rorippa islandica (Oeder) Borbas (fig. 7:7)

Ovate to round, laterally flattened seeds with distinct epidermis cells and a protruding radicula. *Rorippa islandica* is represented in Vlaardingen and Schiedam. The dimensions for 12 seeds from Vlaardingen have been determined: length 0.79 (0.7-0.8) mm, breadth 0.62 (0.5-0.7) mm. *Rorippa islandica* is a characteristic species of the Bidentetalia tripartiti, which order includes vegetations from moist and nitrate-rich habitats.

Sinapis arvensis L.

The seeds of *Sinapis arvensis* show some resemblance to those of *Brassica campestris*. They can be distinguished from the latter by the much finer reticulate surface pattern. Moreover, in *Sinapis arvensis* the network is, at least in part, longitudinally elongated.

The largest diameter for 8 seeds from Tritsum and 6 specimens from Tzummarum amounts to 1.93 (1.8-2.1) and 1.81 (1.6-2.1) mm respectively. *Sinapis arvensis* is a weed from fields.

Thlaspi arvense L. (fig. 14:9)
Laterally flattened, oval seeds with concentric ridges. *Thlaspi arvense* is represented in Tritsum, Paddepoel, and Den Helder. 44 seeds from Tritsum 1141 were measured: length 2.10 (1.8-2.5) mm, breadth 1.60 (1.4-1.8) mm. *Thlaspi arvense* is a species from fields and roadsides.

3.2.9. CYPERACEAE
For the identification of the Cyperaceous fruits the clear descriptions and figures in Körber-Grohne (1967, pp. 248-258) proved to be extremely valuable. Part 2 of the "Atlas of Seeds" (Berggren, 1969), dealing with the Cyperaceae, came to the author's notice after most of the analyses had been completed. The latter publication rendered particularly good services in the final re-check of the Cyperaceous fruits.

The fruits (achenes) of Cyperaceae are two- or three-sided, with a mostly narrow base. At the top the style base is often present. The subfossil *Carex* fruits are sometimes still enclosed by the perigynium, a more or less inflated sac. In the measurements the style base is not included in the length.

Carex acuta L. (*C. gracilis* Curt.)-type (fig. 12:3)
The fruits of this type are flat and obovate to circular in outline. In contrast to the other *Carex* fruits to be discussed below, in this type the base is broad. The epidermis cells are distinct. The majority of the fruits is naked, but some specimens are still enclosed by the perigynium (see above), or at least remnants of the perigynium cover a smaller or larger part of the fruit. The perigynium or remnants of it are generally in a poor state of preservation, but small, circular to oblong dots are clearly visible on its surface.

This *Carex* fruit type could be established for four sites from the former salt marsh area; larger numbers of fruits were recovered from Paddepoel. The dimensions are shown in table 13.

TABLE 13. DIMENSIONS IN MM AND INDICES FOR *CAREX ACUTA*-TYPE FRUITS

		Length	Breadth	L:B
Paddepoel	min.	1.4	1.0	100
N = 99	mean	1.69	1.34	127
	max.	2.0	1.7	165
Ouddorp	min.	1.4	1.1	103
N = 10	mean	1.62	1.34	121
	max.	1.8	1.6	136
Den Helder		1.6	1.4	114
		1.6	1.3	121
		1.7	1.4	124
		1.6	1.2	126
Sneek		1.8	1.4	129

As for the identification of this fruit type, four species come into consideration, viz. *C. trinervis* Degl., *C. hudsonii* A. Benn. (*C.stricta* Good.), *C. acuta*, and *C. nigra* (L.) Reichard (*C. vulgaris* Fr.). The length of the subfossil fruits, varying from 1.4 to 2.0 mm (see table 13), indicates that *C. trinervis* drops out. According to Berggren (1969, p. 35) the length of *C. trinervis* nutlets ranges from 2.5 to 2.8 mm, while Kern & Reichgelt (1954, p. 80) give a length of 2-2.5 mm. The fruits of the other three species are smaller and their size tallies with that of the subfossil fruits.

Berggren (1969, p. 35) mentions that the perigynium wall in *C. acuta* and *C. hudsonii* is or can be purple-dotted, just as in *C. trinervis*. For *C. nigra* no mention is made of dots, but of the *C. nigra* present in the seed reference collection in the B.A.I. the perigynium of plants from one provenience is purple-dotted. *C. hudsonii* is a marsh plant which does not tolerate salt. *C. nigra*, which occurs in a great variety of habitats, from marshy to rather dry places, is also found in a brackish environment but not in salt marshes (Kern & Reichgelt 1954, pp. 82-3). *C. acuta* is common in various marsh vegetations – it is a characteristic species of the Magnocaricion – and grows also in slightly saline water.

It is most likely that *C. acuta* is concerned in the sites from the former salt marsh area, so that the *Carex* fruit type discussed above is listed as *C. acuta*-type. However, it cannot be excluded that *C. hudsonii* and/or *C. nigra* occurred on the habitation mounds.

Carex disticha Huds. (fig. 12:2)
The flat fruits are ovate to elliptic in outline, with a fine epidermis cell pattern (see *C. otrubae*). A few fruits are still partly covered by a remnant of perigynium. Paddepoel yielded a fairly large number of *C. disticha* fruits (for dimensions see table 14), while also in Ouddorp and Schiedam this species is represented.

C. disticha grows in marshy places, and is also found in a brackish environment (*Eleocharis* variant of the Juncetum gerardii, see 4.2.1.1.).

Carex otrubae Podp. (fig. 12:1)
Naked fruits as well as fruits enclosed by the perigynium were found. The flat fruits are ovate in outline, rather variable in shape. The epidermis cells are more distinct than in *C. disticha*. Moreover, the fruits of *C. otrubae* are on an average somewhat plumper than those of *C. disticha*, which finds expression in the L:B index values (see table 14).

The perigynium is ovate in outline, tapering into a beak. The ventral side is flat and the dorsal side domed. Of the distinct nerves on both sides of the perigynium not all reach the upper end. The fact that there is no difference in the nervation on both sides of the perigynium indicates that *C. vulpina* L. cannot come into consideration. According to Kern & Reichgelt (1954, p. 120) in *C. vulpina* no nerves or only short, indistinct ones are present on the flat ventral side, while Berggren (1969, p. 30) claims that in *C. vulpina* the nerves on the ventral side are half as long as the perigynium or absent.

TABLE 14. DIMENSIONS IN MM AND INDICES FOR *CAREX* FRUITS

		Length	Breadth	L:B
C. disticha	min.	1.5	0.9	141
Paddepoel	mean	1.82	1.08	169
N = 50	max.	2.2	1.3	204
C. otrubae	min.	1.7	1.0	120
Paddepoel	mean	2.10	1.38	153
N = 50	max.	2.4	1.8	179
C. otrubae	min.	1.8	1.2	116
Tritsum	mean	2.11	1.50	141
N = 65	max.	2.5	1.8	175
C. rostrata/vesicaria	min.	2.3	1.3	138
Paddepoel	mean	2.59	1.61	163
N = 14	max.	3.0	1.9	234

C. otrubae is represented in various sites, sometimes by fairly large numbers of fruits (Vlaardingen, Paddepoel, Tritsum). This sedge species, which is common along water and in marshy places, occurs likewise in a brackish environment, among others along ditches in salt marshes.

Carex paniculata L. (fig. 6:4)
Fruits irregularly lozenge-shaped in outline. The dorsal side is somewhat roof-shaped, the ventral side is flat to slightly concave. Schiedam 119 yielded four fruits of this type (1.8 x 1.2, 1.6 x 1.1, 1.6 x 1.0, 1.6 x 1.0 mm). *C. paniculata* grows in marsh vegetations of the Magnocaricion and in alder carr.

Carex pseudocyperus L. (fig. 7:10)
Only one nutlet of this *Carex* species was met with (Tritsum 2762: 1.6 x 0.9 mm). The three-sided fruit is ovate in outline, tapering towards the upper and lower end. The edges are fairly sharp. The larger part of the slender style is still preserved. *C. pseudocyperus* occurs in marsh vegetations in an eutrophic environment.

Carex rostrata Stokes/*vesicaria* L. (fig. 13:2)
Of this type naked fruits as well as fruits enclosed by the perigynium were recovered. The three-sided fruits are obovate in outline, with slightly rounded edges. The base is narrowed into a short "stipe". The lower part of the style is often still present. The epidermis cells are distinct. The perigynium is ovate in outline, with a bidentate beak and distinct nerves.

C. rostrata/vesicaria is represented in most sites, be it mostly by small numbers of fruits. The dimensions for fruits from Paddepoel are shown in table 14. On the ground of the fruits a distinction between *C. rostrata* and C. *vesicaria* is not possible. The condition of the subfossil perigynium did neither allow a more detailed identification. Both *Carex* species grow in marsh vegetations, which does not imply that the ecological requirements of both species are the same. *C. vesicaria* prefers an eutrophic environment and is slightly salt-tolerant. *C. rostrata* is more common in oligotrophic and mesotrophic habitats and cannot stand salt.

Carex serotina Mér.-type (fig. 6:3)
Small, three-sided fruits, obovate in outline, abruptly beaked. The greatest breadth is slightly below the top, tapering towards the base. The epidermis cells are rather distinct. Paddepoel, Ouddorp, Den Helder, Schiedam, and Vlaardingen yielded *C. serotina*-type fruits. Various fruits from Paddepoel are enclosed by remains of the perigynium. The dimensions are shown in table 15.

This type includes a few *Carex* species, such as *C. flava* L., *C. lepidocarpa* Tausch, *C. demissa* Hornem., and *C. serotina.* According to Kern & Reichgelt (1954, pp. 54-5) *C. flava* and *C. lepidocarpa* do not come into consideration for coastal sites. Moreover, these species are very rare in the Netherlands. *C. demissa*, which is characteristic of the Parvocaricetea, could be the species from which the *C. serotina*-type fruits from Vlaardingen and Schiedam originate. It is likely that *C. serotina* ssp. *pulchella* (Lönnr.) Van Ooststr. is represented in the other sites. This subspecies grows in moist dune valleys as well as on the higher parts of the salt marshes (*Eleocharis* variant of the Juncetum gerardii, see 4.2.1.1.).

TABLE 15. DIMENSIONS IN MM AND INDICES FOR *CAREX SEROTINA*-TYPE FRUITS

		Length	Breadth	L:B
Paddepoel	min.	1.1	0.9	110
N = 50	mean	1.35	1.01	130
	max.	1.6	1.2	165
Vlaardingen	min.	1.2	0.8	120
N = 8	mean	1.37	1.03	133
	max.	1.6	1.1	148
Schiedam	min.	1.2	1.0	116
N = 11	mean	1.41	1.05	134
	max.	1.6	1.2	150

Cladium mariscus (L.) Pohl. (fig. 7:5)
The fruits are elliptic in outline and more or less circular in cross-section. The base is collar-shaped and three longitudinal sutures run over the surface. Only Sneek yielded a somewhat larger number of *Cladium* fruits; length and breadth for 22 specimens from this site amount to 2.05 (1.7-2.3) and 1.48 (1.2-1.7) mm respectively.

Cladium mariscus is a marsh plant with a diverse ecological behaviour. It is also found in a slightly brackish environment.

Eleocharis palustris (L.) R. et Sch. (fig. 6:1)
Bi-convex fruits, obovate in outline, with a rounded edge. In most of the sub-fossil *Eleocharis* fruits the characteristic, triangular style base has disappeared completely or for the greater part. Bristles are often still adhering to the fruits from Vlaardingen. Large numbers of *Eleocharis* fruits were recovered from Paddepoel, but this species is also well represented in Vlaardingen and Schiedam. For 96 fruits from Paddepoel the dimensions were obtained: length (without style base) 1.62 (1.2-2.1) mm, breadth 1.20 (0.8-1.4) mm, L:B 136 (106-196).

In *Eleocharis palustris* two subspecies are distinguished, viz. ssp. *palustris* and ssp. *uniglumis* (Link) Hartm. (= *E. uniglumis* Link). According to Reichgelt (1956, pp. 36-37) in ssp. *palustris* the shape of the style base would vary from broader than high to twice as high as broad, while the epidermis cells are isodiametric as well as oblong. In ssp. *uniglumis*, on the other hand, the style base would very rarely be higher than broad, while the epidermis cells would be predominantly isodiametric. As for the difference in shape of the epidermis cells of the fruits of both subspecies, Berggren (1969, p. 16) claims the reverse. Apparently, the shape of the epidermis cells is of no use in distinguishing between both subspecies. In subfossil *Eleocharis* fruits the usefulness of the style base as a distinguishing character is not inconsiderably reduced by the fact that it is difficult to establish whether the style base is complete or not. Particularly the upper part of the style base seems to deteriorate easily. For the reasons set forth above the present author does not feel able to arrive at a satisfactory identification of the subspecies in subfossil *E. palustris* fruits.

On ecological grounds it is most likely that the *Eleocharis* fruits recovered from the sites in the former salt marsh area are of ssp. *uniglumis*. *E. palustris* ssp. *uniglumis*, which does not grow in open water but in moist habitats, shows some preference for a brackish environment. Körber-Grohne (1967) has convincingly demonstrated that this subspecies played an important part in the vegetation from moist, only slightly saline places on the higher parts of the salt marshes (Juncetum gerardii subass. eleocharitetosum, see 4.2.1.1.). The assumption that in the sites from a brackish environment ssp. *uniglumis* is represented, is supported to a certain extent by the fact that among the *Eleocharis* fruits from Paddepoel only one specimen with a style base which is higher than broad was observed. In all other fruits with a more or less complete style base the latter is broader than high.

One may assume that in Vlaardingen and Schiedam ssp. *palustris* is concerned. This subspecies prefers shallow, open water without much other vegetation, but it is also found in various marsh vegetations. Vlaardingen and Schiedam yielded a number of *Eleocharis* fruits the style base of which is higher than broad or at least as high as broad, although specimens with a plumper style base are more numerous.

Scirpus lacustris L. ssp. *glaucus* (Sm.) Hartm. (*Sc. tabernaemontani* C.C. Gmel.) (fig. 13:3)

The bi-convex fruits are obovate to elliptic in outline. The epidermis cells are distinct, but smaller than in *Sc. maritimus* (see below). Bristles are sometimes still adhering to the fruit base. *Sc. lacustris* ssp. *glaucus* fruits are present in various sites, but only occasionally in somewhat larger numbers. Fruits from three sites were measured (see table 16). This species occurs in fresh as well as in brackish water.

TABLE 16. DIMENSIONS IN MM AND INDEX VALUES FOR *SCIRPUS* SPECIES

		Length	Breadth	L:B
Sc. lacustris glaucus	min.	2.0	1.4	132
Tritsum	mean	2.23	1.49	150
N = 13	max.	2.6	1.7	173
Sc. lacustris glaucus	min.	1.8	1.1	125
Paddepoel	mean	2.25	1.51	150
N = 15	max.	2.5	1.7	211
Sc. lacustris glaucus	min.	1.9	1.4	120
Vlaardingen	mean	2.29	1.57	146
N = 22	max.	2.7	2.0	170
Sc. maritimus	min.	2.5	1.7	115
Tritsum	mean	3.03	2.16	141
N = 100	max.	3.9	2.8	171
Sc. maritimus	min.	2.2	1.6	113
Paddepoel	mean	2.92	2.07	143
N = 50	max.	3.6	2.9	191

Scirpus maritimus L. (fig. 13:1)
The fruits of *Sc. maritimus* are very variable in shape. They are obovate in outline, tapering towards the base. The shape of the upper part varies from abruptly to gradually narrowed into the style base. The ventral side is more or less flat, while the dorsal side is generally roof-shaped with a rounded median edge. Besides, specimens occur in which the dorsal side or both the dorsal and the ventral side are domed. The surface shows a distinct cell pattern.

Körber-Grohne (1967, pp. 256-257) has already pointed out that in subfossil *Scirpus* fruits it can be difficult to determine whether they originate from *Sc. maritimus* or from *Sc. lacustris* L. ssp. *lacustris*, although in modern fruits the differences between both types are clear. No distinctly *Sc. lacustris* ssp. *lacustris* fruits were found in the material studied.

Sc. maritimus is represented in all sites examined. The dimensions are shown in table 16. *Sc. maritimus* is common in brackish water, where it is the dominant species in the Scirpetum maritimi.

Scirpus planifolius Grimm (*Blysmus compressus* Panz. ex Link) (fig. 7:9)
One Cyperaceous fruit from Den Helder 920 is attributed to *Sc. planifolius.* The compressed, two sided fruit (2.0 x 1.3 mm) is obovate in outline, with a stipitated base. The lower part of 6 bristles is still adhering to the fruit base. *Sc planifolius* is found in wet grasslands and in wet dune valleys.

3.2.10. ERICACEAE
Calluna vulgaris (L.) Hull
Of *Calluna vulgaris* seeds, leaves and leafy branches were found. The seeds are elliptic in outline, rounded at one end and truncated at the other end. The epidermis cells are relatively large. Six seeds from Schiedam measure 0.50-0.65 x 0.30-0.40 mm. The shoots have four rows of closely spaced, lanceolate, sessile leaves.

Calluna is represented in various sites. It is most likely that the *Calluna* remains are of secondary origin, viz. that they originate from peat deposits in the coastal area which have been eroded by the sea.

Erica tetralix L.
Leaves as well as seeds of *Erica tetralix* were met with. The seeds are elliptic in outline, with rounded upper and lower end. The epidermis cells are smaller than in *Calluna vulgaris* seeds. For a few seeds the dimensions were obtained: 0.35 x 0.25, 0.40 x 0.30, and 0.40 x 0.25 mm. The lanceolate leaves have a recurved margin. Just as in *Calluna*, the *Erica* remains would have been of secondary origin, at least in the sites from the former salt marsh area.

3.2.11. EUPHORBIACEAE
Euphorbia helioscopia L. (fig. 7:11)
The fruits of *Euphorbia helioscopia* are obovate in outline and more or less circular in cross-section. On the surface a coarse network. On one side of the fruit a keel runs from the lower flattened end (with the caruncula) to the opposite end. Of *Euphorbia helioscopia*, which is a weed in fields, both in Tzummarum and Paddepoel one fruit was found (2.6 x 2.1 x 2.1 and 2.2 x 1.6 x 1.6 mm).

3.2.12. FAGACEAE
Fagus sylvatica L.
Vlaardingen and Schiedam yielded a few immature cupules of *Fagus sylvatica.* Beech could have occurred in the forest on levees along rivers in the Vlaardingen-Schiedam area.

Quercus spec.
A few larger pieces of an acorn were recovered from Vlaardingen II/III. In the Vlaardingen area *Quercus* would have grown in the same localities as beech.

3.2.13. GENTIANACEAE

Centaurium spec. (fig. 9:8)
Very small, somewhat irregularly shaped seeds with a distinct reticulate surface pattern. The seeds of *Centaurium* have a dot-shaped hilum. *Centaurium* seeds show some resemblance to those of *Calluna*, but the hilum is a good distinguishing character. Tzummarum yielded a larger number of *Centaurium* seeds; the largest diameter for 71 specimens from this site varies from 0.40-0.60 mm (mean 0.47 mm).

The present author does not feel able to identify the *Centaurium* seeds to the species. On ecological grounds *C. pulchella* (Sw.) Druce and/or *C. littorale* (Turner) Gilmour are most likely; both *Centaurium* species occur, among others, in a brackish environment.

Menyanthes trifoliata L.
Flattened seeds, elliptic in outline, with slightly domed sides and a rounded edge. The hilum is situated in an oblong depression in the edge. The smooth surface is shiny. This seed type was found only in Den Helder. Length and breadth for 6 seeds amount to 2.8 (2.5-3.3) and 2.3 (2.0-2.6) mm respectively. *Menyanthes trifoliata* grows in marshes and in shallow lakes.

3.2.14. GRAMINEAE

For the identification of the subfossil grass caryopses the key and the descriptions in Körber-Grohne (1964) were of invaluable help. A small part of the Gramineous fruits could not be identified, which was not always caused by poor preservation.

Agrostis spec. (fig. 11:5)
Small caryopses with a slender hilum. A satisfactory distinction between the subfossil fruits of *Agrostis canina* L., *A. stolonifera* L., and *A. tenuis* Sibth. is not possible. It is likely that in the samples from sites in the former salt marsh area *A. stolonifera* is concerned. This species is characteristic of the Armerion maritimae.

Agrostis fruits were found in all sites examined. For 100 specimens from Paddepoel and Tritsum the length has been determined: 1.19 (0.9-1.5) and 1.05 (0.8-1.3) mm.

Alopecurus geniculatus L. (fig. 11:1)
Alopecurus caryopses are characterized by the lateral position of the round to oval hilum directly at the base of the fruit, and by the appendage at the apex which is often still preserved in subfossil fruits. The identification as *Alopecurus geniculatus* is based on the size of the fruits met with in this study (no specimens with a length of more than 1.8 mm have been observed) and on the distinct striation of the fruit wall. In Paddepoel and Schiedam this type was found in larger numbers. The length for 100 fruits from Paddepoel varies from 1.0 to 1.7 mm (mean 1.42 mm).

Alopecurus geniculatus is common in moist places which are rich in nitrates, also in brackish environment.

Avena spec.
A few charred *Avena* fruits were recovered from Paddepoel. As no flower bases are preserved the species cannot be determined. It is likely that *Avena sativa* L. is concerned here (see 5.1.2.).

Bromus mollis L./*secalinus* L.
Fairly large fruits. The narrow but distinct hilum does not reach the upper end of the caryops. Rows of longitudinal cells radiate from the upper end of the hilum to the fruit apex. The fruits of *B. mollis* differ from those of *B. secalinus* by a narrower upper part. Characteristic fruits of both *Bromus* species were found, but also intermediate forms. For that reason this fruit type is indicated as *B. mollis/secalinus.*

23 specimens from Tritsum measure 5.57 (4.9-7.0) x 1.98 (1.5-2.6) mm. *B. secalinus* is a weed in grain fields. *B. mollis* grows in a great variety of habitats, such as grasslands, roadsides, and fields.

Echinochloa crus-galli (L.) P.B.
This species is represented by spikelets, in some of which the remains of the fruit are still present. At first the spikelets of this type were attributed to *Panicum miliaceum* (see below). The *Echinochloa* spikelets differ from those of *Panicum* by a smaller size, by thinner bracts, by a flat ventral side, and by the shape of the epidermis cells (cf. Netolitzky 1914). Vlaardingen, Schiedam, and Paddepoel yielded one or a few *Echinochloa* spikelets. This species is a weed in fields.

Elytrigia repens (L.) Desv./*pungens* (Pers.) Tutin
This type is characterized by a long, robust hilum and by the distinct transverse cells arranged in longitudinal rows. The distinction between the subfossil fruits

of *Elytrigia repens* (= *Agropyron repens*) and *Elytrigia pungens* (= *Agropyron littorale*) is problematical and has not been attempted here.

Elytrigia repens/pungens is represented in most of the sites, but seldom by a larger number of fruits. The length for 65 specimens from Tritsum varies from 2.7 to 6.8 mm (mean 4.01 mm). *E. pungens* is a salt marsh species, whereas *E. repens* is common in fields and on ruderal sites.

Festuca rubra L. (fig. 11:3)
The upper part of the fairly long hilum in *Festuca rubra* fruits has often a horsetail-like appearance which is due to dark lines radiating from the hilum. Mostly only small numbers of this type were found. The length for 28 caryopses from Paddepoel varies from 2.4 to 4.0 mm (mean 3.29 mm). At present *Festuca rubra* is a very common species occurring in a great variety of habitats.

Glyceria maxima (Hartm.) Holmb.
Fairly plump caryopses with a long, narrow hilum. The length of both fruits recovered from Vlaardingen VI amounts to 2.2 and 2.4 mm. The outer layer of the fruit wall consists of polygonal cells. *Glyceria maxima* is particularly found in marsh vegetations of the Phragmitetea.

Holcus lanatus L.
One Gramineous fruit from Tritsum 2762 has been attributed to *Holcus lanatus* (length 1.6 mm). Characteristic of the caryopses of this species are the folds of the fruit wall. *Holcus lanatus* is common in grasslands.

Hordeum spec.
Medium-sized to large caryopses. The hilum ends at a short distance from the fruit apex. In view of the variation in size (ca. 3 to ca. 7.5 mm) and shape of the fruits and in the thickness of the hilum it is likely that various *Hordeum* species are represented.

Hordeum vulgare L. emend Lamk.
In addition to the small *Hordeum* sample Tritsum 81, carbonized hulled barley grains turned up in other samples (see table 44). Because of deformations no measurements were taken.

Lolium perenne L.
In the caryopses of *Lolium perenne* the long hilum (extending over 3/4 to 5/6 of the fruit) tapers towards its upper end. For 37 caryopses from Paddepoel

and for 27 from Tritsum the length was measured: 3.21 (2.2-4.2) and 3.35 (2.6-3.9) mm. *Lolium perenne* occurs in grasslands which are rich in nitrates (due to grazing or manuring) and in trodden places (Lolio-Plantaginetum). It is also found in a somewhat saline environment.

Molinia coerulea (L.) Moench.
Characteristic of the caryopses of *Molinia coerulea* is the broad and long hilum (extending over about 2/3 of the fruit). In the subfossil fruits the wall is often ruptured at the hilum. Five *Molinia* fruits were found in Vlaardingen, varying in length from 1.6 to 2.2 mm. One specimen from Ouddorp measures 2.3 mm. *Molinia coerulea* occurs in a great variety of vegetations on moist sandy soils and on peatlands.

Panicum miliaceum L. (fig. 13:4)
Three more or less damaged spikelets of *Panicum miliaceum* were found in Vlaardingen. Originally more similar spikelets were identified as *Panicum*, but on closer inspection they turned out to belong to *Echinochloa* (see above).

Parapholis strigosa (Dum.) Hubbard (*Lepturus incurvatus* L.)
The medium-sized caryopses of *Parapholis strigosa* can be recognized by the delicate wall in which no cells are observed and by the fairly large, oblong hilum. Only a few specimens of this type were found (2.8, 3.2, 3.4, 3.5 mm). *Parapholis strigosa* is a salt marsh plant.

Phalaris arundinacea L.
Two caryopses of *Phalaris arundinacea* were found in Schiedam 119. The hilum which is shorter than half the length of the fruit has a lateral position. There are no distinct epidermis cells. The tubular appendix at the apex has disappeared in both subfossil fruits from Schiedam. Length: 1.5 and 1.8 mm. *Phalaris arundinacea* is a plant from marshy places.

Phragmites australis (Cav.) Trin. ex Steud. (= *P. communis* Trin.) (fig. 11:4)
Characteristic of the fruits of *Phragmites australis* are the shape and the position of the hilum. The latter is about 2 to 3 times as long as broad and it is situated at some distance (about the length of the hilum) from the lower end of the fruit.

Phragmites fruits are fairly rare. Only occasionally somewhat larger numbers were found. The following measurements were obtained for the length: Tritsum (N = 9), 1.45 (1.2-1.8) mm; Sneek (N = 15), 1.39 (1.2-1.7) mm; Ouddorp (N = 26), 1.39 (1.1-1.7) mm. *Phragmites* is common along lakes and water courses and in other wet habitats, in a freshwater as well as in a brackish environment.

Poa annua L. (fig. 11:6)
In contrast to that of *Poa pratensis/trivialis* the fruit wall of *Poa annua* shows a distinct rectangular cell pattern. The hilum is more or less circular. This species is represented in most of the sites examined, but only occasionally by somewhat larger numbers of fruits (Paddepoel 299). 29 specimens from Paddepoel measure from 1.2 to 1.8 mm (mean 1.49 mm). *Poa annua* is a species from trodden places and ruderal sites.

Poa pratensis L./*trivialis* L. (fig. 11:2)
According to Körber-Grohne (1964) the fruits of *Poa pratensis* and *Poa trivialis* differ from each other by the shape of the hilum. *Poa pratensis* has a circular hilum and *Poa trivialis* an oval one. *Poa* fruits with a round as well as with an oval hilum were found, but it has not been attempted to separate both types. A few small *Poa* fruits (1.1-1.3 mm) which have been included in the *Poa pratensis/trivialis*-type may have originated from *Poa palustris* L.

Poa pratensis/trivialis caryopses were found in the majority of the samples. For 100 fruits from Paddepoel and 126 fruits from Tritsum the length has been determined: 1.76 (1.1-2.3) and 1.47 (1.2-2.3) mm. *Poa pratensis* and *Poa trivialis* are both species from grassland vegetations.

Puccinellia distans (L.) Parl. and *Puccinellia maritima* (Huds.) Parl. (figs. 11:7 and 8)
The subfossil caryopses of *Puccinellia distans* and *P. maritima* are characterized by the distinct rectangular cell pattern of the fruit wall and by the oblong hilum. The fruits of *P. distans* are smaller than those of *P. maritima.* According to Körber-Grohne (1964) *P. distans* fruits measure from 1.4 to 1.8 mm, whereas the length of *P. maritima* fruits would range from 2.1 to 2.8 mm. Among the *Puccinellia* fruits met with in samples from Dutch coastal sites specimens are present which are between 1.8 and 2.1 mm long. The line between both species has arbitrarily been laid at 2.0 mm.

It cannot be excluded that among the fruits listed as *P. distans* specimens of *P. capillaris* (Liljebl.) Jansen (=*P. retroflexa*) occur. The size of the caryopses of *P. capillaris* corresponds to that of *P. distans.* According to Westhoff & Den Held (1969, p. 176) the Puccinellietum retroflexae is rare in the Netherlands.

P. distans is represented in all sites from a saline environment included in this study. *P. maritima* fruits, on the other hand, were less frequently found. Only in some of the samples from Den Helder this type is more frequent. For fruits of both species the length was determined:

P. distans, Paddepoel (N = 100), 1.2-1.9 mm (mean 1.56 mm);
P. distans, Tritsum (N = 74), 1.2-1.8 mm (mean 1.46 mm);
P. distans, Den Helder (N = 50), 1.3-2.0 mm (mean 1.75 mm);
P. maritima, Den Helder (N = 82), 2.0-2.7 mm (mean 2.34 mm).

P. maritima is the dominant species of the Puccinellietum maritimae. *P. distans* is particularly found in places trodden by man and animals and in places where sods have been cut (Puccinellietum distantis).

Triticum aestivum L.
In Ouddorp 1 and 6 a charred grain of *Triticum aestivum* was met with. One of the charred grain samples from this site which has already been published (Van Zeist (1968) 1970, p. 125) consisted nearly exclusively of *Triticum aestivum.*

Triticum dicoccum Schübl.
Paddepoel yielded one carbonized spikelet and one naked grain of *Triticum dicoccum.* The spikelet shows two grains which are for the larger part enclosed by the glumes.

3.2.15. HALORAGACEAE
Myriophyllum cf. *spicatum* L. (fig. 7:8)
Paddepoel 272 yielded a ca. 3 mm long fragment of a scale leaf of *Myriophyllum* cf. *spicatum*: a flat central axis with some lateral scales. This water plant is also found in brackish water.

3.2.16. HIPPURIDACEAE
Hippuris vulgaris L.
Cylinder-shaped fruits with truncated upper end and rounded lower end (in subfossil fruits the outer fruit wall ending in a tip is not preserved). One *Hippuris* fruit was found in Tritsum (1.7 x 1.1 mm) and Paddepoel (1.9 x 1.1 mm), while Ouddorp yielded two specimens (1.8 x 1.2 and 1.6 x 1.0 mm).

Hippuris vulgaris is a characteristic species of the Eleocharito-Hippuridetum, which plant community occurs, among other things, in ditches with brackish water.

3.2.17. HYPERICACEAE
Hypericum spec. (fig. 9:7)
Two *Hypericum* seeds were recovered from Leeuwarden I (0.80 x 0.35, 0.85 x

0.40 mm). One end of the cylindrical seeds is rounded, the other end has a short, obtuse point. The surface shows a fine, but distinct reticulate pattern.

3.2.18. IRIDACEAE

Iris pseudacorus L.

Disc-shaped seeds with sharp edges and flat upper and lower side. *Iris pseudacorus* is represented in Vlaardingen, Schiedam, and Ezinge by small numbers of seeds. Two specimens from Vlaardingen measure: 8.6 x 8.2 x 3.7 and 8.8 x 8.2 x 4.2 mm. *Iris pseudacorus* grows in swamp vegetations of the Phragmitetea and in alder carr.

3.2.19. JUNCACEAE

For the determination of subfossil *Juncus* seeds Körber-Grohne's (1964) identification key is indispensable. It was Körber-Grohne who for the first time called attention to the diagnostic value of the structure of the seed wall. For the identification of *Juncus* seeds magnifications from 100 to 1000 x in transmitted light are necessary.

Juncus articulatus L.

The seed surface of this species shows rows of toothed projections at the junctions of the short longitudinal and long transverse cell walls. In *Juncus articulatus* the bowed transverse cell walls are narrow. It cannot be excluded that among the seeds attributed to *J. articulatus* some are of *J. acutiflorus* Ehrh. ex Hoffm. or/and *J. bulbosus* L. The distinction between the subfossil seeds of these three *Juncus* species may not always be satisfactory.

J. articulatus is represented in various sites. This species is common in marshy places; it occurs also in a brackish environment.

Juncus bufonius L.

The seeds of *Juncus bufonius* are characterized by a large number (about 20 on each half of the seed) of longitudinal rows of small cells. *J. bufonius* is represented in all sites but one. This species is found on moist soils.

Juncus effusus L.-type

Each half of the seed shows 5 to 7 longitudinal rows of somewhat irregular cells that are broader than high. The *J. effusus* seed type may include seeds of *J. subuliflorus* Drej (= *J. conglomeratus* auct.) and/or *J. inflexus* L. *J. effusus*-type seeds were found in Leeuwarden, Vlaardingen, and Schiedam.

Juncus gerardii Loisl.
The seeds of *Juncus gerardii* can easily be recognized, even at lower magnifications. The irregularly shaped cells which are 4 to 5 times as broad as high are arranged in a small number of longitudinal rows (4 to 7 in each half of the seed). The short longitudinal cell walls are thicker than the transverse walls which are not infrequently branched.

In the samples from the sites in the former salt marsh area *J. gerardii* seeds are often very numerous. *J. gerardii* is a very common species on the higher parts of the salt marshes (Juncetum gerardii).

Juncus subnodulosus Schrank
Characteristic of the seeds of *Juncus subnodulosus* is the arrangment of the toothed projections in a rectangular pattern. Bowed cell walls as in *J. articulatus* are not present. The seeds of *J. subnodulosus* were found in samples from Leeuwarden, Den Helder, Vlaardingen, and Schiedam. *J. subnodulosus* grows in marsh vegetations.

3.2.20. LABIATAE
Galeopsis tetrahit L./ *speciosa* Mill. (fig. 15:6)
Fruits obovate in outline, the lower end with the rounded triangular hilum pointed. Both the dorsal and the ventral side are domed; on the ventral side a distinct ridge runs from the hilum to the middle of the fruit. Surface smooth. Length and breadth for 100 specimens from Paddepoel 299, which yielded a large number of *Galeopsis* fruits, amount to 3.21 (2.6-3.6) and 2.48 (1.9-3.0) mm respectively. It is not possible to separate the subfossil fruits of *G. tetrahit* from those of *G. speciosa.* Both are species from fields and ruderal sites.

Lamium purpureum L. (fig. 16:3)
Fruits with more or less parallel lateral sides, with rounded upper end and pointed lower end. The dorsal side is domed and the ventral side roof-shaped. The surface is densely covered with irregularly shaped warts. This fruit type was only found in Paddepoel. Length 2.24 (2.1-2.4) mm, breadth 1.37 (1.3-1.4) mm for 8 specimens. *Lamium purpureum* is common on roadsides, in fields and in ruderal places.

Lycopus europaeus L. (figs. 8:5 and 17:5)
Quadrangular fruits with a flat dorsal side and a roof-shaped ventral side. Characteristic of the fruits of *Lycopus europaeus* is the thickened margin of white tissue which is interrupted at the lower end. Vlaardingen and Schiedam yielded somewhat larger numbers of this fruit type. For 30 specimens from

Vlaardingen the dimensions were obtained: length 1.49 (1.2-1.6) mm, breadth 1.13 (1.0-1.2) mm. *Lycopus europaeus* is a species from a wet environment; it is characteristic of the Phragmitetea.

Mentha aquatica L./*arvensis* L.
The ovate fruits have a domed dorsal side and a roof-shaped ventral side. The lower end is pointed; the fruit surface is pitted. It is not possible to distinguish between the subfossil fruits of *M. aquatica* and *M. arvensis.* As *M. arvensis* is particularly a weed in fields on wet sandy soils, it is more likely that *M. aquatica*, which is found in marsh vegetations, wet grasslands, and dune valleys, is concerned here. This fruit type was met with in various sites, but only in Vlaardingen in a slightly larger number: length 1.06 (0.9-1.2) mm, breadth 0.75 (0.7-0.8) mm for 10 specimens.

Prunella vulgaris L. (fig. 8:2)
Fruits oval in outline, with pointed lower end. In subfossil *Prunella* fruits, on the roof-shaped ventral side a longitudinal groove can be observed which is accentuated by the peeling epidermis. Of the sites examined *Prunella* fruits were most common in Paddepoel: length 1.88 (1.6-2.2) mm, breadth 1.08 (0.9-1.3) mm for 32 specimens. *Prunella vulgaris* is common in grassland vegetations (Molinio-Arrhenatheretea).

Scutellaria galericulata L. (fig. 8:4)
The fruits are broadly ovate in outline. The dorsal side is slightly domed; the ventral side is roof-shaped, with a protruding radicula. The surface is densely covered with warts.

Vlaardingen yielded a small number of *Scutellaria* fruits, while one specimen was recovered from Leeuwarden. Six fruits were measured: 1.79 (1.7-1.9) x 1.53 (1.4-1.6) mm. *Scutellaria galericulata* grows in marsh vegetations; it is a characteristic species of the Magnocaricion.

Stachys arvensis (L.) L.
The oval fruits of *Stachys arvensis* have a roof-shaped ventral side and a domed dorsal side. The lower end is pointed. The fruit wall has small warts. This fruit type was scarcely met with. Three specimens from Tritsum measure: 2.4 x 1.6, 2.2 x 1.6, and 2.4 x 1.6 mm. *Stachys arvensis* is a weed in fields.

Stachys palustris L.
The fruits of *S. palustris* can be distinguished from those of *S. arvensis* by the smooth fruit wall. *S. palustris*, which is characteristic of the Filipendulion, is represented in Vlaardingen and Schiedam (2.5 x 1.8, 2.9 x 2.0, 2.4 x 1.6 mm).

3.2.21. LINACEAE

Linum catharticum L. (fig. 6:10)

Seeds oval in outline, with a little pronounced beak. One side is flat and the other slightly domed. *Linum catharticum* is represented in Ouddorp and Paddepoel. Mean length and breadth for 5 seeds amount to 1.3 and 0.8 mm respectively. *Linum catharticum* is a species from moist inland habitats, but it is also recorded for the upper part of the salt marsh area (Gillner 1960, p. 158).

Linum usitatissimum L. (figs. 13:6 and 7)

Flat, oval seeds with a bright margin and a distinct beak. In fresh seeds of *Linum usitatissimum* both sides are somewhat domed, but in subfossil material they are mostly flat. The surface shows a fine hexagonal cell pattern. This seed type was found in various sites, sometimes in fairly large numbers (Vlaardingen, Schiedam). Fruit capsule fragments were recovered from Schiedam and Paddepoel.

The following measurements were obtained: Vlaardingen (N = 100), length 3.57 (2.8-4.0) mm, breadth 2.02 (1.7-2.2) mm; Schiedam (N = 27), length 3.78 (3.4-4.2) mm, breadth 2.19 (1.9-2.5) mm; Tritsum (N = 28), length 3.72 (3.0-4.0) mm, breadth 2.11 (1.8-2.4) mm.

Linum usitatissimum is a crop plant.

3.2.22. LYTHRACEAE

Lythrum salicaria L. (fig. 6:7)

The small, cuneiform seeds of *Lythrum salicaria* show the greatest thickness in the upper part of the seed. The epidermis cells are longitudinally elongated which gives the seed surface a striate appearance. *Lythrum* seeds were not only met with in the sites from a freshwater environment, but also in Paddepoel, Leeuwarden, and Ouddorp.

12 seeds from Vlaardingen were measured: length 1.06 (0.9-1.2) mm, breadth 0.48 (0.4-0.5) mm. *Lythrum salicaria* is a species from wet to moist freshwater habitats.

3.2.23. MALVACEAE

Althaea officinalis L. (fig. 8:1)

Of this species naked seeds, seeds enclosed by the fruit (mericarp) wall, and loose fruit walls or parts of it were found. The wedge-shaped seeds are reniform in outline, with a smooth wall. The thinnest part is at the incurved ventral side. Most of the subfossil seeds are immature or damaged, so that only a few specimens could be measured: 2.4 x 1.8, 2.6 x 2.1, 2.9 x 2.2 mm.

Remains of *Althaea officinalis* were particularly recovered from Leeuwarden and Ezinge. This species occurs in brackish marsh vegetations.

3.2.24. MYRICACEAE

Myrica gale L. (fig. 14:7)

The somewhat flattened fruits of *Myrica gale* consist of a middle part, the original ovary, and two lateral parts, the original bracts. All three parts end in a point. Of the small glands on the surface of the fruits a larger or smaller number is still present in the subfossil specimens.

Myrica gale is fairly well represented in Vlaardingen. For 18 fruits from this site the dimensions have been obtained: length 2.42 (2.0-3.3) mm, breadth 2.31 (1.6-2.8) mm, thickness 1.42 (1.1-1.7) mm. This species grows in an oligotrophic, wet environment.

3.2.25. ONAGRACEAE

Epilobium palustre L. (fig. 6:9)

The oblong seeds are broadest in the upper third part. The long hairs at the upper, flattened end of the seeds have disappeared in the subfossil specimens. The ribbon-shaped stripe on the ventral side widens towards the upper end. The seed surface is smooth.

Epilobium palustre seeds were only found in Vlaardingen (1.8 x 0.6, 1.7 x 0.6, 1.6 x 0.6, 1.6 x 0.5, 1.8 x 0.5 mm). This species grows in marsh vegetations (Caricetalia nigrae).

Epilobium spec.

The seeds are oblong-obovate in outline. The dorsal side is domed; the ribbon-shaped stripe on the flat ventral side widens towards the upper end. The surface is covered with rows of fine warts. At least three *Epilobium* species produce seeds of this type, viz. *E. hirsutum* L., *E. parviflorum* Schreb., and *E. montanum* L.

Small numbers of this seed type were recovered from Tritsum, Schiedam, and Vlaardingen. Dimensions: 1.0 x 0.5, 1.2 x 0.6, 1.1 x 0.6, 1.0 x 0.5, 0.9 x 0.5 mm).

3.2.26. PAPAVERACEAE

Papaver somniferum L.

In Ouddorp 5 (from a deep pit) one seed of *Papaver somniferum* was found (1.0 x 0.8 x 0.8 mm). The seeds of opium poppy are kidney-shaped with a coarse reticulate surface pattern. The presence of this *Papaver* seed in a Roman civil settlement does not necessarily imply that opium poppy was grown here. It is not unlikely that the seeds were imported.

3.2.27. PAPILIONACEAE

Medicago lupulina L. (fig. 14:11)

This species is represented by its characteristic pods. The flattened, kidney-shaped pods haves a strong, reticulate nervation. A somewhat larger number of pods was recovered from Tritsum; the dimensions for 34 specimens from this site amount to 2.46 (1.8-3.0) x 2.04 (1.6-2.3) mm. Leeuwarden, Paddepoel, and Schiedam yielded one or a few pods.

Medicago lupulina is a species from grasslands and roadsides.

Trifolium campestre Schreb.

Tritsum 1141 yielded a large number of petals and one-seeded pods in various stages of development. The nervation of the standard-petal resembles that in *Trifolium repens* (cf. Körber-Grohne 1967, plate 67h). However, the petals of *Tr. campestre* are smaller than those of *Tr. repens.* Moreover, the fact that only one-seeded pods were found was decisive for the identification as *Tr. campestre.* The pods of *Tr. repens* contain 3 to 4 seeds.

Tr. campestre grows in grasslands, in fields, and in the dunes.

Trifolium pratense L. (fig. 8:6)

Rather small numbers of calyces of *Tr. pratense* were found in Tritsum 1141 and 3094, while one calyx was recovered from Schiedam 203. The funnel-shaped calyces of *Tr. pratense* have 10 ribs. In the subfossil calyces the teeth are no longer preserved. In contrast to those of *Tr. repens* the calcyces of *Tr. pratense* are hairy.

Tr. pratense is a plant from grasslands and roadsides.

Trifolium repens L.

Larger numbers of petals of *Tr. repens* were recovered from Paddepoel and from Schiedam 203, while calyces of this species were found in Tritsum 1264, Tzummarum 79, and Paddepoel 299 and 300. In the subfossil, more or less damaged state the calyces of *Tr. repens* can be separated from those of *Tr. pratense* by the absence of hairs.

Tr. repens is common in grasslands and on roadsides.

Vicia faba L. var. *minor* (Peterm. emend. Harz) Beck.

One damaged, carbonized seed of celtic bean was found in Paddepoel 224. Bcause of the damage no measurements were taken.

Vicia sativa L. ssp. *obovata* (Ser.) Gaud.

From Den Helder 919 a somewhat deformed, charred seed of *Vicia sativa* ssp.

obovata was recovered. The flattened seed is more or less circular in outline (diameter ca. 5 mm). In this connection it should be mentioned that the seeds of this species show a great variety in shape. *Vicia sativa* ssp. *obovata*, which occurs as a weed in fields, is also cultivated.

3.2.28. PLANTAGINACEAE

Plantago major L. (fig. 17:9)

The seeds of *Pl. major* are elliptical to lozenge-shaped in outline. The surface shows wavy ridges, on the ventral side radiating from the hilum and the hilum-like scar, on the other side longitudinally arranged. *Pl. major* is represented in all sites; various samples yielded large numbers of this seed type. Length and breadth of 100 seeds from Tritsum were determined: 1.38 (1.1-1.7) and 0.82 (0.6-1.0) mm respectively.

At present *Pl. major* is a common species along roads, in trodden places, on ruderal sites, and in fields.

Plantago maritima L. (figs. 7:14 and 17:8)

Of *Pl. maritima* seeds as well as capsule lids were found. The seeds of this species are elliptical with a circular hilum, which in subfossil seeds is sometimes difficult to observe. The conical capsule lids have a spine-like projection at the top. *Pl. maritima* is represented in most sites from the former salt marsh area.

For two sites the seeds were measured: Tritsum (N = 28), length 2.68 (1.9-3.2) mm, breadth 1.06 (0.8-1.4) mm; Tzummarum (N = 22), length 2.59 (2.1-3.0) mm, breadth 1.10 (1.0-1.4) mm. Length and largest diameter for 40 capsule lids from Den Helder amount to 2.46 (2.2-2.9) and 1.63 (1.4-1.9) mm respectively. *Pl. maritima* occurs in various halophytic vegetations (Asteretea tripolii).

3.2.29. PLUMBAGINACEAE

Armeria maritima (Mill.) Willd. (fig. 7:13)

In addition to calyces, a small number of seeds of *Armeria maritima* was found. The seeds are oblong, tapering towards both ends. The upper end has a short, obtuse point, the basal end is dark-coloured. On the seed surface a fine cell pattern can be observed. Three seeds from Tritsum have been measured: 2.6 x 1.1, 2.3 x 1.0, 2.6 x 1.2 mm. The narrow, funnel-shaped calyx has 10 ribs, 5 of which continue into the calyx teeth. The ribs are densely set with stiff hairs.

This species is only represented in Tritsum, Tzummarum, and Den Helder. *Armeria maritima* is a characteristic species of the Juncetum gerardii.

Limonium vulgare Mill. (fig. 7:12)

This species is represented by parts of the inflorescence, loose calyces and loose bracts. The narrow, funnel-shaped calyx of *Limonium vulgare* has 5 ribs, some of which show a simple row of stiff hairs. *Limonium vulgare* occurs in various halophytic plant communities.

3.2.30. POLYGONACEAE

Polygonum aviculare L. (fig. 16:5)

Three-sided fruits with acuminate upper end and unequal sides. The fruit surface shows a longitudinal striation. *Polygonum aviculare,* the dimensions of which are given in table 17, is represented in all sites examined. It is a common species in fields and on roadsides. *P. aviculare* is also characteristic of the vegetation in frequently trodden places.

Polygonum convolvulus L.

Three-sided fruits with pointed upper and lower end. On the concave sides a longitudinal striation is present as in *P. aviculare.* Tritsum and Den Helder yielded a few *P. convolvulus* fruits (4.0 x 2.5, 4.2 x 2.6, 4.2 x 2.6, 4.1 x 2.6 mm). *P. convolvulus* is a weed in fields.

Polygonum hydropiper L. (fig. 16:7)

Fruits ovate in outline with acuminate upper end; on the glossy surface a fine striation. Two-sided as well as three-sided fruits occur in *P. hydropiper*, but only one three-sided specimen was observed. *P. hydropiper* is represented in Vlaardingen and Schiedam. 8 fruits from Vlaardingen were measured: length 3.18 (2.9-3.4) mm, breadth 2.01 (1.8-2.1) mm. *P. hydropiper* is found in wet, nitrate-rich habitats (Bidention).

Polygonum lapathifolium L.

The flat fruits of *P. lapathifolium* are more or less circular in outline, with a pointed upper end. The fruit surface is shiny and both sides show a central depression. The fruits of *P. lapathifolium* are fairly numerous in some samples from Paddepoel and Vlaardingen (for dimensions see table 17). *P. lapathifolium* includes various subspecies which cannot be distinguished on the ground of the fruits.

Polygonum minus Huds.

Flattened, ovate fruits with acuminate upper end and glossy surface. Only in Vlaardingen and Schiedam fruits of *P. minus* were met with. Length and breadth for 10 fruits from both sites amount to 2.01 (1.0-2.2) and 1.33 (1.2-1.4) mm respectively. *P. minus* occurs in the same habitats as *P. hydropiper.*

Polygonum persicaria L. (fig. 16:6)
The fruits of *P. persicaria* are circular to ovate in outline with a pointed upper end. Two-sided as well as three-sided fruits were found, although the former are in the majority. The three-sided fruits have rounded edges. It is sometimes difficult to distinguish the two-sided fruits of *P. persicaria* from those of *P. lapathifolium.* In that case the transition from body to apex may be a reliable criterion. In *P. persicaria* this transition is gradual, whereas in *P. lapathifolium* a distinct bend can be observed.

The fruits of *P. persicaria* are most numerous in Vlaardingen and Paddepoel. The dimensions are shown in table 17. *P. persicaria* is a common weed in fields.

TABLE 17. DIMENSIONS IN MM FOR *POLYGONUM* FRUITS

		length	breadth	L:B
P. aviculare	min.	2.4	1.3	149
Tritsum 2981	mean	3.00	1.66	182
N = 100	max.	3.8	2.3	238
P. lapathifolium	min.	1.9	1.6	100
Paddepoel 299	mean	2.27	1.96	116
N = 45	max.	2.7	2.2	138
P. lapathifolium	min.	2.0	1.6	109
Vlaardingen	mean	2.40	1.99	121
N = 100	max.	2.7	2.5	138
P. persicaria	min.	2.0	1.6	109
Paddepoel	mean	2.49	1.97	127
N = 50	max.	2.7	2.3	154
P. persicaria	min.	2.2	1.7	113
Vlaardingen	mean	2.52	2.03	124
N = 60	max.	2.8	2.4	139

Rumex acetosella L. (fig. 12:7)
Three-sided fruits with rounded edges and a glossy surface. This type was only seldom encountered, which is not surprising because *R. acetosella* is a species from dry, sandy soils. The following dimensions were obtained: 1.0 x 0.9 mm (Paddepoel); 1.1 x 1.0, 1.2 x 1.0, 1.0 x 0.9, 1.1 x 0.9, and 1.2 x 1.0 mm (Ouddorp).

Rumex crispus L. (fig. 10:5)
Of *R. crispus* naked fruits, fruits enclosed by the valves (the inner three sepals), and loose valves were found. In *R. crispus* only one of the three valves bears a prominent grain-like tubercle. The fruits are three-sided with sharp edges, and tapering upper and lower end. *R. crispus* is represented in all sites but one. For two sites the fruits were measured: Tritsum (N = 25), length 2.47 (2.0-3.3) mm, breadth 1.59 (1.3-2.1) mm; Paddepoel (N = 30), length 2.32 (1.8-2.8) mm, breadth 1.59 (1.4-2.0) mm.

R. crispus is common in fields and in ruderal habitats. It is also found in the Juncetum gerardii on the higher parts of the salt marshes, where it would be favoured by grazing.

Rumex hydrolapathum Huds. (fig. 10:3)
Naked fruits as well as fruits enclosed by the valves were found. The relatively large, three-sided fruits have sharp edges. The upper and lower end are pointed, the sides somewhat concave. *R. hydrolopathum* is represented in Vlaardingen and Schiedam. Three fruits from Vlaardingen were suitable for measuring: 3.8 x 2.6, 3.9 x 2.3, and 3.8 x 2.4 mm. *R. hydrolapathum* is a characteristic species of the Phragmitetea, which class includes marsh vegetations.

Rumex maritimus L. (fig. 16:4)
In Schiedam 191 a large number of *R. maritimus* fruits enclosed by the valves was found. The valves of this species are characterized by the long marginal bristles. The fruits are smaller and more slender than those of the other *Rumex* species represented in the sites examined. Dimensions for 50 fruits from Schiedam: length 1.37 (1.2-1.6) mm, breadth 0.75 (0.7-0.8) mm.

R. maritimus occurs in habitats which are rich in nitrates, also on brackish soils.

Rumex obtusifolius L. (fig. 10:11)
The samples from Schiedam yielded a fairly large number of naked fruits and fruits enclosed by the valves of *R. obtusifolius.* A few naked fruits were found in Vlaardingen. The distinction between the naked fruits of *R. obtusifolius* and *R. crispus* is difficult and sometimes even arbitrary because both fruit types vary in shape to some extent. The best distinguishing character is perhaps in the short "stipe" at the base of the *R. crispus* fruits (fig. 10:5).

Length and breadth for 25 fruits from Schiedam amount to 1.97 (1.7-2.1) and 1.39 (1.2-1.5) mm respectively. *R. obtusifolius* is found in a great variety of habitats.

3.2.31. POTAMOGETONACEAE

Potamogeton cf. *pectinatus* L. (fig. 10:1)

Laterally flattened fruits, semi-circular in outline. The fruits are thinnest at the nearly straight ventral side. In Paddepoel 299 one fruit of this type was found (4.0 x 2.8 mm), while two specimens were recovered from Ezinge A (4.6 x 4.0, 5.8 x 4.6 mm). *Potamogeton pectinatus* grows in fresh as well as in brackish water (Potametea).

Potamogeton pusillus L. (fig. 7:6)

The fruits of *Potamogeton pusillus* can be distinguished from those of most other pondweed species by the small size. The flattened fruits are obliquely elliptic in outline, with pointed upper and lower end. Paddepoel 300 and Sneek 3 yielded each two fruits: 1.5 x 1.1, 1.6 x 1.0, 1.4 x 1.0, and 1.3 x 0.9 mm. *Potamogeton pusillus*, which occurs also in oligohalinic water, is characteristic of the Parvopotametalia.

One fruit from Tritsum 3280 and two fruits from Ouddorp 6 are listed as *Potamogeton* spec.

Ruppia maritima L. (fig. 7:4)

Both from Paddepoel 272 and from Ouddorp 6 one fruit of *Ruppia maritima* was recovered. The fruits are obliquely ovate in outline, with pointed upper end. In the specimen from Ouddorp a part of the fruit stalk is still preserved. On the dorsal side a fairly wide, longitudinal opening is visible. Both subfossil fruits measure: 2.0 x 1.2 and 1.8 x 1.0 mm.

Ruppia maritima is a species from brackish water (Ruppion maritimae).

Zannichellia palustris L. ssp. *pedicellata* Rosén et Wahlenb. (fig. 7:3)

Flattened fruits, oblong to lanceolate in outline, slightly twisted. On the outer (dorsal) side a row of bristles is present. In most of the sufossil specimens, at least a part of the long, bristle-like projection at the upper end and of the fruit stalk is still preserved. The fruit wall is smooth.

This species is represented by small numbers of fruits in Paddepoel and Ouddorp. Length and breadth for 8 fruits from Ouddorp amount to 2.45 (2.3-2.6) and 0.85 (0.7-1.0) mm respectively. *Zannichellia palustris* ssp. *pedicellata* has about the same ecological requirements as *Ruppia maritima*.

3.2.32. PRIMULACEAE

Anagallis arvensis L.

Conical seeds with sharp edges. The base is elliptic in outline; the linear hilum is found at the opposite, narrow end of the seed. In the subfossil seeds the basal part of the scales, which cover the surface, is generally still preserved. *Anagallis arvensis* is represented in Tritsum, Tzummarum, and Ouddorp by small numbers of seeds. The dimensions for 4 specimens from Tzummarum amount to 1.4 x 1.0 x 0.8, 1.4 x 1.0 x 0.9, 1.4 x 1.1 x 0.9, and 1.2 x 1.0 x 0.8 mm.

This species is characteristic of the Polygono-Chenopodietalia, which order includes vegetations in fields of summer cereals.

Centunculus minimus L.
Paddepoel yielded a small number of *Centunculus minimus* seeds. The shape of these seeds shows much resemblance to that of *Anagallis arvensis* seeds. The elliptic base is somewhat pointed at both ends. The surface is covered with fine papillae. The seeds are small: 0.55 x 0.50 x 0.30, 0.60 x 0.50 x 0.35 mm.

Centunculus minimus grows in pioneer vegetations on wet, sandy soils. Körber-Grohne (1967, p. 293) suggests that in the vicinity of the Feddersen Wierde this species occurred in the *Eleocharis* variant of the Juncetum gerardii.

Glaux maritima L. (fig. 9:4)
The shape of the seeds of *Glaux maritima* is largely similar to that of *Anagallis arvensis*, but the base is somewhat domed. Moreover, in *Glaux maritima* the seed surface has a reticulate pattern. Seeds of this species were found in nearly all sites from the former salt marsh area, sometimes in fairly large numbers. For 66 seeds from Tzummarum the dimensions were obtained: 1.40 (1.2-1.6) x 1.02 (0.8-1.3) x 0.81 (0.6-1.0) mm.

Glaux maritima is common in the Juncetum gerardii, but it is also found in other salt marsh plant communities.

3.2.33. RANUNCULACEAE

Ranunculus flammula L. (fig. 10:9)
Bi-convex fruits, elliptic to obovate in outline. The upper end is rounded, in its lower part the fruit is obliquely tapering towards the base. The surface shows a fine, but distinct reticulate pattern. One or a few specimens of this fruit type were found in Den Helder, Schiedam, and Ouddorp. Dimensions: 1.6 x 1.2, 1.3 x 1.0, 1.5 x 1.3, and 1.4 x 1.9 mm.

R. flammula occurs in wet grasslands and in vegetations from marshy places (Caricetalia nigrae).

Ranunculus lingua L. (fig. 10:10)
Two *Ranunculus* fruits from Vlaardingen have been attributed to *R. lingua.* They differ from the fruits of *R. repens* (see below) by the more sharply pointed lower end and by the somewhat more domed sides. Moreover, in general *R.*

lingua fruits are more slender than those of *R. repens.* Both fruits from Vlaardingen measure: 2.7 x 2.1 and 2.3 x 1.4 mm.

R. lingua, which does not tolerate salt, is a characteristic species of the Phragmition (communis), which alliance includes marsh vegetations in eutrophic water.

Ranunculus repens L. (fig. 15:1)
The outline of the flat fruits of *R. repens* varies from nearly circular to elliptic and ovate. The lower end is obliquely pointed; sometimes at the upper end a slightly curved point can be observed in the subfossil fruits. A distinct margin consisting of elongated cells is present. The surface shows a reticulate pattern. In Paddepoel 290 many *R. repens* fruits were encountered (for the greatest diameter see table 18).

R. repens, which is a species from moist, grassy places, is also found in ruderal habitats and in fields.

Ranunculus sardous Crantz (fig. 6:2)
The flat fruits are more or less circular in outline, with slightly pointed lower end. The margin is narrower than in *R. repens.* The fruits of this species can easily be distinguished from those of other *Ranunculus* species by the distinct warts on the surface.

From Tritsum 1141 a large number of *R. sardous* fruits was recovered (table 18). In other samples from Tritsum and in samples from Tzummarum, Paddepoel, and Ouddorp small numbers of this fruit type were found. This species occurs, among others, in a brackish, moist environment. Körber-Grohne's (1967, p. 278) results indicate that *R. sardous* would mainly have occurred in the *Eleocharis* variant of the Juncetum gerardii.

TABLE 18. GREATEST DIAMETER IN MM FOR *RANUNCULUS* FRUITS

	min.	mean	max.
R. repens, Paddepoel (N = 100)	2.0	2.47	3.0
R. sardous, Tritsum (N = 100)	1.5	1.89	2.3
R. sceleratus, Paddepoel (N = 90)	0.8	1.07	1.2

Ranunculus sceleratus L. (fig. 17:7)
Flat fruits, circular to elliptic in outline. Characteristic of the fruits of *R. sceleratus* is the broad, thickened margin of white, spongy tissue. The central part of both flat sides shows a transverse wrinkling. *R. sceleratus* fruits were recovered from various sites; in particular Paddepoel 300 yielded a larger number (for the greatest diameter see table 18).

R. sceleratus is common in wet places which are rich in nitrates.

Some fruits were at first identified as *Ranunculus acris* L., but at a re-examination this identification was considered too unsatisfactory. These fruits are listed as *Ranunculus* spec.

Thalictrum flavum L. (fig. 10:8)
Spindle-shaped fruits with pointed ends and 8 to 10 longitudinal ribs which are not equally strong. Vlaardingen yielded three *Thalictrum* fruits (2.4 x 1.4 and 2.3 x 1.6 mm), while one seriously damaged specimen was recovered from Tritsum 1264. *Thalictrum flavum* is a characteristic species of the Valeriano-Filipenduletum.

3.2.34. ROSACEAE

Filipendula ulmaria (L.) Maxim. (fig. 16:1)
Flat, sickle-shaped fruits, rounded at the upper end and pointed at the lower end. Schiedam yielded one and Vlaardingen three *Filipendula* fruits, two of which were suitable for measuring: 3.0 x 1.3 and 3.2 x 1.2 mm. *Filipendula ulmaria*, which is a characteristic species of the Valeriano-Filipenduletum, is found in wet habitats.

Potentilla anserina L. (fig. 16:2)
The fruits of *P. anserina* show a great variability with respect to shape as well as to size. The shape varies from kidney-shaped to triangular in outline. A longitudinal groove surrounds the fruit except at the hilum. At one end the fruit is thicker than at the other end. The uneven surface is finely pitted. This species is represented in most of the sites included in this study. Larger numbers of *P. anserina* fruits were recovered from Paddepoel samples. For 100 fruits from Paddepoel 274 the dimensions have been obtained: length 2.08 (1.6-2.5) mm, breadth 1.44 (1.0-1.8) mm, thickness 1.25 (0.9-1.6) mm.

P. anserina is common in grasslands, on roadsides and in fields. This salt-tolerant species would be indicative of grazing of salt marsh vegetations.

Potentilla erecta (L.) Räuschel
The wedge-shaped fruits are obliquely ovate in outline. The ventral side, where the fruit is thinnest, is nearly straight, whereas the dorsal side is curved. On the surface a pattern of ridges and some warts can be observed. In subfossil fruits the surface pattern can have disappeared.

Only a few fruits of this type were found. Both for Ezinge and Sneek one specimen has been measured: 1.8 x 1.2 and 1.8 x 1.2 mm. *P. erecta* is a species from moist to dry sandy and peaty soils.

Potentilla palustris (L.) Scop. (*Comarum palustre* L.)
One nutlet of *Potentilla palustris* was found in Den Helder 866. The laterally flattened fruit is ovate in outline with a somewhat obliquely pointed upper end (1.4 x 1.3 x 1.0 mm). The broad sides are domed. The fruit surface is smooth.

Potentilla palustris is found in marsh vegetations, in shallow lakes and in dune valleys.

Potentilla reptans L. (fig. 6:6)
This species is only represented in Ouddorp. As for the shape, the fruits of *P. reptans* resemble those of *P. erecta,* although the former are more semi-circular in outline. *P. reptans* fruits can be distinguished from those of *P. erecta* by the smaller size and particularly by the surface pattern which consists predominantly of warts. Unfortunately, the warts have often disappeared in subfossil fruits.

Length and breadth for 10 *P. reptans* fruits from Ouddorp 6 amount to 1.16 (1.0-1.2) and 0.80 (0.7-1.0) mm respectively. This species grows along roads and in other disturbed habitats.

Rosa pimpinellifolia L. (fig. 17:3)
Irregularly shaped fruit stones; elliptic to obliquely ovate in outline, triangular to quadrangular in cross-section. The outer side is domed, the other sides are mostly flat. The fruit wall is smooth and shiny.

The subfossil fruit stones which were recovered from Den Helder show much resemblance to those of *Rosa pimpinellifolia* in the seed reference collection in the B.A.I. They measure 5.0 x 2.7 x 3.5, 4.7 x 2.9 x 3.0, 5.1 x 3.1 x 2.7, 4.2 x 2.9 x 2.4, and 3.7 x 2.5 x 2.6 mm. *Rosa pimpinellifolia* grows in the dunes.

Rubus spec.
Tritsum 3280 yielded one *Rubus* fruit. The reticulate surface pattern is characteristic of *Rubus* fruits, but because of the atypical shape the species cannot be determined.

3.2.35. RUBIACEAE

Galium aparine L.
Tritsum 3280 and Schiedam 178 yielded a few fruits of *Galium aparine.* Of these specimens only the thin, inner fruit wall has been preserved, in consequence of which the fruits are more or less compressed. The inner fruit wall shows rows of rectangular cells, while a round to elliptic cavity on the ventral side indicates the place of the hilum. The largest diameter of the subfossil fruits amounts to about 3.2 mm.

Galium aparine grows along roads, in hedges, and in ruderal habitats.

Galium palustre L.
Nearly globular fruits. The indented hilum covers the larger part of the ventral side. The wrinkled outer fruit wall has often disappeared; the inner fruit wall shows a reticulate cell pattern.

Only small numbers of this fruit type were met with. For 10 specimens from various sites the following dimensions were obtained: 1.38 (1.0-1.5) x 1.23 (0.9-1.4) x 1.06 (0.7-1.2) mm. *Galium palustre* is a species from marshy to moist habitats.

Galium uliginosum L.
The fruits are elliptic in outline, with a domed dorsal side. The relatively large, oblong hilum on the ventral side is more or less intruded. The surface is densely covered with fine warts.

Galium uliginosum is only represented in Vlaardingen (1.2 x 0.9 x 0.8, 1.2 x 1.0 x 0.7, 1.0 x 0.8 x 0.6 mm). This species is found in moist places.

For one *Galium* fruit from Tritsum 1141, with a reticulate surface pattern, measuring 2.2 x 1.9 x 1.4 mm, the species could not be determined.

3.2.36. SCHEUCHZERIACEAE

Triglochin maritima L. (fig. 7:1)
The lanceolate fruits are in cross-section triangular with an intruded base. The edges are sharp. At the upper end of the fruit a curved beak is present.

Not infrequently loose "inner" fruits are found. The oblong, flat "inner" fruits show a superficial resemblance to grass caryopses. The black stripe at the sharp dorsal side widens into an oblong spot at one end of the "inner" fruit.

Triglochin maritima is represented in all sites from former salt marsh area. The dimensions for fruits from Tritsum and Paddepoel are shown in table 19. *Triglochin maritima* is a salt marsh plant which is found in various halophytic vegetations; it is a characteristic species of the Asteretea tripolii.

TABLE 19. DIMENSIONS IN MM FOR *TRIGLOCHIN MARITIMA*

		L	B	T
	min.	4.0	0.9	0.9
Paddepoel	mean	4.59	1.17	1.13
N = 50	max.	5.0	1.5	1.4
	min.	4.0	1.0	0.9
Tritsum	mean	4.44	1.24	1.09
N = 50	max.	5.0	1.6	1.4

Triglochin palustris L. (fig. 7:2)
Linear fruits; the upper part is gradually tapering into a sharp point. The lower end is truncated. *Triglochin palustris* fruits were met with in Paddepoel, Vlaardingen, and Schiedam. Length and breadth for 7 fruits from Vlaardingen range from 5.6-8.0 and 0.7-1.0 mm respectively; for 6 specimens from Paddepoel these dimensions vary from 5.6-6.6 and 0.6-1.0 mm respectively.

Triglochin palustris occurs on moist to marshy inland sites as well as in a brackish environment.

3.2.37. SCROPHULARIACEAE

Odontites litoralis (Fr.) Lange/*verna* (Bell.) Dum. (fig. 6:8)
The somewhat flattened seeds of *Odontites* are elliptic in outline, with pointed upper and lower end. In addition to 12-18 longitudinal ribs, a thickened margin is present along one side of the seed, which, however, is not always distinct in the subfossil seeds. The ribs are laterally connected by densely set "rungs". *Odontites* is represented in all sites except Den Helder. Various samples yielded larger numbers of *Odontites* seeds. The dimensions are shown in table 20.

The taxonomy of *Odontites* is somewhat confusing. Thus, *Odontites rubra* in Körber-Grohne (1967, pp. 301-302) includes *O. litoralis* and *O. verna*. *Odontites litoralis* and *O. verna* ssp. *serotina* (Wettst.) E.F. Warb. occur both in halophytic vegetations. *O. verna* ssp. *verna* is found in fields. The *Odontites* seeds in Vlaardingen and Schiedam would either have originated from *O. verna* ssp. *verna* or from an inland type of ssp. *serotina*. There is no significant difference between the *Odontites* seeds from Tzummarum and Tritsum on the one hand and those from Vlaardingen on the other hand (table 20).

TABLE 20. DIMENSIONS IN MM FOR *ODONTITES VERNA/LITORALIS*

		Length	Breadth
Tzummarum	min.	1.6	0.7
N = 33	mean	1.98	0.94
	max.	2.4	1.2
Tritsum	min.	1.7	0.8
N = 67	mean	2.20	1.06
	max.	2.8	1.3
Vlaardingen	min.	1.8	0.8
N = 28	mean	2.14	1.07
	max.	2.4	1.2

Pedicularis palustris L. (fig. 13:8)
Seeds obovate in outline, with pointed lower end. One side is domed, the other side is flattened, with a dark, longitudinal groove. The seed surface shows a distinct reticulate pattern.

Only Vlaardingen yielded some seeds of *Pedicularis palustris* (2.5 x 1.4, 2.4 x 1.4, 2.0 x 1.3, 2.5 x 1.4, 2.0 x 1.2 mm). This species is found in marsh vegetations of the Parvocaricetea.

Rhinanthus spec. (fig. 8:3)
In the subfossil *Rhinanthus* seeds met with in this study at most a remnant is left of the wing which surrounds the larger part of the seed. Also the thickened part with the hilum (the wingless lateral part) has mostly completely disappeared. The flat "inner" seeds are obliquely obovate in outline, with pointed lower end. *Rhinanthus* seeds were found in Tritsum 1141, Paddepoel, Vlaardingen II/III, and Schiedam 203. The following dimensions were obtained: Tritsum (N = 10), 2.70 (2.3-3.1) x 1.78 (1.5-1.9) mm; Paddepoel (N = 10), 2.84 (2.6-3.1) x 1.91 (1.7-2.2) mm; Schiedam (N = 6), 3.24 (2.9-3.6) x 2.12 (1.8-2.5) mm.

Three *Rhinanthus* species come into consideration, viz. *R. minor* L., *R. serotinus* (Schönh.) Oborny, and *R. alectorolophus* Poll. These species occur all in grassland vegetations.

3.2.38. SOLANACEAE

Solanum dulcamara L.
The flat seeds are circular to oval in outline. The lower end with the hilum is truncated or slightly concave. The network on the surface has wavy walls. One or two seeds of *Solanum dulcamara* were found in Tritsum 2762, Ezinge B, and Schiedam 119 (1.9 x 2.2, 2.3 x 2.6, 2.2 x 2.5 mm). This species grows preferably in alder carr and in shrub vegetations in moist places.

Solanum nigrum L. (fig. 12:9)
The flat seeds are oval in outline; the upper end is rounded and the lower end is obliquely pointed. The surface pattern is the same as in *S. dulcamara*. Paddepoel, in particular Paddepoel 299, yielded a large number of *S. nigrum* seeds. Small numbers of seeds were recovered from Tritsum, Vlaardingen, Ouddorp, and Leeuwarden. 100 seeds from Paddepoel were measured: length 1.93 (1.6-2.2) mm, breadth 1.53 (1.2-1.8) mm, L:B index 126 (110-147).

S. nigrum is a common species on ruderal sites, in fields, and along roads.

3.2.39. SPARGANIACEAE

Sparganium erectum L.

From Paddepoel 124 one somewhat damaged fruit of *Sparganium erectum* was recovered. The narrow, white ribs on the lower part of the funnel-shaped fruit are hardly visible. The white, spongy tissue which surrounds the upper part of the fruit is still present. *Sparganium erectum* grows along ditches and lakes, particularly in eutrophic water (Phragmitetalia).

3.2.40. TYPHACEAE

Typha latifolia L.

Small, cylindrical fruits with tapering lower end; the upper end is truncated. The surface is glossy. Two fruits of *Typha latifolia* were found in Sneek 2 (1.1 x 0.3, 1.0 x 0.3 mm). This species, which is characteristic of the Phragmitetalia, grows along ditches and lakes.

3.2.41. UMBELLIFERAE

Aethusa cynapium L. (fig. 8:9)

From Tritsum 1141 three split fruits of *Aethusa cynapium* were recovered. The fruits are ovate in outline, with pointed upper end. The ventral side is flat, whereas the dorsal side is domed. Of the five pronounced longitudinal ribs on the dorsal side the lateral ones have a narrow wing. Of this wing only remnants are left in the subfossil fruits from Tritsum, two of which have been measured: 3.4 x 2.1 and 3.4 x 2.1 mm.

Aethusa cynapium is a weed from ruderal sites.

Apium graveolens L. (fig. 6:11)

Small fruits, elliptic to ovate in outline; with flat ventral side and strongly domed dorsal side. The five longitudinal ribs on the dorsal side are narrow but relatively high. Fruits of *Apium graveolens* have been recovered from Ezinge and Leeuwarden. Because of fairly poor preservation and lateral compression of the fruits only the length could be determined satisfactorily. For six fruits this dimension varies from 1.0 to 1.5 mm.

Apium graveolens is a species from moist, brackish habitats.

Conium maculatum L. (fig. 8:10)

From Ouddorp a few plant remains were recovered which turned out to be "inner" fruits of *Conium maculatum* or parts of it. The present author doubts whether he would have been able to identify this partly decayed fruit type if it had not been described and depicted by Knörzer (1970, p. 94, plate 15:7). These fruits are slightly angular in cross-section, while the ventral side shows a deep groove. Characteristic are the longitudinal, somewhat undulating, narrow ridges and the rows of transversally elongated cells of the inner fruit wall. The length of the (swollen?) "inner" fruits from Ouddorp is about 3.0-3.2 mm.

Conium maculatum is a plant from ruderal habitats (Artemisietalia vulgaris).

Daucus carota L. (fig. 15:3)
Flattened fruits, elliptic to ovate in outline. The ventral side is flat and the dorsal side is slightly domed. The four pronounced longitudinal ribs on the dorsal side alternate with three slender ones. The row of spines on top of the stout ribs has often disappeared in the subfossil fruits. In poorly preserved fruits of *Daucus carota* the ribs can have decayed completely in which case the oil tubes become the most prominent feature (see *Oenanthe lachenalii*).

Daucus carota is represented in Tritsum, Paddepoel, and Ouddorp. 59 fruits from Tritsum were measured (without bristles): 2.41 (1.7-3.0) x 1.38 (1.0-1.9) mm. *Daucus carota* is characteristic of the Arrhenatheretum elatioris (grassland vegetations on soils which are rich in nutrients), but it is also found in more ruderal habitats. Moreover, one must seriously take into consideration that this species could have been cultivated (see chapter 5).

Hydrocotyle vulgaris L. (fig. 15:4)
Fruits semi-circular in outline, strongly compressed in lateral direction. There are five slender ribs: two along the narrow ventral side, a curved one on each of both flat sides and one dorsal rib. *Hydrocotyle vulgaris* is represented in Leeuwarden, Ouddorp, Vlaardingen, and Schiedam by small numbers of fruits. Length and thickness for 9 fruits from various sites amount to 1.75 (1.3-2.0) and 1.26 (1.0-1.5) mm respectively.

Hydrocotyle vulgaris is found in a fairly great variety of moist habitats.

Oenanthe aquatica (L.) Poir.
In Tritsum 1541 one damaged Umbelliferous fruit was found which has been attributed to O. *aquatica.* The split fruits of O. *aquatica* are oblong-ovate in outline, with flat ventral side and domed dorsal side. Of the five longitudinal ribs, consisting of spongy tissue, the lateral ones are thicker than the others. O. *aquatica* grows in ditches and marshes.

Oenanthe fistulosa L. (fig. 15:2)
The fairly well preserved subfossil split fruits of O. *fistulosa* are trapezoid in outline. The ventral side is flat, whereas the dorsal side is domed. Of the five longitudinal ribs on the dorsal side, which consist of spongy, white tissue, both lateral ones are much thicker than the others and triangular in cross-section.

Along the dorsal edge of the truncated upper end of the fruit two to three spine-like projections are present. Of the style only the lower part is preserved in the subfossil fruits. In the more seriously damaged fruits the ribs, in particular the lateral ones, have decayed completely or in part.

A fairly large number of *O. fistulosa* fruits was found in Vlaardingen. Length (style base not included) and breadth for 12 specimens amount to 3.50 (3.1-3.9) and 2.44 (2.0-2.9) mm respectively. Moreover, Tritsum 1541 and Ouddorp 2 yielded each one fruit. *O. fistulosa*, which is a species from freshwater marshes, is most abundant in vegetations of the Nasturtio-Glycerietalia.

Oenanthe lachenalii C.C. Gmel. (fig. 15:5)
Modern split fruits of *O. lachenalii* show a superficial resemblance to those of *O. fistulosa*, but the latter are considerably larger. Unfortunately, only more or less seriously damaged fruits of *O. lachenalii* have been recovered. For that reason no measurements were taken. Not only the ribs have often disappeared completely or in part, but also the upper end of the fruit with the style base is no longer intact in the subfossil fruits met with in this study. These partly decayed fruits are elliptic to oblong in outline. As in *Daucus carota* the oil tubes become very conspicuous in poorly preserved fruits. By the vesiculate structure of the oil tubes the fruits of *O. lachenalii* can be distinguished from those of *Daucus carota* if poorly preserved.

O. lachenalii is represented in all sites from the former salt marsh area. According to Körber-Grohne (1967, p. 289) it must have been a common species in the *Eleocharis* variant of the Juncetum gerardii (see 4.2.1.1.).

Peucedanum palustre (L.) Moench (fig. 8:8)
Flat, broadly winged fruits, elliptic in outline. On the slightly domed dorsal side three longitudinal, rather broad but low ribs are present. Two more or less damaged fruits were recovered from Vlaardingen II/III (ca. 4.8 x 3.6 mm). *Peucedanum palustre* is a species from marshy and other wet habitats.

Sium erectum Huds. (fig. 8:7)
Fruits ovate in outline, with pointed upper end; pentagonal in cross-section. The longitudinal ribs are weak; in modern fruits these ribs are somewhat more distinct. The fruit surface is rough.

This species from a freshwater environment (Phragmitetea) is not only represented in Vlaardingen and Schiedam, but also Tritsum 2762 and Tzummarum 80 yielded fruits of *Sium erectum*. Six fruits from Vlaardingen measure: 1.7 (1.5-1.8) x 1.1 (0.9-1.2) mm.

3.2.42. URTICACEAE

Urtica dioica L.

The laterally flattened fruits are ovate in outline, with pointed upper and lower end. Both sides are somewhat domed. The surface shows no distinct structure. The fruits of *Urtica dioica* were not commonly found; only Ezinge yielded a somewhat larger number (table 21). *Urtica dioica* is very common in places which are rich in nitrates.

TABLE 21. DIMENSIONS IN MM AND INDEX VALUES FOR *URTICA*

		Length	Breadth	L:B
U. dioica	min.	1.0	0.7	133
Ezinge	mean	1.12	0.78	150
N = 25	max.	1.4	0.8	168
U. urens	min.	1.5	1.1	115
Paddepoel	mean	1.70	1.32	129
N = 100	max.	1.9	1.5	144

Urtica urens L. (fig. 12:4)

The flat fruits are ovate in outline, with pointed upper end and rounded lower end. One side is slightly roof-shaped. The surface is densely set with small, but distinct warts. From Paddepoel 299 a very large number of *Urtica urens* fruits could be isolated (table 21), but this species is also represented in other sites. *Urtica urens* which grows, among others, on muck-heaps is a characteristic species of the Chenopodio-Urticetum urentis.

3.2.43. VALERIANACEAE

Valeriana officinalis L. (fig. 8:11)

From Vlaardingen II/III one damaged fruit of *Valeriana officinalis* was recovered. The flat fruit is ovate in outline, with a truncated upper end. One flat side has one longitudinal rib; of the three ribs on the other side, two are still preserved in the specimen from Vlaardingen. Length 3.5 mm, the breadth could not be determined.

Valeriana officinalis, which is a characteristic species of the Valeriano-Filipenduletum, grows in wet habitats.

TABLE 22. PADDEPOEL-GRONINGEN

percentage group	sample frequency		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Thero-Suaedetalia	Ruppion maritimae	Potametea	Eleochari to-Hippuridetum	Scirpetum maritimi	Scirpo-Phragmitetum	Arrhenatherion elatioris	Bidention	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
1	10	Spergularia media-type	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	30	Plantago maritima	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	40	Aster tripolium	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	10	Suaeda maritima	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
2	90	Triglochin maritima	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6	100	Juncus gerardii	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	30	Elytrigia repens/pungens	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	+	+
3	100	Agrostis spec.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+
1	10	Centaurium spec.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	10	Cochlearia danica	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	90	Odontites verna/litoralis	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+
1	40	Festuca rubra	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	70	Glaux maritima	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	70	Sagina spec.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	20	Linum catharticum	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	50	Rhinanthus spec.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	60	Hordeum spec.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+
1	10	Bryum marratii	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	20	Drepanocladus aduncus	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	60	Eurhynchium praelongum	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	50	Carex disticha	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+
3	90	Eleocharis uniglumis/palustris	.	+	.	.	.	.	+	+	+	.	.	.	.	.	.	.	+
3	90	Juncus articulatus	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
1	70	Oenanthe lachenalii	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	40	Ranunculus sardous	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	30	Centunculus minimus	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	70	Carex serotina-type	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	100	Alopecurus geniculatus	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
1	20	Medicago lupulina	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	70	Prunella vulgaris	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	60	Ranunculus repens	.	+	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+
1	50	Calliergonella cuspidata	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	10	Leptodictyum kochii	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	90	Leptodictyum riparium	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	90	Leontodon autumnalis	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+
2	90	Potentilla anserina	.	+	+	.	.	.	.	.	.	+	.	.	+	+	.	.	+
1	50	Lolium perenne	.	+	+	.	.	.	.	.	.	+	.	.	.	+	.	.	+
2	90	Poa pratensis/trivialis	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	80	Rumex crispus	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+
1	50	Taraxacum spec.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	80	Trifolium repens	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+
1	60	Bromus mollis/secalinus	.	+	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.
1	40	Cerastium holosteoides	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	10	Triglochin palustris	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+
1	90	Polygonum aviculare	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.
3	100	Plantago major	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+
1	50	Poa annua	.	.	+	.	.	.	.	.	.	.	.	+	.	+	.	.	.
1	20	Capsella bursa-pastoris	.	.	+	.	.	.	.	.	.	.	.	+	+	+	.	.	.
3	100	Juncus bufonius	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.

TABLE 22. PADDEPOEL-GRONINGEN (cont'd)

percentage group	sample frequency		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Thero-Suaedetalia	Ruppion maritimae	Potametea	Eleocharito-Hippuridetum	Scirpetum maritimi	Scirpo-Phragmitetum	Arrhenatherion elatioris	Bidention	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
2	80	Puccinellia distans	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	70	Spergularia marina-type	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4	100	Atriplex hastata/patula	.	.	+	+	.	.	.	.	.	.	.	+	.	+	.	.	.
1	30	Atriplex littoralis-type	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.
2	100	Matricaria maritima ssp. inodora	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	.
1	10	Ruppia maritima	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
1	30	Zannichellia palustris ssp. pedic.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
1	10	Potamogeton cf. pectinatus	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
1	10	Potamogeton pusillus	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
1	10	Myriophyllum cf. spicatum	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
1	10	Hippuris vulgaris	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
2	100	Scirpus maritimus	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
1	60	Scirpus lacustris ssp. glaucus	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
2	80	Carex otrubae	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+
1	10	Phragmites australis	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.
1	10	Althaea officinalis	.	.	.	.	.	.	.	?	+	.	.	.	.	.	.	.	.
1	30	Alisma plantago-aquatica	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	50	Carex rostrata/vesicaria	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	10	Lycopus europaeus	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	40	Lythrum salicaria	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	40	Mentha aquatica/arvensis	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.
1	30	Galium palustre	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
1	80	Carex acuta-type	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
1	10	Sparganium erectum	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	10	Campylium stellatum	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	40	Lychnis flos-cuculi	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
1	30	Daucus carota	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	10	Potentilla erecta	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	20	Rhytidiadelphus squarrosus	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	50	Ranunculus sceleratus	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
1	30	Rumex maritimus	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
1	70	Bidens tripartitus	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
1	80	Polygonum lapathifolium	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.
1	70	Chenopodium rubrum/glaucum	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.
1	90	Chenopodium album	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.
2	70	Solanum nigrum	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.
1	30	Chenopodium polyspermum	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	10	Echinochloa crus-galli	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	30	Erysimum cheiranthoides	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	10	Euphorbia helioscopia	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	40	Galeopsis tetrahit/speciosa	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
1	30	Lamium purpureum	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	70	Polygonum persicaria	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	10	Rumex acetosella	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
1	30	Sonchus arvensis	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	10	Stachys arvensis	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	30	Thlaspi arvense	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
2	100	Sonchus asper	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
2	50	Sonchus oleraceus	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
1	90	Stellaria media	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
2	100	Chenopodium ficifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
1	70	Cirsium arvense	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
3	20	Urtica urens	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
1	20	Carduus crispus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
1	30	Urtica dioica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.

TABLE 23. EZINGE

percentage group		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Thero-Suaedetalia	Angelicion litoralis	Potametea	Scirpetum maritimi	Scirpo-Phragmitetum	Arrhenatherion elatioris	Bidention	Polygono-Chenopodietalia	Sisymbrietalia	Artemisietalia vulgaris	Agropyro-Rumicion crispi
2	Salicornia europaea	+	+	.	.	.	.	.	.	.	.	.	.	.	.
1	Spergularia media-type	+	+	.	.	.	.	.	.	.	.	.	.	.	.
4	Limonium vulgare	+	+	.	.	.	.	.	.	.	.	.	.	.	.
1	Plantago maritima	+	+	.	.	.	.	.	.	.	.	.	.	.	.
2	Triglochin maritima	+	+	.	.	.	.	.	.	.	.	.	.	.	.
2	Suaeda maritima	+	.	+	+	.	.	.	.	.	.	.	.	.	.
7	Juncus gerardii	+	+	+	.	.	.	.	.	.	.	.	.	.	.
1	Aster tripolium	+	+	+	.	.	.	.	.	.	.	.	.	.	.
2	Odontites verna/litoralis	.	+	.	.	.	.	.	.	.	.	.	.	.	+
2	Glaux maritima	.	+	.	.	.	.	.	.	.	.	.	.	.	.
2	Hordeum spec.	.	+	.	.	.	.	.	.	.	.	.	+	.	+
1	Festuca rubra	.	+	.	.	.	.	.	.	+	.	.	.	.	.
2	Elytrigia repens/pungens	.	+	+	.	.	.	.	.	.	.	.	+	+	+
4	Agrostis spec.	.	+	+	.	.	.	.	.	+	.	.	.	.	+
2	Oenanthe lachenalii	.	+	.	.	.	.	.	.	.	.	.	.	.	.
1	Bromus mollis/secalinus	.	+	.	.	.	.	.	.	+	.	.	+	.	.
2	Rumex crispus	.	+	.	.	.	.	.	.	.	.	+	+	+	+
1	Polygonum aviculare	.	.	+	.	.	.	.	.	.	.	.	+	.	.
1	Puccinellia distans	.	.	+	.	.	.	.	.	.	.	.	.	.	.
2	Spergularia marina-type	.	.	+	.	.	.	.	.	.	.	.	.	.	.
5	Atriplex hastata/patula	.	.	+	+	.	.	.	.	.	.	.	+	.	.
1	Atriplex littoralis-type	.	.	+	+	.	.	.	.	.	.	.	+	.	.
3	Plantago major	.	.	+	.	.	.	.	.	.	.	.	+	.	.
2	Matricaria maritima ssp. inodora	.	.	.	+	.	.	.	.	.	.	+	+	.	.
2	Apium graveolens	.	.	.	.	+	.	.	.	.	.	.	.	.	.
1	Scirpus maritimus	.	.	.	.	+	.	+	.	.	.	.	.	.	.
2	Althaea officinalis	.	.	.	.	+	.	?	+	.	.	.	.	.	.
1	Potamogeton cf. pectinatus	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	Phragmites australis	.	.	.	.	.	.	+	+	.	.	.	.	.	.
1	Carex rostrata/vesicaria	.	.	.	.	.	.	.	+	.	.	.	.	.	.
1	Iris pseudacorus	.	.	.	.	.	.	.	+	.	.	.	.	.	.
1	Solanum dulcamara	.	.	.	.	.	.	.	+	.	.	.	.	.	.
1	Sonchus palustris	.	.	.	.	.	.	.	+	.	.	.	.	.	.
1	Potentilla erecta	.	.	.	.	.	.	.	.	+	.	.	.	.	.
1	Ranunculus sceleratus	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	Rumex maritimus	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	Polygonum lapathifolium	.	.	.	.	.	.	.	.	.	+	+	.	.	.
1	Polygonum persicaria	.	.	.	.	.	.	.	.	.	.	+	.	.	.
2	Sonchus asper	.	.	.	.	.	.	.	.	.	.	+	+	.	.
1	Chenopodium ficifolium	.	.	.	.	.	.	.	.	.	.	.	+	.	.
1	Chenopodium rubrum/glaucum	.	.	.	.	.	.	.	.	.	.	.	+	.	.
1	Carduus crispus	.	.	.	.	.	.	.	.	.	.	.	.	+	.
4	Urtica dioica	.	.	.	.	.	.	.	.	.	.	.	.	+	.

TABLE 24. TZUMMARUM

percentage group	sample frequency		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Thero-Suaedetalia	Scirpetum maritimi	Scirpo-Phragmitetum	Arrhenatherion elatioris	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Agropyro-Rumicion crispi
1	17	Parapholis strigosa	+	+	.	.	.	.	.	.	.	.	.	.
1	67	Spergularia media-type	+	+	.	.	.	.	.	.	.	.	.	.
3	83	Salicornia europaea	+	+	.	.	.	.	.	.	.	.	.	.
1	50	Limonium vulgare	+	+	.	.	.	.	.	.	.	.	.	.
1	83	Plantago maritima	+	+	.	.	.	.	.	.	.	.	.	.
3	100	Triglochin maritima	+	+	.	.	.	.	.	.	.	.	.	.
2	83	Suaeda maritima	+	.	+	+	.	.	.	.	.	.	.	.
6	100	Juncus gerardii	+	+	+	.	.	.	.	.	.	.	.	.
1	67	Aster tripolium	+	+	+	.	.	.	.	.	.	.	.	.
1	67	Armeria maritima	.	+	.	.	.	.	.	.	.	.	.	.
2	67	Odontites verna/litoralis	.	+	.	.	.	.	.	.	.	.	+	+
2	83	Glaux maritima	.	+	.	.	.	.	.	.	.	.	.	.
1	33	Sagina spec.	.	+	.	.	.	.	.	.	.	.	.	.
1	33	Festuca rubra	.	+	.	.	.	.	+	.	.	.	.	.
1	33	Elytrigia repens/pungens	.	+	+	.	.	.	.	.	.	+	.	+
3	100	Agrostis spec.	.	+	+	.	.	.	+	.	.	.	.	+
4	100	Centaurium spec.	.	+	.	.	.	.	.	.	.	.	.	.
1	67	Oenanthe lachenalii	.	+	.	.	.	.	.	.	.	.	.	.
1	67	Ranunculus sardous	.	+	.	.	.	.	.	.	.	.	.	.
2	83	Leontodon autumnalis	.	+	.	.	.	.	+	.	.	.	.	.
1	33	Bromus mollis/secalinus	.	+	.	.	.	.	+	.	.	+	+	.
1	50	Poa pratensis/trivialis	.	+	.	.	.	.	+	.	.	.	.	.
1	67	Potentilla anserina	.	+	+	.	.	.	+	.	+	+	.	+
1	17	Rumex crispus	.	+	.	.	.	.	.	.	+	+	.	+
1	17	Trifolium repens	.	+	.	.	.	.	+	.	.	.	.	+
2	50	Puccinellia distans	.	.	+	.	.	.	.	.	.	.	.	.
2	100	Spergularia marina-type	.	.	+	.	.	.	.	.	.	.	.	.
1	33	Poa annua	.	.	+	.	.	.	.	+	.	+	.	.
1	67	Polygonum aviculare	.	.	+	.	.	.	.	.	.	+	.	.
2	83	Plantago major	.	.	+	.	.	.	.	.	.	+	.	+
3	33	Juncus bufonius	.	.	+	.	.	.	.	.	+	.	.	.
5	100	Atriplex hastata/patula	.	.	+	+	.	.	.	+	.	+	.	.
1	33	Atriplex littoralis-type	.	.	+	+	.	.	.	.	.	+	.	.
1	50	Matricaria maritima ssp. inodora	.	.	.	+	.	.	.	.	+	+	.	.
1	67	Scirpus maritimus	.	.	.	.	+	.	.	.	.	.	.	.
1	17	Phragmites australis	.	.	.	.	+	+	.	.	.	.	.	.
1	33	Carex rostrata/vesicaria	.	.	.	.	.	+	.	.	.	.	.	.
1	17	Mentha aquatica/arvensis	.	.	.	.	.	+	.	.	+	.	.	.
1	17	Sium erectum	.	.	.	.	.	+	.	.	.	.	.	.
1	50	Chenopodium rubrum/glaucum	.	.	.	.	.	.	.	+	.	+	.	.
1	50	Chenopodium album	.	.	.	.	.	.	.	+	+	+	.	.
1	17	Euphorbia helioscopia	.	.	.	.	.	.	.	.	+	.	.	.
1	17	Sonchus arvensis	.	.	.	.	.	.	.	.	+	.	.	.
1	33	Anagallis arvensis	.	.	.	.	.	.	.	.	+	.	.	.
1	83	Sonchus asper	.	.	.	.	.	.	.	.	+	+	.	.
1	17	Stellaria media	.	.	.	.	.	.	.	.	+	+	.	.
2	67	Chenopodium ficifolium	.	.	.	.	.	.	.	.	.	+	.	.
1	33	Cirsium arvense	.	.	.	.	.	.	.	.	.	+	+	.
1	50	Sinapis arvensis	.	.	.	.	.	.	.	.	.	.	+	.

TABLE 25. LEEUWARDEN

percentage group		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Thero-Suaedetalia	Angelicion litoralis	Scirpetum maritimi	Scirpo-Phragmitetum	Arrhenatherion elatioris	Bidention	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
1	Puccinellia maritima	+	.	.	.	.	.	.	.	.	.	.	.	.	.
2	Limonium vulgare	+	+	.	.	.	.	.	.	.	.	.	.	.	.
3	Salicornia europaea	+	+	.	.	.	.	.	.	.	.	.	.	.	.
1	Spergularia media-type	+	+	.	.	.	.	.	.	.	.	.	.	.	.
1	Plantago maritima	+	+	.	.	.	.	.	.	.	.	.	.	.	.
2	Triglochin maritima	+	+	.	.	.	.	.	.	.	.	.	.	.	.
1	Suaeda maritima	+	.	+	+	.	.	.	.	.	.	.	.	.	.
7	Juncus gerardii	+	+	+	.	.	.	.	.	.	.	.	.	.	.
1	Aster tripolium	+	+	+	.	.	.	.	.	.	.	.	.	.	.
1	Odontites verna/litoralis	.	+	.	.	.	.	.	.	.	.	.	+	.	+
2	Centaurium spec.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
2	Glaux maritima	.	+	.	.	.	.	.	.	.	.	.	.	.	.
2	Sagina spec.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
1	Hordeum spec.	.	+	.	.	.	.	.	.	.	.	+	.	.	+
1	Festuca rubra	.	+	.	.	.	.	.	+	.	.	.	.	.	
1	Elytrigia repens/pungens	.	+	.	.	.	.	.	.	.	.	+	.	+	+
4	Agrostis spec.	.	+	+	.	.	.	.	+	.	.	.	.	.	+
1	Eurhynchium praelongum	.	+	.	.	.	.	+	.	.	.	.	.	.	.
1	Eleocharis uniglumis/palustris	.	+	.	.	.	+	+	.	.	.	.	.	.	+
2	Oenanthe lachenalii	.	+	.	.	.	.	.	.	.	.	.	.	.	.
1	Alopecurus geniculatus	.	+	.	.	.	.	+	.	.	.	.	.	.	+
2	Juncus articulatus	.	+	.	.	.	.	+	.	.	.	.	.	.	+
1	Medicago lupulina	.	+	.	.	.	.	.	+	.	.	.	.	.	.
1	Ranunculus repens	.	+	.	.	.	.	.	+	.	+	.	.	.	+
1	Hydrocotyle vulgaris	.	+	.	.	.	.	+	.	.	.	.	.	.	+
1	Calliergonella cuspidata	.	+	.	.	.	.	+	.	.	.	.	.	.	.
1	Leptodictyum riparium	.	+	.	.	.	.	.	.	.	.	.	.	.	.
1	Potentilla anserina	.	+	+	.	.	.	.	+	.	+	+	.	.	+
2	Poa pratensis/trivialis	.	+	.	.	.	.	.	+	.	.	.	.	.	.
1	Rumex crispus	.	+	.	.	.	.	.	.	.	+	+	.	+	+
1	Bromus mollis/secalinus	.	+	.	.	.	.	.	+	.	.	+	+	.	.
1	Cerastium holosteoides	.	+	.	.	.	.	.	+	.	.	.	.	.	.
1	Polygonum aviculare	.	.	+	.	.	.	.	.	.	.	+	.	.	.
1	Puccinellia distans	.	.	+	.	.	.	.	.	.	.	.	.	.	.
2	Spergularia marina-type	.	.	+	.	.	.	.	.	.	.	.	.	.	.
2	Atriplex hastata/patula	.	.	+	+	.	.	.	.	.	.	+	.	.	.
1	Atriplex littoralis-type	.	.	+	+	.	.	.	.	.	.	+	.	.	.
2	Plantago major	.	.	+	.	.	.	.	.	.	.	+	.	.	+
5	Juncus bufonius	.	.	+	.	.	.	.	.	.	+	.	.	.	.
1	Matricaria maritima ssp. inodora	.	.	.	+	.	.	.	.	.	+	+	.	.	.
1	Apium graveolens	.	.	.	.	+	.	.	.	.	.	.	.	.	.
1	Althaea officinalis	.	.	.	.	+	?	+	.	.	.	.	.	.	.
2	Scirpus maritimus	.	.	.	.	+	+	.	.	.	.	.	.	.	.
1	Scirpus lacustris ssp. glaucus	.	.	.	.	.	+	.	.	.	.	.	.	.	.
2	Phragmites australis	.	.	.	.	.	+	+	.	.	.	.	.	.	.
1	Carex otrubae	.	.	.	.	.	+	+	.	.	.	.	.	.	+
1	Cladium mariscus	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	Carex rostrata/vesicaria	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	Eupatorium cannabinum	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	Galium palustre	.	.	.	.	.	.	+	.	.	.	.	.	.	.

percentage group		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Thero-Suaedetalia	Angelicion litoralis	Scirpetum maritimi	Scirpo-Phragmitetum	Arrhenatherion elatioris	Bidention	Polygono-Chenopodietalia	Sicymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
1	Hypericum spec.	.	.	.	.	.	.	?	.	.	.	.	.	.	.
2	Juncus effusus-type	.	.	.	.	.	.	+	.	.	.	.	.	.	+
3	Juncus subnodulosus	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	Lychnis flos-cuculi	.	.	.	.	.	.	+	+	.	.	.	.	.	.
1	Lycopus europaeus	.	.	.	.	.	.	+	.	.	.	.	.	.	.
2	Lythrum salicaria	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	Mentha aquatica/arvensis	.	.	.	.	.	.	+	.	.	+	.	.	.	.
1	Scutellaria galericulata	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	Potentilla erecta	.	.	.	.	.	.	.	+	.	.	.	.	.	.
2	Rumex maritimus	.	.	.	.	.	.	.	.	+	.	.	.	.	.
2	Ranunculus sceleratus	.	.	.	.	.	.	.	.	+	.	.	.	.	.
1	Sonchus arvensis	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	Rumex acetosella	.	.	.	.	.	.	.	.	.	+	.	+	.	.
1	Chenopodium album	.	.	.	.	.	.	.	.	.	+	+	.	.	.
1	Solanum nigrum	.	.	.	.	.	.	.	.	.	+	+	.	.	.
2	Chenopodium ficifolium	.	.	.	.	.	.	.	.	.	.	+	.	.	.
2	Chenopodium rubrum/glaucum	.	.	.	.	.	.	.	.	.	.	+	.	.	.
1	Cirsium arvense	.	.	.	.	.	.	.	.	.	.	+	+	.	.

TABLE 26. TRITSUM

percentage group	sample frequency		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Thero-Suaedetalia	Potametea	Eleochari to-Hippuridetum	Scirpetum maritimi	Scirpo-Phragmitetum	Arrhenatherion elatioris	Bidention	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
1	31	Puccinellia maritima	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	6	Parapholis strigosa	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	25	Limonium vulgare	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	31	Salicornia europaea	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	19	Spergularia media-type	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	56	Plantago maritima	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	75	Triglochin maritima	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	31	Suaeda maritima	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
5	94	Juncus gerardii	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
1	56	Aster tripolium	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
2	13	Armeria maritima	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	88	Odontites verna/litoralis	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	+
3	69	Glaux maritima	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	6	Sagina spec.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	19	Hordeum spec.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+
1	31	Festuca rubra	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
2	44	Elytrigia repens/pungens	.	+	+	.	.	.	.	.	.	.	.	.	+	.	+	+
3	88	Agrostis spec.	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	+
1	6	Rhinanthus spec.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	6	Eleocharis uniglumis/palustris	.	+	.	.	.	+	+	+	.	.	.	.	.	.	.	+
2	63	Oenanthe lachenalii	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	38	Ranunculus sardous	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	19	Alopecurus geniculatus	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	+
2	38	Medicago lupulina	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	13	Ranunculus repens	.	+	.	.	.	.	.	.	+	.	.	+	.	.	.	+
1	6	Prunella vulgaris	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
2	63	Leontodon autumnalis	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+
1	38	Bromus mollis/secalinus	.	+	.	.	.	.	.	.	+	.	.	.	+	+	.	.
1	75	Poa pratensis/trivialis	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
2	63	Potentilla anserina	.	+	+	.	.	.	.	.	+	.	.	+	+	.	.	+
2	38	Rumex crispus	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	+
1	6	Taraxacum spec.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
2	13	Trifolium pratense	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
4	6	Trifolium repens	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+
3	6	Trifolium campestre	.	?	.	.	.	.	.	.	+	.	.	+	.	.	.	.
1	44	Lolium perenne	.	+	+	.	.	.	.	.	+	.	.	.	+	.	.	+
2	13	Cerastium holosteoides	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	13	Poa annua	.	.	+	.	.	.	.	.	.	.	+	.	+	.	.	.
2	75	Polygonum aviculare	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.
2	81	Puccinellia distans	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
1	31	Spergularia marina-type	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
4	94	Atriplex hastata/patula	.	.	+	+	.	.	.	.	.	.	+	.	+	.	.	.
1	44	Atriplex littoralis-type	.	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.
4	88	Plantago major	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	+
1	6	Juncus bufonius	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.
1	31	Capsella bursa-pastoris	.	.	+	.	.	.	.	.	.	.	+	+	+	.	.	.
1	56	Matricaria maritima ssp. inodora	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.
1	6	Potamogeton spec.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
1	6	Hippuris vulgaris	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.

TABLE 26. TRITSUM (cont'd)

percentage group	sample frequency		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Thero-Suaedetalia	Potametea	Eleocharito-Hippuridetum	Scirpetum maritimi	Scirpo-Phragmitetum	Arrhenatherion elatioris	Bidention	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
2	75	Scirpus maritimus	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
2	19	Scirpus lacustris ssp. glaucus	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
1	31	Phragmites australis	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.
3	25	Carex otrubae	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+
1	6	Alisma plantago-aquatica	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	31	Carex rostrata/vesicaria	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	6	Carex pseudocyperus	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	13	Lycopus europaeus	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	19	Mentha aquatica/arvensis	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.
1	6	Galium palustre	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
1	6	Solanum dulcamara	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	6	Thalictrum flavum	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	6	Oenanthe aquatica	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	6	Oenanthe fistulosa	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	6	Cirsium palustre	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
2	6	Sium erectum	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
4	38	Daucus carota	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	6	Holcus lanatus	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	50	Ranunculus sceleratus	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
2	19	Rumex maritimus	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
1	13	Polygonum lapathifolium	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.
2	56	Chenopodium rubrum/glaucum	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.
2	38	Chenopodium album	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.
1	19	Solanum nigrum	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.
1	13	Galeopsis tetrahit/speciosa	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
1	19	Polygonum persicaria	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	19	Sonchus arvensis	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	19	Stachys arvensis	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
2	6	Thlaspi arvense	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
2	25	Erysimum cheiranthoides	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	6	Anagallis arvensis	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	13	Chenopodium polyspermum	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
2	38	Sonchus asper	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
1	50	Sonchus oleraceus	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
2	88	Stellaria media	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
2	56	Chenopodium ficifolium	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
1	31	Cirsium arvense	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
2	25	Urtica urens	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
1	13	Polygonum convolvulus	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
2	13	Sinapis arvensis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
1	6	Aethusa cynapium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
1	13	Carduus crispus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
1	19	Cirsium vulgare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
1	6	Galium aparine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
1	6	Urtica dioica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.

TABLE 27. SNEEK

percentage group	sample frequency		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Thero-Suaedetalia	Potametea	Scirpetum maritimi	Scirpo-Phragmitetum	Arrhenatherion elatioris	Bidention	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
1	50	Salicornia europaea	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·
1	25	Spergularia media-type	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·
2	75	Aster tripolium	+	+	+	·	·	·	·	·	·	·	·	·	·	·	·
6	100	Juncus gerardii	+	+	+	·	·	·	·	·	·	·	·	·	·	·	·
1	50	Suaeda maritima	+	·	+	+	·	·	·	·	·	·	·	·	·	·	·
1	100	Triglochin maritima	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·
1	25	Elytrigia repens/pungens	·	+	+	·	·	·	·	·	·	·	·	+	·	·	+
4	100	Agrostis spec.	·	+	+	·	·	·	·	+	·	·	·	·	·	·	+
1	75	Odontites verna/litoralis	·	+	·	·	·	·	·	·	·	·	·	·	+	·	+
1	75	Festuca rubra	·	+	·	·	·	·	·	+	·	·	·	·	·	·	·
1	25	Hordeum spec.	·	+	·	·	·	·	·	·	·	·	·	+	·	·	+
1	100	Eleocharis uniglumis/palustris	·	+	·	·	·	+	+	·	·	·	·	·	·	·	+
1	100	Oenanthe lachenalii	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·
1	100	Juncus articulatus	·	+	·	·	·	·	+	·	·	·	·	·	·	·	+
1	25	Alopecurus geniculatus	·	+	·	·	·	·	+	·	·	·	·	·	·	·	+
1	25	Leptodictyum kochii	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·
1	50	Leptodictyum riparium	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·
1	50	Leontodon autumnalis	·	+	·	·	·	·	·	+	·	·	·	·	·	·	+
1	100	Poa pratensis/trivialis	·	+	·	·	·	·	·	+	·	·	·	·	·	·	·
1	100	Potentilla anserina	·	+	+	·	·	·	·	+	·	·	+	+	·	·	+
1	75	Rumex crispus	·	+	·	·	·	·	·	·	·	·	+	+	·	·	+
1	25	Cerastium holosteoides	·	+	·	·	·	·	·	+	·	·	·	·	·	·	·
1	25	Puccinellia distans	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·
3	100	Atriplex hastata/patula	·	·	+	+	·	·	·	·	·	+	·	+	·	·	·
1	75	Atriplex littoralis-type	·	·	+	+	·	·	·	·	·	·	·	+	·	·	·
1	75	Spergularia marina-type	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·
2	100	Plantago major	·	·	+	·	·	·	·	·	·	·	·	+	·	·	+
1	50	Poa annua	·	·	+	·	·	·	·	·	·	+	·	+	·	·	·
1	25	Polygonum aviculare	·	·	+	·	·	·	·	·	·	·	·	+	·	·	·
2	100	Juncus bufonius	·	·	+	·	·	·	·	·	·	·	+	·	·	·	·
1	50	Capsella bursa-pastoris	·	·	+	·	·	·	·	·	·	+	+	+	·	·	·
1	50	Matricaria maritima ssp. inodora	·	·	·	+	·	·	·	·	·	·	+	+	·	·	·
2	25	Potamogeton pusillus	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·
1	100	Scirpus maritimus	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·
1	25	Scirpus lacustris ssp. glaucus	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·
1	75	Phragmites australis	·	·	·	·	·	+	+	·	·	·	·	·	·	·	·
1	100	Carex otrubae	·	·	·	·	·	+	+	·	·	·	·	·	·	·	+
1	25	Althaea officinalis	·	·	·	·	·	?	+	·	·	·	·	·	·	·	·
1	25	Typha latifolia	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·
1	50	Cladium mariscus	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·
1	25	Carex acuta-type	·	·	·	·	·	·	+	·	·	·	·	·	·	·	+
1	25	Mentha aquatica/arvensis	·	·	·	·	·	·	+	·	·	·	+	·	·	·	·
1	25	Potentilla erecta	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·
1	25	Bidens tripartitus	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·
1	75	Ranunculus sceleratus	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·
2	100	Chenopodium rubrum/glaucum	·	·	·	·	·	·	·	·	·	+	·	+	·	·	·
1	75	Chenopodium album	·	·	·	·	·	·	·	·	·	+	+	+	·	·	·
1	25	Sonchus arvensis	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·
1	100	Sonchus asper	·	·	·	·	·	·	·	·	·	·	+	+	·	·	·
1	75	Sonchus oleraceus	·	·	·	·	·	·	·	·	·	·	+	+	·	·	·
1	50	Stellaria media	·	·	·	·	·	·	·	·	·	·	+	+	·	·	·
2	100	Chenopodium ficifolium	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·
1	25	Urtica urens	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·
1	25	Cirsium arvense	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·
1	50	Urtica dioica	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·

TABLE 28. DEN HELDER-HET TORP

percentage group	sample frequency		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Scirpetum maritimi	Scirpo-Phragmitetum	Parvocaricetea	Arrhenatherion elatioris	dry habitats in dunes	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
2	83	Puccinellia maritima	+	.	.	.	.	.	.	.	.	.	.	.	.
1	17	Parapholis strigosa	+	+	.	.	.	.	.	.	.	.	.	.	.
2	83	Limonium vulgare	+	+	.	.	.	.	.	.	.	.	.	.	.
4	100	Spergularia media-type	+	+	.	.	.	.	.	.	.	.	.	.	.
3	83	Salicornia europaea	+	+	.	.	.	.	.	.	.	.	.	.	.
3	83	Plantago maritima	+	+	.	.	.	.	.	.	.	.	.	.	.
4	83	Triglochin maritima	+	+	.	.	.	.	.	.	.	.	.	.	.
2	100	Suaeda maritima	+	.	+	.	.	.	.	.	.	.	.	.	.
6	100	Juncus gerardii	+	+	+	.	.	.	.	.	.	.	.	.	.
1	50	Aster tripolium	+	+	+	.	.	.	.	.	.	.	.	.	.
2	83	Armeria maritima	.	+	.	.	.	.	.	.	.	.	.	.	.
1	83	Glaux maritima	.	+	.	.	.	.	.	.	.	.	.	.	.
1	17	Centaurium spec.	.	+	.	.	.	.	.	.	.	.	.	.	.
2	50	Sagina spec.	.	+	.	.	.	+	.	.	.	.	.	.	.
1	100	Festuca rubra	.	+	.	.	.	.	+	.	.	.	.	.	.
1	33	Hordeum spec.	.	+	.	.	.	.	.	.	.	+	.	.	+
4	100	Agrostis spec.	.	+	+	.	.	+	+	.	.	.	.	.	+
1	33	Eleocharis uniglumis/palustris	.	+	.	+	+	.	.	.	.	.	.	.	+
1	17	Oenanthe lachenalii	.	+	.	.	.	.	.	.	.	.	.	.	.
2	33	Juncus articulatus	.	+	.	.	.	+	.	.	.	.	.	.	+
1	17	Carex serotina-type	.	+	.	.	.	.	.	.	.	.	.	.	.
1	33	Prunella vulgaris	.	+	.	.	.	.	+	.	.	.	.	.	.
1	17	Calliergonella cuspidata	.	+	.	.	+	+	.	.	.	.	.	.	.
1	33	Leontodon autumnalis	.	+	.	.	.	.	+	.	.	.	.	.	+
1	67	Poa pratensis/trivialis	.	+	.	.	.	.	+	.	.	.	.	.	.
1	33	Bromus mollis/secalinus.	.	+	.	.	.	.	+	.	.	+	+	.	.
1	17	Cerastium holosteoides	.	+	.	.	.	.	+	.	.	.	.	.	.
1	33	Plantago major	.	.	+	.	.	.	.	.	.	+	.	.	+
2	83	Polygonum aviculare	.	.	+	.	.	.	.	.	.	+	.	.	.
2	50	Juncus bufonius	.	.	+	.	.	.	.	.	+	.	.	.	.
2	83	Puccinellia distans	.	.	+	.	.	.	.	.	.	.	.	.	.
4	100	Spergularia marina-type	.	.	+	.	.	.	.	.	.	.	.	.	.
4	100	Atriplex hastata/patula	.	.	+	.	.	.	.	.	.	+	.	.	.
1	17	Capsella bursa-pastoris	.	.	+	.	.	.	.	.	+	+	.	.	.
1	67	Scirpus maritimus	.	.	.	+	.	.	.	.	.	.	.	.	.
1	50	Scirpus lacustris ssp. glaucus	.	.	.	+	.	.	.	.	.	.	.	.	.
1	33	Phragmites australis	.	.	.	+	+	.	.	.	.	.	.	.	.
1	50	Carex acuta-type	.	.	.	.	+	.	.	.	.	.	.	.	+
1	33	Calliergon stramineum	.	.	.	.	+	+	.	.	.	.	.	.	.
1	33	Lycopus europaeus	.	.	.	.	+	.	.	.	.	.	.	.	.
1	33	Lychnis flos-cuculi	.	.	.	.	+	.	+	.	.	.	.	.	.
1	33	Cladium mariscus	.	.	.	.	+	+	.	.	.	.	.	.	.
1	50	Carex rostrata/vesicaria	.	.	.	.	+	+	.	.	.	.	.	.	.
1	17	Juncus subnodulosus	.	.	.	.	.	+	.	.	.	.	.	.	.
1	33	Menyanthes trifoliata	.	.	.	.	.	+	.	.	.	.	.	.	.
1	17	Potentilla palustris	.	.	.	.	.	+	.	.	.	.	.	.	.
1	17	Scirpus planifolius	.	.	.	.	.	+	.	.	.	.	.	.	.
1	17	Ranunculus flammula	.	.	.	.	.	+	.	.	.	.	.	.	.
1	33	Aulacomnium palustre	.	.	.	.	.	+	.	.	.	.	.	.	.
1	17	Drepanocladus vernicosus	.	.	.	.	.	+	.	.	.	.	.	.	.
1	67	Tomenthypnum nitens	.	.	.	.	.	+	.	.	.	.	.	.	.

TABLE 28. DEN HELDER-HET TORP (cont'd)

percentage group	sample frequency		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Scirpetum maritimi	Scirpo-Phragmitetum	Parvocaricetea	Arrhenatherion elatioris	dry habitats in dunes	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
1	67	Rosa pimpinellifolia	.	.	.	.	.	.	.	+	.	.	.	.	.
1	17	Betula spec.	.	.	.	.	.	.	.	+	.	.	.	.	.
1	17	Calluna vulgaris	.	.	.	.	.	.	.	+	.	.	.	.	.
1	17	Dicranum scoparium	.	.	.	.	.	.	.	+	.	.	.	.	.
1	17	Hypnum cupressiforme	.	.	.	.	.	.	.	+	.	.	.	.	.
1	17	Thlaspi arvense	.	.	.	.	.	.	.	.	+	.	.	.	.
2	83	Polygonum lapathifolium	.	.	.	.	.	.	.	.	+	.	.	.	.
2	17	Polygonum persicaria	.	.	.	.	.	.	.	.	+	.	.	.	.
1	17	Galeopsis tetrahit/speciosa	.	.	.	.	.	.	.	.	+	.	+	.	.
1	17	Rumex acetosella	.	.	.	.	.	.	.	.	+	.	+	.	.
1	33	Spergula arvensis	.	.	.	.	.	.	.	.	+	.	+	.	.
2	67	Sonchus oleraceus	.	.	.	.	.	.	.	.	+	+	.	.	.
1	83	Stellaria media	.	.	.	.	.	.	.	.	+	+	.	.	.
1	33	Senecio cf. vulgaris	.	.	.	.	.	.	.	.	+	+	.	.	.
1	83	Chenopodium album	.	.	.	.	.	.	.	.	+	+	.	.	.
1	17	Chenopodium rubrum/glaucum	.	.	.	.	.	.	.	.	.	+	.	.	.
2	100	Urtica urens	.	.	.	.	.	.	.	.	.	+	.	.	.
1	17	Agrostemma githago	.	.	.	.	.	.	.	.	.	.	+	.	.
1	17	Raphanus raphanistrum	.	.	.	.	.	.	.	.	.	.	+	.	.
1	17	Polygonum convolvulus	.	.	.	.	.	.	.	.	.	.	+	.	.
1	33	Sinapis arvensis	.	.	.	.	.	.	.	.	.	.	+	.	.
1	33	Lapsana communis	.	.	.	.	.	.	.	.	.	.	.	+	.

TABLE 29. OUDDORP

percentage group	sample frequency		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Thero-Suaedetalia	Ruppion maritimae	Potametea	Eleochari to-Hippuridetum	Scirpetum maritimi	Scirpo-Phragmitetum	Arrhenatherion elatioris	Bidention	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
1	29	Salicornia europaea	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	57	Aster tripolium	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	86	Triglochin maritima	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	43	Suaeda maritima	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
6	100	Juncus gerardii	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	57	Agrostis spec.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+
2	43	Odontites verna/litoralis	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+
2	43	Glaux maritima	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	14	Linum catharticum	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	43	Carex disticha	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+
3	100	Eleocharis uniglumis/palustris	.	+	.	.	.	.	+	+	+	.	.	.	.	.	.	.	+
3	86	Juncus articulatus	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
1	43	Oenanthe lachenalii	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	100	Ranunculus sardous	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	14	Carex serotina-type	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	43	Alopecurus geniculatus	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
1	43	Prunella vulgaris	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
2	43	Ranunculus repens	.	+	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+
1	29	Hydrocotyle vulgaris	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
2	43	Ranunculus flammula	.	?	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
1	57	Leontodon autumnalis	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+
1	14	Bromus mollis/secalinus	.	+	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.
2	71	Poa pratensis/trivialis	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
2	57	Potentilla anserina	.	+	+	.	.	.	.	.	.	+	.	.	+	+	.	.	+
2	29	Potentilla reptans	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	14	Taraxacum spec.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
1	14	Cerastium holosteoides	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
4	100	Juncus bufonius	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.
2	57	Plantago major	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.
3	14	Poa annua	.	.	+	.	.	.	.	.	.	.	.	+	.	+	.	.	.
2	57	Polygonum aviculare	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.
3	43	Spergularia marina-type	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	29	Puccinellia distans	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	100	Atriplex hastata/patula	.	.	+	+	.	.	.	.	.	.	.	+	.	+	.	.	.
1	14	Capsella bursa-pastoris	.	.	+	.	.	.	.	.	.	.	.	+	+	+	.	.	.
2	14	Matricaria maritima ssp. inodora	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	.
1	14	Ruppia maritima	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
2	57	Zannichellia palustris ssp. pedic.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
1	14	Potamogeton spec.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
1	29	Hippuris vulgaris	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
2	86	Scirpus maritimus	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
2	86	Scirpus lacustris ssp. glaucus	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
2	43	Carex otrubae	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+
4	43	Phragmites australis	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.
1	14	Alisma plantago-aquatica	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	57	Carex rostrata/vesicaria	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	29	Lycopus europaeus	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	14	Lythrum salicaria	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
1	29	Mentha aquatica/arvensis	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.

TABLE 29. OUDDORP (cont'd)

percentage group	sample frequency		Puccinellietum maritimae	Juncetum gerardii	Puccinellietum distantis	Thero-Suaedetalia	Ruppion maritimae	Potametea	Eleochari to-Hippuridetum	Scirpetum maritimi	Scirpo-Phragmitetum	Arrhenatherion elatioris	Bidention	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
2	14	Oenanthe fistulosa	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
2	43	Carex acuta-type	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
2	29	Daucus carota	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
2	57	Ranunculus sceleratus	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
1	29	Polygonum lapathifolium	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.
1	43	Chenopodium rubrum/glaucum	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.
1	14	Chenopodium album	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.
1	29	Solanum nigrum	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.
2	43	Anagallis arvensis	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
2	29	Erysimum cheiranthoides	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
1	29	Rumex acetosella	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
2	86	Sonchus asper	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
1	43	Sonchus oleraceus	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
2	86	Stellaria media	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
1	29	Arenaria serpyllifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
2	43	Chenopodium ficifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
3	71	Urtica urens	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
1	14	Agrostemma githago	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
1	29	Arctium cf. pubens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
1	14	Cirsium vulgare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
2	29	Conium maculatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
1	43	Rumex obtusifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
2	57	Urtica dioica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.

TABLE 30. VLAARDINGEN-BROEKPOLDER

percentage group	sample frequency		Carici elongatae-Alnetum	Magnocaricion	Scirpo-Phragmitetum	Molinietalia	Caricetalia nigrae	Lolio-Plantaginetum	Bidention	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
1	25	Alnus glutinosa	+	.	.	.	.	.	.	.	.	.	.	.	.
1	75	Lythrum salicaria	+	.	.	+	.	.	.	.	.	.	.	.	.
1	50	Lycopus europaeus	+	+	+	.	.	.	.	.	.	.	.	.	.
1	25	Iris pseudacorus	+	+	+	.	.	.	.	.	.	.	.	.	.
1	25	Carex paniculata	+	+	.	.	.	.	.	.	.	.	.	.	.
1	25	Solanum dulcamara	+	.	+	.	.	.	.	.	.	.	.	.	.
1	50	Juncus subnodulosus	.	+	.	+	.	.	.	.	.	.	.	.	.
1	25	Phalaris arundinacea	.	+	.	+	.	.	.	.	.	.	.	.	.
1	25	Carex rostrata/vesicaria	.	+	.	.	+	.	.	.	.	.	.	.	.
1	25	Sium erectum	.	+	+	.	.	.	.	.	.	.	.	.	.
1	25	Mentha aquatica/arvensis	.	+	+	.	.	.	.	.	+	.	.	.	.
1	25	Alisma plantago-aquatica	.	+	+	.	.	.	.	.	.	.	.	.	.
1	25	Rumex hydrolapathum	.	+	+	.	.	.	.	.	.	.	.	.	.
1	50	Carex otrubae	.	+	+	.	.	.	.	.	.	.	.	.	+
1	25	Carex disticha	.	+	+	.	.	.	.	.	.	.	.	.	+
1	25	Myosotis cf. scorpioides	.	+	+	.	.	.	.	.	.	.	.	.	.
1	100	Eleocharis palustris/uniglumis	.	+	+	.	+	.	.	.	.	.	.	.	+
1	25	Calliergonella cuspidata	.	+	+	.	+	.	.	.	.	.	.	.	.
1	75	Alopecurus geniculatus	.	?	?	.	.	.	.	.	.	.	.	.	+
1	25	Scirpus maritimus	.	.	?	.	.	.	.	.	.	.	.	.	.
1	25	Lychnis flos-cuculi	.	.	+	+	.	.	.	.	.	.	.	.	.
1	25	Filipendula ulmaria	.	.	.	+	.	.	.	.	.	.	.	.	.
1	25	Stachys palustris	.	.	.	+	.	.	.	.	.	.	.	.	.
2	75	Juncus effusus-type	.	.	.	+	.	.	.	.	.	.	.	.	+
3	75	Juncus articulatus	.	.	.	+	.	.	.	.	.	.	.	.	+
1	75	Carex serotina-type	.	.	.	+	.	.	.	.	.	.	.	.	.
1	25	Medicago lupulina	.	.	.	+	.	.	.	.	.	.	.	.	.
1	75	Poa pratensis/trivialis	.	.	.	+	.	.	.	.	.	.	.	.	.
1	50	Prunella vulgaris	.	.	.	+	.	.	.	.	.	.	.	.	.
1	75	Ranunculus repens	.	.	.	+	.	.	.	.	+	.	.	.	+
1	25	Rhinanthus spec.	.	.	.	+	.	.	.	.	.	.	.	.	.
1	25	Trifolium pratense	.	.	.	+	.	.	.	.	.	.	.	.	.
1	25	Trifolium repens	.	.	.	+	.	.	.	.	.	.	.	.	+
1	75	Leontodon autumnalis	.	.	.	+	.	.	.	.	.	.	.	.	+
1	25	Climacium dendroides	.	.	.	+	.	.	.	.	.	.	.	.	.
2	75	Agrostis spec.	.	.	.	+	+	+	.	.	.	.	.	.	+
1	25	Hydrocotyle vulgaris	.	.	.	+	+	.	.	.	.	.	.	.	+
1	25	Potentilla erecta	.	.	.	+	+	.	.	.	.	.	.	.	.
1	25	Triglochin palustris	.	.	.	.	+	.	.	.	.	.	.	.	+
1	25	Ranunculus flammula	.	.	.	.	+	.	.	.	.	.	.	.	+
1	25	Aulacomnium palustre	.	.	.	.	+	.	.	.	.	.	.	.	.
1	25	Sphagnum palustre	.	.	.	.	+	.	.	.	.	.	.	.	.
1	50	Capsella bursa-pastoris	.	.	.	.	.	+	.	+	+	+	.	.	.
4	100	Juncus bufonius	.	.	.	.	.	+	.	.	+	.	.	.	.
4	100	Plantago major	.	.	.	.	.	+	.	.	.	+	.	.	+
1	25	Poa annua	.	.	.	.	.	+	.	+	.	+	.	.	.
1	50	Polygonum aviculare	.	.	.	.	.	+	.	.	.	+	.	.	.

TABLE 30. VLAARDINGEN-BROEKPOLDER (cont'd)

percentage group	sample frequency		Carici elongatae-Alnetum	Magnocaricion	Scirpo-Phragmitetum	Molinietalia	Caricetalia nigrae	Lolio-Plantaginetum	Bidention	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
2	29	Capsella bursa-pastoris	.	.	.	.	.	+	.	+	+	+	.	.	.
4	86	Juncus bufonius	.	.	.	.	.	+	.	.	+	.	.	.	.
3	100	Plantago major	.	.	.	.	.	+	.	.	.	+	.	.	+
1	71	Poa annua	.	.	.	.	.	+	.	+	.	+	.	.	.
1	71	Polygonum aviculare	.	.	.	.	.	+	.	.	.	+	.	.	.
2	71	Bidens tripartitus	.	.	.	.	.	.	+	.	.	.	.	.	.
1	14	Polygonum hydropiper	.	.	.	.	.	.	+	.	.	.	.	.	+
1	43	Polygonum minus	.	.	.	.	.	.	+	.	.	.	.	.	.
1	86	Ranunculus sceleratus	.	.	.	.	.	.	+	.	.	.	.	.	.
1	57	Rorippa islandica	.	.	.	.	.	.	+	.	.	.	.	.	.
1	71	Rumex maritimus	.	.	.	.	.	.	+	.	.	.	.	.	.
2	100	Polygonum lapathifolium	.	.	.	.	.	.	+	+	+	.	.	.	.
3	86	Chenopodium rubrum/glaucum	.	.	.	.	.	.	.	+	.	+	.	.	.
1	43	Chenopodium album	.	.	.	.	.	.	.	+	+	+	.	.	.
1	43	Solanum nigrum	.	.	.	.	.	.	.	+	+	+	.	.	.
3	100	Atriplex hastata/patula	.	.	.	.	.	.	.	+	.	+	.	.	.
1	43	Echinochloa crus-galli	.	.	.	.	.	.	.	.	+	.	.	.	.
1	14	Erysimum cheiranthoides	.	.	.	.	.	.	.	.	+	.	.	.	.
2	71	Polygonum persicaria	.	.	.	.	.	.	.	.	+	.	.	.	.
1	14	Sonchus arvensis	.	.	.	.	.	.	.	.	+	.	.	.	.
1	100	Matricaria maritima ssp. inodora	.	.	.	.	.	.	.	.	+	+	.	.	.
1	71	Potentilla anserina	.	.	.	.	.	.	.	.	+	+	.	.	+
1	14	Rumex crispus	.	.	.	.	.	.	.	.	+	+	.	.	+
2	86	Sonchus asper	.	.	.	.	.	.	.	.	+	+	.	.	.
1	43	Sonchus oleraceus	.	.	.	.	.	.	.	.	+	+	.	.	.
2	100	Stellaria media	.	.	.	.	.	.	.	.	+	+	.	.	.
1	14	Bromus mollis/secalinus	.	.	.	.	.	.	.	.	.	+	+	.	.
2	86	Chenopodium ficifolium	.	.	.	.	.	.	.	.	.	+	.	.	.
2	100	Odontites verna/litoralis	.	.	.	.	.	.	.	.	.	.	+	.	.
1	14	Cirsium vulgare	.	.	.	.	.	.	.	.	.	.	.	+	.
1	43	Rumex obtusifolius	.	.	.	.	.	.	.	.	.	.	.	+	.
1	14	Urtica dioica	.	.	.	.	.	.	.	.	.	.	.	+	.

TABLE 31. SCHIEDAM-KETHEL

percentage group	sample frequency		Carici elongatae-Alnetum	Magnocaricion	Scirpo-Phragmitetum	Molinietalia	Caricetalia nigrae	Lolio-Plantaginetum	Bidention	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
1	29	Alnus glutinosa	+	.	.	.	.	.	.	.	.	.	.	.	.
2	57	Iris pseudacorus	+	+	+	.	.	.	.	.	.	.	.	.	.
2	86	Lycopus europaeus	+	+	+	.	.	.	.	.	.	.	.	.	.
1	86	Lythrum salicaria	+	.	.	+	.	.	.	.	.	.	.	.	.
1	14	Peucedanum palustre	+	.	.	.	+	.	.	.	.	.	.	.	.
1	43	Scutellaria galericulata	+	+	.	.	.	.	.	.	.	.	.	.	.
1	29	Carex rostrata/vesicaria	.	+	.	.	+	.	.	.	.	.	.	.	.
1	57	Galium palustre	.	+	.	+	.	.	.	.	.	.	.	.	+
2	71	Juncus subnodulosus	.	+	.	+	.	.	.	.	.	.	.	.	.
2	100	Carex otrubae	.	+	+	.	.	.	.	.	.	.	.	.	+
1	57	Rumex hydrolapathum	.	+	+	.	.	.	.	.	.	.	.	.	.
1	14	Glyceria maxima	.	+	+	.	.	.	.	.	.	.	.	.	.
1	86	Mentha aquatica/arvensis	.	+	+	.	.	.	.	.	+	.	.	.	.
2	86	Oenanthe fistulosa	.	+	+	.	.	.	.	.	.	.	.	.	.
1	57	Sium erectum	.	+	+	.	.	.	.	.	.	.	.	.	.
4	100	Eleocharis palustris/uniglumis	.	+	+	.	+	.	.	.	.	.	.	.	+
1	57	Myosotis cf. scorpioides	.	+	+	.	.	.	.	.	.	.	.	.	.
1	57	Alopecurus geniculatus	.	?	?	.	.	.	.	.	.	.	.	.	+
1	14	Phragmites australis	.	.	+	.	.	.	.	.	.	.	.	.	.
1	14	Ranunculus lingua	.	.	+	.	.	.	.	.	.	.	.	.	.
1	29	Scirpus maritimus	.	.	?	.	.	.	.	.	.	.	.	.	.
1	86	Scirpus lacustris ssp. glaucus	.	.	?	.	.	.	.	.	.	.	.	.	.
1	86	Lychnis flos-cuculi	.	.	+	+	.	.	.	.	.	.	.	.	.
1	14	Eupatorium cannabinum	.	.	.	+	.	.	.	.	.	.	.	.	.
1	29	Filipendula ulmaria	.	.	.	+	.	.	.	.	.	.	.	.	.
1	43	Stachys palustris	.	.	.	+	.	.	.	.	.	.	.	.	.
1	29	Thalictrum flavum	.	.	.	+	.	.	.	.	.	.	.	.	.
1	14	Valeriana officinalis	.	.	.	+	.	.	.	.	.	.	.	.	.
1	29	Juncus effusus-type	.	.	.	+	.	.	.	.	.	.	.	.	+
1	29	Molinia coerulea	.	.	.	+	.	.	.	.	.	.	.	.	.
2	71	Juncus articulatus	.	.	.	+	.	.	.	.	.	.	.	.	+
1	86	Cerastium holosteoides	.	.	.	+	.	.	.	.	.	.	.	.	.
2	86	Poa pratensis/trivialis	.	.	.	+	.	.	.	.	.	.	.	.	.
2	71	Prunella vulgaris	.	.	.	+	.	.	.	.	.	.	.	.	.
1	14	Rhinanthus spec.	.	.	.	+	.	.	.	.	.	.	.	.	.
1	57	Carex serotina-type	.	.	.	+	.	.	.	.	.	.	.	.	.
1	14	Ranunculus repens	.	.	.	+	.	.	.	.	+	.	.	.	+
2	86	Agrostis spec.	.	.	.	+	+	+	.	.	.	.	.	.	+
1	43	Galium uliginosum	.	.	.	+	+	.	.	.	.	.	.	.	.
1	43	Hydrocotyle vulgaris	.	.	.	+	+	.	.	.	.	.	.	.	+
1	14	Potentilla erecta	.	.	.	+	+	.	.	.	.	.	.	.	.
1	57	Pedicularis palustris	.	.	.	.	+	.	.	.	.	.	.	.	.
1	43	Triglochin palustris	.	.	.	.	+	.	.	.	.	.	.	.	+
1	43	Epilobium palustre	.	.	.	.	+	.	.	.	.	.	.	.	.
2	86	Myrica gale	.	.	.	.	+	.	.	.	.	.	.	.	.

TABLE 31. SCHIEDAM-KETHEL (cont'd)

percentage group	sample frequency		Carici elongatae-Alnetum	Magnocaricion	Scirpo-Phragmitetum	Molinietalia	Caricetalia nigrae	Lolio-Plantaginetum	Bidention	Chenopodietum glauco-rubri	Polygono-Chenopodietalia	Sisymbrietalia	Secalietea	Artemisietalia vulgaris	Agropyro-Rumicion crispi
1	100	Bidens tripartitus	.	.	.	.	.	.	+	.	.	.	.	.	.
1	25	Polygonum hydropiper	.	.	.	.	.	.	+	.	.	.	.	.	+
1	25	Polygonum minus	.	.	.	.	.	.	+	.	.	.	.	.	.
1	50	Ranunculus sceleratus	.	.	.	.	.	.	+	.	.	.	.	.	.
1	75	Rorippa islandica	.	.	.	.	.	.	+	.	.	.	.	.	.
4	75	Rumex maritimus	.	.	.	.	.	.	+	.	.	.	.	.	.
1	100	Polygonum lapathifolium	.	.	.	.	.	.	+	+	+	.	.	.	.
1	50	Chenopodium rubrum/glaucum	.	.	.	.	.	.	.	+	.	+	.	.	.
1	25	Chenopodium album	.	.	.	.	.	.	.	+	+	+	.	.	.
2	100	Atriplex hastata/patula	.	.	.	.	.	.	.	+	.	+	.	.	.
1	25	Echinochloa crus-galli	.	.	.	.	.	.	.	.	+	.	.	.	.
1	25	Erysimum cheiranthoides	.	.	.	.	.	.	.	.	+	.	.	.	.
1	50	Polygonum persicaria	.	.	.	.	.	.	.	.	+	.	.	.	.
1	75	Sonchus arvensis	.	.	.	.	.	.	.	.	+	.	.	.	.
1	50	Matricaria maritima ssp. inodora	.	.	.	.	.	.	.	.	+	+	.	.	.
1	75	Potentilla anserina	.	.	.	.	.	.	.	.	+	+	.	.	+
1	50	Rumex crispus	.	.	.	.	.	.	.	.	+	+	.	+	+
1	100	Sonchus asper	.	.	.	.	.	.	.	.	+	+	.	.	.
1	75	Sonchus oleraceus	.	.	.	.	.	.	.	.	+	+	.	.	.
2	100	Stellaria media	.	.	.	.	.	.	.	.	+	+	.	.	.
1	50	Atriplex littoralis-type	.	.	.	.	.	.	.	.	.	+	.	.	.
1	50	Bromus mollis/secalinus	.	.	.	.	.	.	.	.	.	+	+	.	.
1	75	Chenopodium ficifolium	.	.	.	.	.	.	.	.	.	+	.	.	.
1	25	Elytrigia repens/pungens	.	.	.	.	.	.	.	.	.	+	.	.	+
1	75	Hordeum spec.	.	.	.	.	.	.	.	.	.	+	.	.	+
1	75	Sagina spec.	.	.	.	.	.	.	.	.	.	+	.	.	.
1	50	Odontites verna/litoralis	.	.	.	.	.	.	.	.	.	.	+	.	.
3	25	Arctium cf. pubens	.	.	.	.	.	.	.	.	.	.	.	+	.
3	25	Cirsium vulgare	.	.	.	.	.	.	.	.	.	.	.	+	.
1	25	Galium aparine	.	.	.	.	.	.	.	.	.	.	.	+	.
2	75	Rumex obtusifolius	.	.	.	.	.	.	.	.	.	.	.	+	.
1	50	Urtica dioica	.	.	.	.	.	.	.	.	.	.	.	+	.

4. RECONSTRUCTION OF THE VEGETATION

4.1. INTRODUCTION

Before discussing the reconstruction of the vegetation which is shown in tables 22 to 31, some introductory remarks will be made.

For the reconstruction of the vegetation, the results of all samples from one site have been combined. For sites with a rather long lasting habitation the age of the samples can vary considerably. Thus, the samples from Tritsum range from ca. 500 B.C. to ca. 200 A.D., and those from Paddepoel from ca. 200 B.C. to ca. 250 A.D. Consequently, one could wonder whether it is justified to combine samples in cases where they differ in age by several hundreds of years, since in a period of a few hundred years the vegetation may have changed to some extent. However, the numbers of samples per site are generally too small to allow a division into periods, each with a satisfactory number of samples. For two sites with a somewhat larger number of samples, viz. Tritsum and Paddepoel, the main results are also shown per period of a few hundred years (tables 36 to 43). As will be discussed later (4.2.2.3.), changes in the vegetation are suggested by the palaeobotanical evidence at least for Tritsum. This would indicate that the lumping of the data from samples from different periods is not entirely unobjectable, but the usually small numbers of samples available for one site leave no other choice.

One may assume that most of the seeds, fruits, and other plant macrofossils which were found in the settlement remains originate from species which grew on or in the vicinity of the sites. Some exceptions must be made. Thus, the leaves and seeds of *Calluna vulgaris* and *Erica tetralix* as well as the remains of *Sphagnum* recovered from sites in a brackish environment are most probably derived from peat deposits in the coastal area which were eroded by the sea. Various mosses, such as *Antitrichia curtipendula*, *Neckera*, and *Ulota*, would have arrived in the settlements concerned on tree trunks imported from the higher sandy soils.

In tables 22 to 31, two figures are shown before each plant name, except for tables 23 and 25 in which only one figure is indicated. In the first figure the mean percentage is expressed. The mean percentage is calculated in the following way. For instance, in Paddepoel (table 1) *Sagina* seeds were found in 7 of the 10 samples. The sum of the *Sagina* percentages in each of the samples in which this species is represented amounts to 40.4%. For the calculation of the mean percentage this sum is divided by 7 (and not by 10), which results in a value of 5.8%. The mean percentages are classified into the following percentage groups:

"present" and less than 1%	1
1- 5%	2
5-10%	3
10-25%	4
25-50%	5
50-75%	6
more than 75%	7

Thus, *Sagina* is classified into percentage group 3.

The second figure indicates the number of samples in which the species concerned was found, expressed as a percentage (sample frequency). For instance, *Suaeda maritima*, which occurred in 5 of the 16 samples from Tritsum (table 5), has a sample frequency of 31 (5/16 = 31.3%). The sample frequency is not given in tables 23 and 25.

As for the relative frequencies of the plant remains, one should take into consideration that the production and the dispersal of seeds show large differences among the various plant species. The extremely large numbers of *Juncus gerardii* seeds in various samples are not only due to a common occurrence of mud rush in the vicinity of the sites concerned, but they are particularly caused by the prolific seed production of this species. Moreover, some plants were brought to the site intentionally as cattle fodder, as litter for the animals, as material for roofing or perhaps to be used as spice (*Apium graveolens*), whereas other plants or their seeds and fruits must have arrived in the settlement by accident.

From the above it will be clear that a quantitative reconstruction of the vegetation is not possible. That does not yet mean that quantitative analyses would be of no use. On the contrary, they provide us with at least some information on the share of the various plant species in the vegetation, assuming that the differences in the production and dispersal of seeds are taken into consideration. Further, together with the sample frequencies, the mean percentages (percentage groups) allow a better comparison between the sites (see tables 32, 33, 34, and 35, and the relevant discussion).

The reconstruction of the vegetation is also handicapped by the fact that not all of the plant species which occurred in and near the settlement at the time are represented by macrofossil remains. On the other hand, it should be mentioned that of the more common halophytes, only for *Halimione portulacoides* (L.) Aellen and *Artemisia maritima* L. have no seeds or fruits been recovered. Last but not least, in all the samples included in this study plants are represented which cannot have grown together; in other words, the fruits and seeds from one sample are from plants which occurred in different habitats. This is not astonishing, since the plant remains which landed on the muck-heap or which were thrown away in a ditch or elsewhere would have been of heterogeneous origin.

The reconstruction of the vegetation which will be presented in this paper is primarily based on the results of phytosociological investigations. In the Netherlands, and in many other countries inside as well as outside Europe, the vegetation is studied and classified according to the Zürich-Montpellier (French-Swiss)-School, which was developed by Braun-Blanquet (1964). The basic syntaxonomic unit is the plant association or plant community. A plant community is characterized by its floristic composition. Some species, the so-called faithful or characteristic species, show a distinct preference for a particular vegetation unit, whereas other species, with a wider ecological range, occur in a larger number of vegetation types. Thus, a plant community consists of species which have a preference for that vegetation type and of other species which are either "neutral" or which may even have a preference for other vegetation types.

Syntaxonomically related plant associations are grouped into alliances. In their turn alliances are united into orders and orders into classes. Each of these higher syntaxonomic units has one or more characteristic species. Thus, a characteristic species of an alliance has a greater preference for the plant communities of that particular alliance than for other plant communities.

As for the names of the syntaxonomic units, an association is indicated with the suffix *-etum* behind the root of the generic name of the plant chosen as an index species, this being followed by the specific name in the genitive, e.g. Puccinellietum maritimae after *Puccinellia maritima*. In case an association is named after two species, the root of the generic name of the first species gets the suffix *-o*, e.g. Scirpo-Phragmitetum. Alliances, orders, and classes are indicated with the suffix *-ion*, *-etalia*, and *-etea* respectively (Arrhenatherion elatioris, Sisymbrietalia, Potametea).

In reconstructing the vegetation from the kind of data available in this study – in the case that the samples consist of material of heterogeneous origin – species which show a distinct preference for a particular vegetation type are most useful. Besides, other species which are common in the vegetation types suggested by the characteristic species are very helpful, as they confirm the conclusions to some extent. The presence of a plant community or of a higher syntaxonomic unit is generally only concluded if a larger number of species which are characteristic of or/and common in that particular vegetation unit is represented in the settlement site in question. However. sometimes the indications for a certain vegetation type are confined to very few species. The present author is aware of the fact that many uncertainties are involved in a reconstruction of the vegetation in earlier times on the ground of sometimes rather fragmentary data and that not everybody will agree with the conclusions presented in this paper. As all the data are published in chapter 2, the reader is enabled to make other reconstructions.

For the reconstruction of the vegetation, the work of Westhoff & Den Held (1969) on plant communities in the Netherlands and their classification is indispensable. Without this modern and critical survey of the vegetation units, the present author would have arrived at many more unjustified conclusions than he has. Further, the publication of Beeftink (1965) on salt marsh vegetations in the southwest of the Netherlands and that of Gillner (1960) on halophytic vegetations in southwestern Sweden proved to be very useful in interpreting the palaeobotanical data from sites in the former salt marsh area. Moreover, the conclusions arrived at by Körber-Grohne (1967) for the Feddersen Wierde have been fully utilized as will be clear, among other things, from the discussion on the Juncetum gerardii (4.2.1.1.).

At the top of tables 22 to 31 the syntaxonomic units are indicated which have been deduced for that particular site. A plus sign shows whether at present the species at the left side of the table is found in the syntaxonomic unit concerned. From these tables it is also clear that many species are found in more than one of the postulated syntaxonomic units. It should be mentioned that perhaps more of the species represented in a particular site occur in one of the vegetation types demonstrated for that site than is indicated in the table concerned. In this the present author has not aimed at perfection. The main objective consisted in the determining of the vegetational units which were present at the time.

First the vegetations which could be demonstrated for the sites from a brackish environment (Ouddorp, Den Helder, Sneek, Tritsum, Tzummarum, Leeuwarden, Ezinge, Paddepoel) will be discussed. This discussion will be followed by some additional remarks on the vegetation in the vicinity of some of these sites. Thereafter, the vegetation arrived at for Vlaardingen and Schiedam, both sites from a freshwater environment, will come up for discussion. It is true that in this way some duplication cannot be avoided, but a joint discussion of the sites from two different environments would sometimes be rather confusing.

4.2. *THE SITES FROM BRACKISH ENVIRONMENT*

4.2.1. THE VEGETATION TYPES

4.2.1.1. *Juncetum gerardii*

A fairly large number of species which are shown in tables 22 to 29 occurs in the Juncetum gerardii. This halophytic plant community is found on the higher parts of the salt marshes, in the zone between 0.1-0.2 m below mean spring-tide level and storm-flood level. The larger part of this zone is inundated by the sea only during very high floods, once or a few times per year. Species which are characteristic of or common in the Juncetum gerardii include *Juncus gerardii*, *Festuca rubra*, *Triglochin maritima*, *Glaux maritima*, *Odontites verna*, *Armeria maritima*, and *Plantago maritima*. It must have been in the areas covered by the Juncetum gerardii that man settled in the former salt marshes along the Dutch coast. At present, after the construction of the dikes, the zone of the Juncetum gerardii is mostly only a narrow strip, but one may assume that originally in the coastal area this vegetation type covered a zone several kilometres wide. This environment must have been attractive for habitation because of its nearly unlimited potentialities for grazing.

For the Juncetum gerardii in the vicinity of the Feddersen Wierde Körber-Grohne (1967, pp. 72-75) could demonstrate three different types or subassociations. This was made possible by the analysis of so-called pure samples ("reine Proben"). Körber-Grohne claims that it is difficult, if not impossible, to obtain satisfactory information on former vegetation types from vegetal debris in which remains from various plant communities are represented. For that reason she looked for vegetal debris which would have originated from only one vegetation type. This material should not have been mixed with plant remains from other places, which would have happened e.g. if it was brought to the byre either as cattle fodder or as litter. Körber-Grohne was able to select layers or patches of vegetal debris which could be considered as "pure", in other words the plant remains in those places had originated from one plant community. This does, of course, not imply that all species from the vegetation type concerned are represented. Moreover, one cannot exclude the possibility that these layers do contain small numbers of seeds and fruits which originally were not present in this material. However, by far the majority of the macroscopic plant remains is of primary origin.

Two major kinds of plant remains which would have originated from one vegetation type are distinguished by Körber-Grohne for the Feddersen Wierde. One type was largely made up of the fine stems of *Juncus gerardii*. The other type consisted for the larger part of the rather broad stems of *Phragmites* and/or *Scirpus maritimus.* As for the *Juncus gerardii* stem layers, not infrequently fruited inflorescences of *Potentilla anserina* and *Eleocharis* and flowers of *Trifolium repens* were present in larger numbers, indicating that Juncetum gerardii vegetations occurred in which these species were quite common.

One of the three types of Juncetum gerardii vegetations established by Körber-Grohne for the Feddersen Wierde is poor in species. This type corresponds with the present-day subassociation "typicum" of the Juncetum gerardii (Westhoff & Den Held 1969, p. 172). Another type, in which, among others, *Leontodon autumnalis*, *Trifolium repens*, *Poa pratensis/trivialis*, *Bromus mollis*, and *Potentilla anserina* occur, has its modern analogue in the subassociation "leontodontetosum autumnalis" of the Juncetum gerardii (Westhoff & Den Held 1969, p. 172). This subassociation has been described by Gillner (1960, pp. 52-53) for southwestern Sweden and by Tüxen *et al.* (1957, p. 214) for the islet of Neuwerk, northwest of Cuxhaven. The Juncetum gerardii subass. leontodontetosum autumnalis would have been induced by grazing (Gillner 1960). Besides, this vegetation type would also occur without grazing pressure, in areas with a lower salinity of the flood water (as a result of mixing with water from rivers) and in places on the salt marshes with fresh seepage water (Beeftink 1965, p. 107). In tables 22 to 29 the species which would be indicative of this subassociation are framed by a broken line. These species occur otherwise in grassland vegetations of the Arrhenatherion elatioris and in Agropyro-Rumicion crispi vegetations.

A third subassociation of the Juncetum gerardii is characterized by the presence of *Eleocharis palustris* ssp. *uniglumis*, *Oenanthe lachenalii*, *Ranunculus sardous*, *Carex disticha*, *Juncus articulatus*, and a few other species. This vegetation type would have been present in those places in the salt marshes where fresh water could accumulate. During the larger part of the year these places would have been wet with a low salt content. Only after periods of prolonged dryness would the salinity of these places have increased considerably. For this subassociation "eleocharitetosum" no modern counterpart has been described so far. For a discussion of vegetation types which show some resemblance to the Juncetum gerardii subass. eleocharitetosum the reader is referred to Körber-Grohne (1967, pp. 111-112). The absence of a modern analogue for this subassociation may be caused by the fact that at present the Juncetum gerardii is confined to rather small areas which show less variation in local topography than the extensive areas which were formerly covered by this plant association. In tables 22 to 29 the species which distinguish this subassociation from the other Juncetum gerardii vegetations are framed by a solid line.

TABLE 32. Differential species of the subass. leontodontetosum autumnalis of the Juncetum gerardii. The presence of a species in a particular site is indicated by two figures, viz. the percentage group and the sample frequency. For Ezinge and Leeuwarden only the percentage group is given

	Tritsum	Paddepoel	Ouddorp	Tzummarum	Sneek	Leeuwarden	Den Helder	Ezinge
Number of samples	*16*	*10*	*7*	*6*	*4*	*2*	*6*	*2*
Number of species	*103*	*109*	*90*	*55*	*60*	*71*	*73*	*48*
Leontodon autumnalis	2 63	3 90	1 57	2 83	1 50	—	1 33	—
Potentilla anserina	2 63	2 90	2 57	1 67	1 100	1	—	—
Poa pratensis/trivialis	1 75	2 90	2 71	1 50	1 100	2	1 67	—
Rumex crispus	2 38	1 80	—	1 17	1 75	1	—	2
Bromus mollis/secalinus	1 38	1 60	1 14	1 33	—	1	1 33	1
Cerastium holosteoides	2 13	1 40	1 14	—	1 25	1	1 17	—
Taraxacum spec.	1 6	1 50	1 14	—	—	—	—	—
Trifolium repens	4 6	1 80	—	1 17	—	—	—	—
Lolium perenne	1 44	1 50	—	—	—	—	—	—
Trifolium pratense	2 13	—	—	—	—	—	—	—
Potentilla reptans	—	—	2 29	—	—	—	—	—

As for the Juncetum gerardii subass. leontodontetosum autumnalis, in table 32 it is indicated which of the species considered to be indicative of this subassociation (the so-called differential species) are represented in the various sites. In tables 32 to 35, the presence of a species in a particular site is usually indicated by two figures, viz. the percentage group and the sample frequency. For Ezinge and Leeuwarden only the percentage group is given. The sample frequencies and the percentage groups provide information on the relative importance of the species concerned. In evaluating table 32, and the same is *mutatis mutandis* true for tables 33, 34, and 35, one should take into consideration that the numbers of species which have been demonstrated for each site vary quite considerably. It is self-evident that, at least to a certain extent, more species which are indicative of a particular vegetation type can be expected in sites for which a larger number of species has been ascertained than in sites which are poorer in species, often as a result of a smaller number of samples.

From table 32 it is clear that differential species of this subassociation are well represented in Tritsum and Paddepoel. The fruits of *Leontodon autumnalis*, *Potentilla anserina*, *Poa pratensis/trivialis*, and *Rumex crispus* are quite frequent in these sites. Further, near Ouddorp, Tzummarum, and Sneek this subassociation would have covered larger areas. On the other hand, the botanical evidence

TABLE 33. Differential species of the subass. eleocharitetosum of the Juncetum gerardii

	Paddepoel	Ouddorp	Tritsum	Leeuwarden	Den Helder	Sneek	Tzummarum	Ezinge
Number of samples	*10*	*7*	*16*	*2*	*6*	*4*	*6*	*2*
Number of species	*109*	*90*	*103*	*71*	*73*	*60*	*55*	*48*
Eleocharis uniglumis/palustris	3 90	3 100	1 6	1	1 33	1 100	—	—
Oenanthe lachenalii	1 70	1 43	2 63	2	1 17	1 100	1 67	2
Juncus articulatus	3 90	3 86	—	2	2 33	1 100	—	—
Ranunculus sardous	1 40	2 100	2 38	—	—	—	1 67	—
Alopecurus geniculatus	2 100	2 43	2 19	1	—	1 25	—	—
Prunella vulgaris	1 70	1 43	1 6	—	1 33	—	—	—
Carex disticha	1 50	2 43	—	—	—	—	—	—
Carex serotina-type	1 70	2 14	—	—	1 17	—	—	—
Medicago lupulina	1 20	—	2 38	1	—	—	—	—
Ranunculus repens	1 60	2 43	1 13	1	—	—	—	—
Centunculus minimus	2 30	—	—	—	—	—	—	—
Hydrocotyle vulgaris	—	1 29	—	1	—	—	—	—

suggests that in the vicinity of Het Torp near Den Helder grazing was apparently of less importance. The fruits of *Leontodon autumnalis* occur in only 2 of the 6 samples from Den Helder, while *Potentilla anserina* is completely absent. The subass. leontodontetosum autumnalis is likewise poorly represented in Ezinge, although it should be mentioned that Beijerinck (1929, table III) recovered one or a few fruits of *Potentilla anserina* from a layer which must be from about the same period as Ezinge A.

The representation of differential species of the subass. eleocharitetosum of the Juncetum gerardii in the various sites is shown in table 33. Mosses have not been included in this table because it is not certain that in the samples which were first examined proper attention was paid to this group of plant remains. This subassociation must have been common in the vicinity of Paddepoel (see also 4.2.2.1.). Seeds and fruits of *Eleocharis uniglumis/palustris*, *Oenanthe lachenalii*, *Alopecurus geniculatus*, and *Juncus articulatus* were found in the majority of the Paddepoel samples. Indicators of this vegetation type are also well represented in Ouddorp. On the other hand, this subassociation is poorly represented in Den Helder (low sample frequencies) and Tzummarum (no *Eleocharis*). Sneek, Tritsum and Leeuwarden hold an intermediate position in this respect.

4.2.1.2. *Puccinellietum maritimae*

Various species represented in the sites from the former salt marsh area are found in the Puccinellietum maritimae, the plant community of the lower parts of the salt marshes. The Puccinellietum maritimae belt, which is situated between mean high water level and a little below spring-tide level, is flooded by the sea quite regularly, though usually for a short time. In table 34 it is indicated for which of the Puccinellietum maritimae species seeds or fruits have been recovered from the various sites. Two groups of species are distinguished here. The upper five species are characteristic of or have their optimum in the Puccinellietum maritimae. This with the exception of *Salicornia europaea*, which is the dominant species of the Salicornietum strictae. However, it is not likely that the Salicornietum strictae, the vegetation of the higher parts of the mud flats, within the daily range of the tidal movements, would have covered larger areas in the immediate vicinity of thc settlement sites. The lower five species are either equally common of even dominant in other halophytic plant communities (*Juncus gerardii*!).

The Puccinellietum maritimae is hardly represented in Paddepoel and Ouddorp. Apparently these sites were situated at a fairly large distance from the coast line, and the Puccinellietum maritimae probably did not occur in their immediate vicinity. On the other hand, table 34 suggests that particularly in the vicinity of Het Torp near Den Helder the Puccinellietum maritimae must have been rather common. The macrofossil evidence indicates that this plant community would have also been found near Tritsum, Tzummarum, and Leeuwarden, but there it would not have been a quantitatively important vegetation type. As for Tritsum, see also 4.2.2.3.

4.2.1.3. *Puccinellietum distantis*

The seeds and fruits recovered from the *terp* samples also point to the presence of a halophytic vegetation which thanks its origin to the activity of man: the Puccinellietum distantis. This is a plant community from a brackish environment which occurs in places where sods have been cut or which are frequently trodden by man and animals. Characteristic of this association are *Spergularia marina* and *Puccinellia distans.* Other species found in this vegetation type include *Polygonum aviculare*, *Plantago major*, *Poa annua*, *Juncus bufonius*, and *Atriplex hastata/patula.* Table 35 shows that this vegetation type is well represented in the settlement sites from the former salt marsh area. This is in itself not strange, as in the vicinity of habitation sites more or less heavily trodden places would always have been present, while sods were regularly cut for the construction of house walls and for other purposes.

TABLE 34. PUCCINELLIETUM MARITIMAE

	Den Helder	Tritsum	Tzummarum	Leeuwarden	Ezinge	Sneek	Paddepoel	Ouddorp
Number of samples	*6*	*16*	*6*	*2*	*2*	*4*	*10*	*7*
Number of species	*73*	*103*	*55*	*71*	*48*	*60*	*109*	*90*
Puccinellia maritima	2 83	1 31	—	1	—	—	—	—
Parapholis strigosa	1 17	1 6	1 17	—	—	—	—	—
Limonium vulgare	2 83	2 25	1 50	2	4	—	—	—
Spergularia media-type	4 100	1 19	1 67	1	1	1 25	1 10	—
Salicornia europaea	3 83	2 31	3 83	3	2	1 50	—	1 29
Plantago maritima	3 83	2 56	1 83	1	1	—	1 30	—
Triglochin maritima	4 83	3 75	3 100	2	2	1 100	2 90	3 86
Suaeda maritima	2 100	2 31	2 83	1	2	1 50	1 10	1 43
Juncus gerardii	6 100	5 94	6 100	7	7	6 100	6 100	6 100
Aster tripolium	1 50	1 56	1 67	1	1	2 75	1 40	2 57

TABLE 35. PUCCINELLIETUM DISTANTIS

	Paddepoel	Tritsum	Sneek	Tzummarum	Ouddorp	Den Helder	Leeuwarden	Ezinge
Number of samples	*10*	*16*	*4*	*6*	*7*	*6*	*2*	*3*
Number of species	*109*	*103*	*60*	*55*	*90*	*73*	*71*	*48*
Puccinellia distans	2 80	2 81	1 25	2 50	2 29	2 83	1	1
Spergularia marina-type	3 70	1 31	1 75	2 100	3 43	4 100	2	2
Polygonum aviculare	1 90	2 75	1 25	1 67	2 57	2 83	1	1
Plantago major	3 100	4 88	2 100	2 83	2 57	1 33	2	3
Juncus bufonius	3 100	1 6	2 100	3 33	4 100	2 50	5	—
Poa annua	1 50	1 13	1 50	1 33	3 14	—	—	—
Capsella bursa-pastoris	1 20	1 31	1 50	—	1 14	1 17	—	—
Atriplex hastata/patula	4 100	4 94	3 100	5 100	2 100	4 100	2	5
Atriplex littoralis-type	1 30	1 44	1 75	1 33	—	—	1	1
Aster tripolium	1 40	1 56	2 75	1 67	2 57	1 50	1	1
Suaeda maritima	1 10	2 31	1 50	2 83	1 43	2 100	1	2
Juncus gerardii	6 100	5 94	6 100	6 100	6 100	6 100	7	7
Agrostis spec.	3 100	3 88	4 100	3 100	2 57	4 100	4	4
Potentilla anserina	2 90	2 63	1 100	1 67	2 57	—	1	—
Elytrigia repens/pungens	1 30	2 44	1 25	1 33	—	—	1	2
Lolium perenne	1 50	1 44	—	—	—	—	—	—
Triglochin palustris	1 10	—	—	—	—	—	—	—

4.2.1.4. *Drift communities*

A small number of species represented in the sites from a brackish environment occurs in the tidal drift communities of the Thero-Suaedetalia. These species are: *Suaeda maritima*, *Atriplex hastata/putala*, *Atriplex littoralis*, and *Matricaria maritima* ssp. *inodora*. However, these species are also found in other vegetation types, so that indications for the presence of Thero-Suaedetalia communities in the vicinity of the sites are not particularly strong.

Apium graveolens is represented only in Ezinge and Leeuwarden. This species is particularly encountered in vegetations of the Angelicion litoralis, which alliance includes nitrophilous plant communities on drift deposits in a mesohalinic environment. Other species which occur in Angelicion litoralis communities and which are represented in Ezinge and Leeuwarden, are *Althaea officinalis*, *Oenanthe lachenalii*, and *Scirpus maritimus*. These species are likewise represented in other sites, but because of the absence of *Apium graveolens* the Angelicion litoralis has not been postulated for those sites.

4.2.1.5. *Aquatic communities*

The few fruits of *Ruppia maritima* and *Zannichellia palustris* ssp. *pedicellata*, which were found in Paddepoel and Ouddorp, are indicative of the Ruppion maritimae. This vegetation type occurs in polyhalinic to oligohalinic water with only slight fluctuations in the water level and little current (Westhoff & Den Held 1969, p. 47). In the vicinity of Ouddorp and Paddepoel the Ruppion maritimae would probably have grown in ditches which became filled with salt water during exceptionally high floods.

Pondweed vegetations (Potametea) are hardly represented in the subfossil plant remains. *Potamogeton pectinatus* and *Potamogeton pusillus* are both found in oligohalinic water. *Myriophyllum spicatum*, a scale leaf fragment of which was encountered in Paddepoel, is a characteristic species of the Potametea. The macrofossil evidence suggests that pondweed vegetations were only fragmentarily developed in the vicinity of the sites.

Although the Eleocharito-Hippuridetum is more a marsh vegetation than an aquatic plant community, it will be mentioned here. Just as for the syntaxonomic units mentioned above, indications for the presence of the Eleocharito-Hippuridetum, which occurs in brackish ditches with a strongly fluctuating water level, are not particularly strong. As a matter of fact, only *Hippuris vulgaris*, which is represented in Tritsum, Paddepoel, and Ouddorp, would be indicative of this vegetation type, *Eleocharis palustris* ssp. *uniglumis* being common also in other vegetations from a brackish environment.

4.2.1.6. *Marsh vegetations*

In all sites from the former salt marsh area species which form part of the Scirpetum maritimi are represented. Characteristic species of the Scirpetum maritimi are *Scirpus maritimus* and *Scirpus lacustris* ssp. *glaucus*. Other species which occur in this plant community include *Phragmites australis* and *Carex otrubae*. This vegetation type, which is generally poor in species, is particularly found in ditches and along streams with brackish water. One must assume that in the vicinity of the sites from a brackish environment conditions must have been favourable for the Scirpetum maritimi, altough the low numbers of *Scirpus maritimus* fruits in Den Helder and Tzummarum would indicate that there this plant association did not play an important part.

In addition to the Scirpetum maritimi, the Scirpo-Phragmitetum is represented in all the sites from the former salt marsh area. At first sight the presence of this plant community, which is a marsh vegetation from a freshwater environment, is somewhat strange. It is true that some Scirpo-Phragmitetum species, such as *Phragmites australis*, *Carex otrubae*, and *Carex vesicaria*, tolerate some salt, but various other species, such as *Lycopus europaeus*, *Sium erectum*, *Lythrum salicaria*, and *Galium palustre*, are confined to a freshwater environment. Where would these latter species have found suitable habitats? In this connection the following should be remarked.

In the brackish environment of the coastal area the drinking-water supply for man as well as for animals would have required special measures. For fresh water one was completely dependent on precipitation. The rain water would have been stored in ditches and ponds on the *terps*. In *terp* excavations these former fresh water reservoirs could be demonstrated. Along these ditches and ponds on the habitation mounds Scirpo-Phragmitetum species could have occurred. The moss species *Calliergonella cuspidata* could also have grown there. As suitable habitats for the Scirpo-Phragmitetum would have been confined to narrow zones it is likely that this plant association was only fragmentarily developed on the *terps*.

4.2.1.7. *Arrhenatherion elatioris*

Seeds and fruits of fairly large numbers of Arrhenatherion species have been recovered. Grassland vegetations of the Arrhenatherion elatoris are found in a freshwater environment. However, most of the Arrhenatherion species represented in the sites from the former salt marsh area occur also in Juncetum gerardii vegetations. Consequently, from the presence of Arrhenatherion species it may not yet be concluded that vegetations of this alliance would have been of importance on or near the sites in question. On the contrary, it is likely that at most only fragments of Arrhenatherion vegetations would have been present.

4.2.1.8. *Agropyro-Rumicion crispi*

Various plants are represented which are characteristic of or common in vegetations of the Agropyro-Rumicion crispi. This group of species includes *Potentilla anserina*, *Ranunculus repens*, *Leontodon autumnalis*, *Elytrigia repens*, *Carex otrubae*, *Rumex crispus*, *Juncus effusus*, *Juncus articulatus*, *Carex disticha*, and *Alopecurus geniculatus*. The plant communities of the Agropyro-Rumicion crispi occur in relatively unstable habitats of transitional zones from dry to wet, from eutrophic to oligotrophic, and from fresh to saline conditions. They can be natural as well as synanthropic. In consequence of the increasing interference of man with his environment Agropyro-Rumicion crispi associations become more and more common. In spite of this, Agropyro-Rumicion crispi vegetations are still insufficiently studied (Westhoff & Den Held 1969, pp, 107-109). Some of the associations mentioned in Westhoff & Den Held are of preliminary character, while it cannot yet be determined how many associations of this alliance can be distinguished for the Netherlands.

There can be little doubt that Agropyro-Rumicion crispi vegetations occurred in the vicinity of the prehistoric and early-historic sites in the coastal area of the Netherlands. However, from the above it will be clear that it makes no sense to try to determine which associations of this alliance may have been present in earlier times. In the first place this alliance should be investigated more thoroughly, and, moreover, it is not unlikely that for Agropyro-Rumicion crispi vegetations which were due to moderate human influence no modern analogues exist.

4.2.1.9. *Ruderal vegetations*

This category includes vegetations from places which are rich in nitrates in consequence of the interference of man and/or domestic animals.

Polygonum lapathifolium, *Ranunculus sceleratus*, *Rumex maritimus*, and *Bidens tripartitus* point to the presence of Bidention vegetations. These vegetations occur in wet to moist habitats with a high nitrate content. Such habitats would have been present in the settlement, for instance in ditches in the immediate vicinity of houses, as well as outside it, near places where domestic animals were usually driven together. Although Bidention vegetations occur also in natural habitats, for instance in places along rivers where organic matter has been deposited during high water, it is likely that in and near the coastal settlement sites they were due to the activity of man.

A fairly large number of species which could be demonstrated for the sites from the former salt marsh area is found in Sisymbrietalia vegetations. The order of the Sisymbrietalia has various species in common with that of the Polygono-Chenopodietalia (see below); both orders belong to the class of the

Chenopodietea. It is likely that of the Sisymbrietalia associations, the Chenopodio-Urticetum urentis was well developed in the coastal sites. Characteristic species of this plant community, which is found on muck-heaps and in other ammonia-rich habitats, are *Urtica urens* and *Chenopodium ficifolium.* Other species which are common in this vegetation type include *Atriplex hastata*, *Atriplex patula*, *Chenopodium rubrum*, and *Chenopodium album.*

Sissingh (1950, p. 127, fig. 12) assumes that the Chenopodio-Urticetum urentis, which has a southern Atlantic distribution, reaches its northern limit in the Netherlands. This may be true for the present time, but the frequent occurrence of *Chenopodium ficifolium* seeds in the settlement remains suggests that at least up to Early-Medieval times (Tzummarum) the Chenopodio-Urticetum urentis was common in this area. Further, *Chenopodium ficifolium* is represented by larger numbers of seeds in the Feddersen Wierde, although at present this species is rare in northwestern Germany (Körber-Grohne 1967, p. 271). The palaeobotanical evidence suggests that at the time this species was much more common in the north of the Netherlands and in northwestern Germany than at present. This could either point to somewhat higher temperatures – *Chenopodium ficifolium* is a thermophilous, Mediterranean-continental species – or to more suitable edaphic conditions in earlier times.

Another vegetation from dung-hills which might have been found in the settlement sites is the Chenopodietum glauco-rubri. This association includes *Chenopodium rubrum*, *Chenopodium glaucum*, *Chenopodium album*, *Atriplex patula*, *Poa annua*, *Capsella bursa-pastoris*, and *Solanum nigrum.* These species are represented in the sites examined, sometimes by larger numbers of seeds.

For Tritsum and Ouddorp a somewhat larger number of Artemisietalia vulgaris species could be demonstrated: *Arctium pubens*, *Cirsium vulgare*, *Carduus crispus*, *Conium maculatum*, *Aethusa cynapium*, *Rumex obstusifolius*, *Urtica dioica.* This suggests that in and near Tritsum and Ouddorp, Artemisietalia vegetations, which are found along roads and fields, in the vicinity of farms, and near dung-hills, were of some importance. Of the Artemisietalia species only *Urtica dioica* is fairly well represented in most of the sites, indicating that stinging nettle was common.

4.2.1.10. *Weed vegetations*

A larger number of species which would be demonstrated for the coastal sites is found in vegetations of the Polygono-Chenopodietalia. It has already been mentioned that the vegetations of this order have various species in common with those of the Sisymbrietalia. Species which show a distinct preference for Polygono-Chenopodietalia vegetations include *Thlaspi arvense*, *Anagallis arvensis*, *Polygonum persicaria*, *Erysimum cheiranthoides*, and *Sonchus arvensis.* The order of the Polygono-Chenopodietalia comprises weed associations of root-crops and summer cereals. It is, again, not possible to establish which associations occurred in the fields of the prehistoric farmers in the coastal area. It may even be questioned whether modern analogues of these earlier weed associations exist. One should not forget that in this region crop growing on saline soils has long been out of use, so that weed associations of the fields concerned are not known. Small-scale farming experiments in the salt marsh (see chapter 5) have shown that various halophytes, e.g. *Suaeda maritima*, *Glaux maritima*, *Salicornia europaea*, *Spergularia marina*, and *Spergularia media*, settle in the fields. In the weed associations of fields on brackish soil halophytes would have played a part.

Species which could point to the presence of weed associations of winter cereals, associations of the class of the Secalietea, are generally scarce or absent. Thus, for Tritsum only *Polygonum convolvulus* and *Sinapis arvensis* come into consideration. *Bromus secalinus* is also characteristic of Secalietea vegetations, but it was not determined whether the caryopses concerned are of *B. mollis* (Sisymbrietalia, Arrhenatherion elatioris) or of *B. secalinus.* Only Den Helder yielded a slightly larger number of Secalietea species (see 4.2.2.4.). No typical Secalietea species are represented in Sneek, Paddepoel, Ezinge, and Leeuwarden. It should be stressed that, again, no sharp line can be drawn between Secalietea and Polygono-Chenopodietalia species. Some of the species represented in the sites under discussion occur in fields of summer crops as well as in those of winter crops, e.g. *Spergula arvensis*, *Rumex acetosella*, and *Raphanus raphanistrum.* The palaeobotanical evidence suggests that except for Den Helder no winter crops were grown.

4.2.2. REMARKS ON THE VEGETATION OF A FEW SITES

4.2.2.1. *Paddepoel-Groningen* (tables 22, 36-38)

Fig. 2, which is largely after Van Es ((1968) 1970, fig. 1) shows the location of the sites Paddepoel I, II, and III, and their environment. The Paddepoel area is situated at the inner edge of the salt marshes. At a short distance from the Paddepoel sites the moraine ridge, called the Hondsrug, dips under the marine sediments. The Hondsrug is bordered by the valleys of the rivers Hunze and Aa, which unite somewhat to the north of the settlement. The course of the rivers on the map of fig. 2 is the possible situation during the first centuries A.D. (Van Es (1968) 1970, p. 193). The river valleys are filled with peat which also expanded to the east and the west of the valleys. In Roman times the border

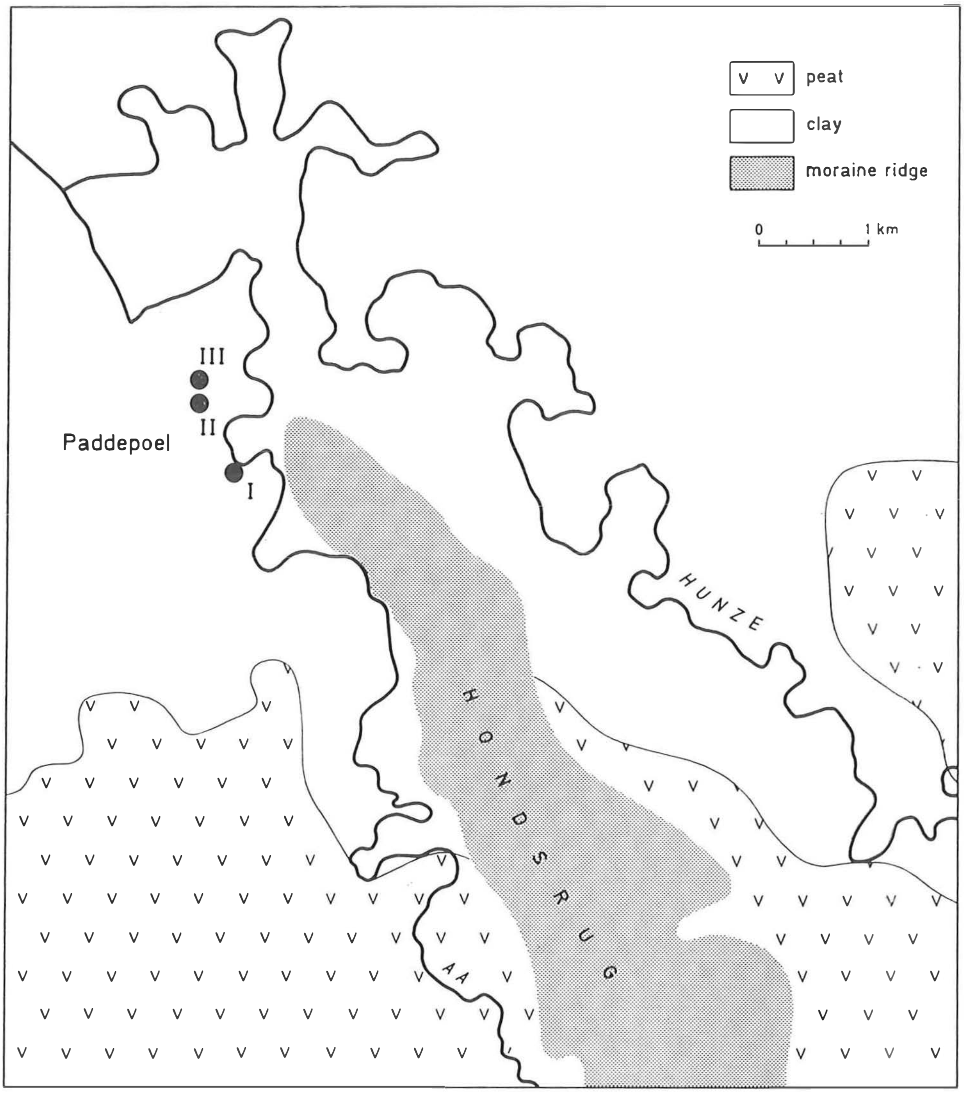

Fig. 2. The Paddepoel sites and their environment.

between clay and peat may have differed somewhat from that indicated on the map.

It is likely that the Paddepoel area formed a relatively low-lying region; at the inner edge of the salt marsh the clay of the Pre-Roman transgression, on which the sites were founded, would have been deposited to a less high level than more seaward. This situation would have caused predominantly wet conditions in this area. Moreover, the area would have been flooded with fresh water when the rivers Hunze and Aa overflowed their banks after periods of heavy rain. Consequently, the salt from an occasional flooding by the sea was diluted by rain water as well as by fresh water from the rivers. During the larger part of the year the water in the Paddepoel area would have been only slightly brackish. This situation, viz. wet, slightly brackish conditions, could explain why the Juncetum gerardii subass. eleocharitetosum was such a common vegetation type in the Paddepoel area. As has already been mentioned (4.2.1.1.), this vegetation type would have occurred in those places of the salt marshes where fresh water could accumulate.

TABLE 36. PADDEPOEL-GRONINGEN, DIFFERENTIAL SPECIES OF THE SUBASS ELEOCHARITETOSUM OF THE JUNCETUM GERARDII

	group I		*group II*	
Number of samples	*4*		*4*	
Number of species	*84+9*		*96+16*	
Carex disticha	—		1	100
Eleocharis uniglumis/palustris	4	75	3	100
Juncus articulatus	2	75	2	100
Oenanthe lachenalii	1	75	1	50
Ranunculus sardous	1	25	1	75
Centunculus minimus	—		1	25
Carex serotina-type	1	25	1	100
Alopecurus geniculatus	1	100	2	100
Medicago lupulina	1	25	1	25
Prunella vulgaris	1	50	1	75
Ranunculus repens	1	25	1	100
Calliergonella cuspidata	1	25	1	75
Leptodictyum kochii	—		1	25
Leptodictyum riparium	1	75	1	100

TABLE 37. PADDEPOEL-GRONINGEN, DIFFERENTIAL SPECIES OF THE SUBASS. LEONTODONTETOSUM AUTUMNALIS OF THE JUNCETUM GERARDII

	group I		*group II*	
Number of samples	*4*		*4*	
Number of species	*84+9*		*96+16*	
Leontodon autumnalis	3	75	2	100
Potentilla anserina	2	75	3	100
Lolium perenne	1	50	1	50
Poa pratensis/trivialis	2	75	3	100
Rumex crispus	1	75	1	100
Trifolium repens	1	75	1	100
Bromus mollis/secalinus	1	50	1	75
Cerastium holosteoides	1	25	2	75
Taraxacum spec.	—		1	100

TABLE 38. PADDEPOEL-GRONINGEN, PUCCINELLIETUM DISTANTIS

	group I		group II	
Number of samples	4		4	
Number of species	84+9		96+16	
Puccinellia distans	2	100	1	100
Spergularia marina-type	4	100	1	50
Polygonum aviculare	1	75	1	100
Plantago major	3	100	2	100
Juncus bufonius	2	100	3	100
Poa annua	1	25	1	100
Capsella bursa-pastoris	1	25	1	25
Atriplex hastata/patula	4	100	2	100
Atriplex littoralis-type	1	50	1	25
Aster tripolium	1	75	—	
Suaeda maritima	1	25	—	
Juncus gerardii	6	100	6	100
Agrostis spec.	4	100	4	100
Potentilla anserina	2	75	3	100
Elytrigia repens/pungens	1	50	1	25
Lolium perenne	1	50	1	50
Triglochin palustris	1	25	—	

It has already been indicated that one should not simply assume that the vegetation did not change in the course of the habitation of the site concerned. As a slightly larger number of samples has been analysed for Paddepoel than for most of the other sites it has been attempted to establish whether in this case changes in the vegetation could be demonstrated. For this purpose two groups of samples are distinguished. Group I comprises samples 224, 246, 248, and 327, which are attributed to period 2 (sample 224 is from period 1 or from the beginning of period 2). The samples from group II (272, 274, 299, and 300) are from the beginning of period 3.

Tables 36 to 38 show the representation of a few series of species, which are indicative of particular vegetations, in both groups of samples. The presence of a species in one or more samples of the group concerned is, again, indicated by two figures, viz. the percentage group and the sample frequency. The mean percentages and the sample frequencies were determined in the way described in 4.1., but now only the samples from one group have been combined. For instance, the fruits of *Potentilla anserina* (table 1) were found in three of the four samples from group I. The sum of the percentages for this species in each of three samples amounts to 3.3%. The mean percentage is 1.1%, viz. 3.3% divided by 3. Thus, in group I *Potentilla anserina* belongs to percentage group 2 and has a sample frequency of 75. As for the total numbers of species represented in one group, the first figure indicates the number of flowering plants (Spermatophyta) and the second figure the number of mosses.

The differential species of the subass. eleocharitetosum of the Juncetum gerardii are shown in table 36. The most marked difference between the two groups is the absence of *Carex disticha* in group I. However, it would be premature to conclude that *Carex disticha* did not settle here until at a later stage of habitation, since in sample 124 from period 1 this sedge species does occur. The much better representation of *Carex serotina*-type in group II could point to an increase of the species concerned in the later stages of habitation but, on the other hand, this fruit type was recovered from samples IIA and 124, both from period 1, suggesting that this sedge was already common at an early stage of habitation. Both examples are a warning to be cautious in drawing conclusions on the ground of small numbers of samples. Accidental factors would certainly have played an important part. Although on an average the differential species of the subass. eleocharitetosum are somewhat better represented in group II than in group I, it is probably not justified to conclude that in the later stages of habitation this vegetation type expanded.

The data from table 37 (differential species of the subass. leontodontetosum autumnalis of the Juncetum gerardii) would suggest a slight increase in grazing intensity, but again the differences between both groups of samples are rather small. Moreover, in comparing the data for both groups one should take into consideration that in sample 327 (group I) only 20 species are represented, whereas in the other samples this number varies from 48 to 79.

As for the Puccinellietum distantis (table 38), the halophyte *Spergularia marina* is considerably better represented in group I than in group II. However, *Puccinellia distans* and various other species which are common in this vegetation type, such as *Polygonum aviculare*, *Plantago major*, *Juncus bufonius*, and *Potentilla anserina*, do not show the same tendency. Consequently, the relative importance of this vegetation type in the vicinity of the site would not have decreased, but it is possible that *Spergularia marina* became less common in the later stages of habitation. This decline in *Spergularia marina* and the fact that *Aster tripolium* and *Suaeda maritima* are no longer represented in group II could point to a decreased salinity.

In summary, one may remark that a comparison between both groups of samples seems to point to small changes in the vegetation. On the other hand, it should be stressed that the differences between both groups are fairly small, so that one may wonder whether it is justified to conclude that there were changes in the vegetation, particularly because each group consists of only a few samples.

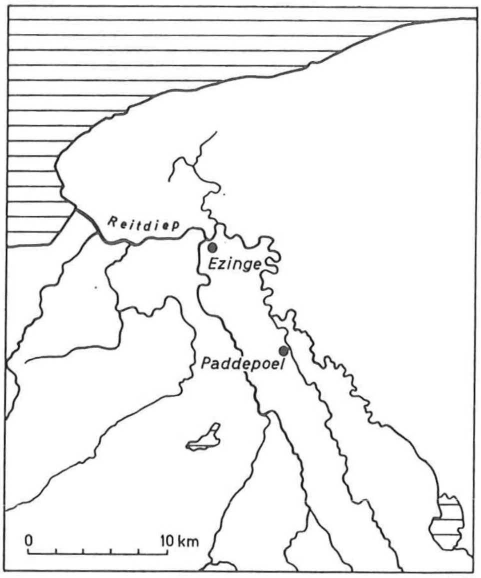

Fig. 3. The location of Ezinge.

4.2.2.2. *Ezinge* (table 23)

The terp of Ezinge is situated along the Reitdiep, the continuation of the rivers Hunze and Aa which join somewhat to the north of the Paddepoel sites (fig. 3). The palaeobotanical information for Ezinge, which is based on the analysis of only two samples (table 2), is supplemented by the results of Beijerinck (1929). This author examined 58 samples from Ezinge, 27 of which constitute a continuous series taken from a vertical section. Altogether Beijerinck (1929, tables II and III) recovered 43 different types of seeds, fruits, and flowers from these samples.

Of the species which are considered to be indicative of the subass. eleocharitetosum of the Juncetum gerardii, only *Oenanthe lachenalii* is represented. Other differential species of this subassociation, such as *Eleocharis palustris* ssp. *uniglumis*, *Juncus articulatus*, *Ranunculus sardous*, and *Alopecurus geniculatus*, were not encountered in the samples from table 2. Beijerinck does report *Eleocharis palustris* for Ezinge, but this species was not recovered from samples from the vertical section, so that it was certainly not a quantitatively important plant in the vicinity of the site. As *Oenanthe lachenalii* could also have occurred in an Angelicion litoralis vegetation (see below), one must assume that the *Eleocharis* variant of the mud rush vegetation was not or hardly found in the Ezinge area. This would imply that, in contrast to the situation at Paddepoel, wet places with predominantly slightly brackish water were not present in the vicinity of Ezinge.

Of the differential species of the subass. leontodontetosum autumnalis of the Juncetum gerardii, only *Rumex crispus* and *Bromus mollis/secalinus* could be demonstrated for Ezinge by the present author. However, *Leontodon autumnalis* and *Potentilla anserina* are recorded by Beijerinck. Consequently, various indicators of grazing of salt marsh vegetations are found in Ezinge, but the rather meagre representation of these species is somewhat strange, for the farm-houses which came to light at the excavations by Van Giffen (1936, 1940) point unmistakably to stock-breeding.

The Puccinellietum distantis is fairly well represented at Ezinge. In addition to *Puccinellia distans* and *Spergularia marina*, both characteristic species of this plant community, *Polygonum aviculare*, *Plantago major*, and *Atriplex* could be demonstrated.

The combination of *Apium graveolens*, *Althaea officinalis*, and *Oenanthe lachenalii* suggests the presence of an Angelicion litoralis vegetation, which could have occurred along the river, in places where organic material was deposited during high water. It must be admitted that the assumption of the Angelicion litoralis in the vicinity of Ezinge is weakened by the fact that *Apium graveolens* was only found in Ezinge B and *Althaea officinalis* only in Ezinge A. The evidence for the occurrence of the Angelicion litoralis near the Leeuwarden site is much better. In this case *Apium*, *Althaea*, and *Oenanthe lachenalii* are represented in both samples (table 4).

It is very striking that all the moss species which could be demonstrated for Ezinge grow on trees. These mosses would have arrived in the site on tree trunks which were imported from the higher sandy areas to the south for the construction of houses and other buildings.

4.2.2.3. *Tritsum* (tables 26, 39-43)

The settlement of Tritsum was founded along a broad gully (cf. Veenenbos 1949, fig. 1). It has already been mentioned that the habitation started about 500 B.C. and that the accumulation continued up to about 200 A.D. Eight major phases of habitation could be established. Also for Tritsum the results of a few groups of samples will be compared with each other. The samples from group I (3266, 2998, 2763, 3234, 3013) are from periods 1 and 2; group II comprises samples 2981, 2986, 2988, 2994, and 3094 from period 3; the samples from group III (1141, 1264, 2762, 1541) originate from periods 7 and 8. The successive periods of habitation have not yet been dated accurately, but one may assume that the samples from groups II and III differ in age by several centuries.

In comparing the results for the three groups, one should take into consideration that in sample 1141 (group III) a much larger number of species is

TABLE 39. TRITSUM, PUCCINELLIETUM MARITIMAE

	group I		group II		group III	
Number of samples	5		5		4	
Number of species	54		60		85	
Puccinellia maritima	1	40	1	20	—	
Limonium vulgare	3	60	1	20	—	
Salicornia europaea	2	80	—		1	25
Spergularia media-type	1	40	1	20	—	
Plantago maritima	2	80	1	60	2	25
Triglochin maritima	2	80	4	100	4	25
Suaeda maritima	1	40	2	20	1	25
Juncus gerardii	6	100	5	100	5	75
Aster tripolium	2	60	1	80	1	50

TABLE 40. TRITSUM, DIFFERENTIAL SPECIES OF THE SUBASS. ELEOCHARITETOSUM OF THE JUNCETUM GERARDII

	group I		group II		group III	
Number of samples	5		5		4	
Number of species	54		60		85	
Eleocharis uniglumis/palustris	—		—		1	25
Oenanthe lachenalii	2	80	2	80	1	25
Ranunculus sardous	1	20	1	20	2	75
Alopecurus geniculatus	1	20	2	20	2	25
Medicago lupulina	1	20	2	60	1	25
Ranunculus repens	—		1	20	1	25
Prunella vulgaris	—		—		1	25

TABLE 41. TRITSUM, DIFFERENTIAL SPECIES OF THE SUBASS. LEONTODONTETOSUM AUTUMNALIS OF THE JUNCETUM GERARDII

	group I		group II		group III	
Number of samples	5		5		4	
Number of species	54		60		85	
Leontodon autumnalis	2	60	2	80	2	50
Poa pratensis/trivialis	2	40	3	100	3	100
Potentilla anserina	2	40	2	100	1	50
Rumex crispus	1	20	1	20	2	75
Lolium perenne	1	60	2	60	—	
Cerastium holosteoides	1	20	—		2	25
Bromus mollis/secalinus	—		2	60	1	75
Trifolium pratense	—		2	20	1	25
Taraxacum spec.	—		1	20	—	
Trifolium repens	—		—		4	25

TABLE 42. TRITSUM, PUCCINELLIETUM DISTANTIS

	group I		group II		group III	
Number of samples	5		5		4	
Number of species	54		60		85	
Puccinellia distans	3	100	2	100	1	25
Spergularia marina-type	1	60	1	20	1	25
Polygonum aviculare	1	80	3	80	1	75
Plantago major	4	100	4	100	3	75
Juncus bufonius	—		—		1	25
Poa annua	—		—		1	50
Capsella bursa-pastoris	1	40	1	40	1	25
Atriplex hastata/patula	5	100	4	100	4	75
Atriplex littoralis-type	1	40	2	60	1	25
Aster tripolium	2	60	1	80	1	50
Suaeda maritima	1	40	2	20	1	25
Juncus gerardii	6	100	5	100	5	75
Agrostis spec.	3	100	2	60	4	100
Potentilla anserina	2	40	2	100	1	50
Elytrigia repens/pungens	—		1	60	1	50
Lolium perenne	1	60	2	60	—	

TABLE 43. TRITSUM, SCIRPO-PHRAGMITETUM

	group I		group II		group III	
Number of samples	5		5		4	
Number of species	54		60		85	
Alisma plantago-aquatica	—		—		1	25
Alopecurus geniculatus	1	20	2	20	2	25
Carex otrubae	1	20	—		3	75
Carex pseudocyperus	—		—		1	25
Carex rostrata/vesicaria	1	20	1	20	1	50
Eleocharis uniglumis/palustris	—		—		1	25
Galium palustre	—		—		1	25
Lycopus europaeus	—		—		1	50
Mentha aquatica/arvensis	1	20	—		1	25
Oenanthe aquatica	—		—		1	25
Oenanthe fistulosa	—		—		1	25
Phragmites australis	1	20	1	40	2	50
Sium erectum	—		—		2	25

represented than in the other Tritsum samples. Sample 1141 yielded 62 different types of seeds, fruits and other plant remains, whereas for the other samples this number varies from 14 to 43. This must, at least partly, be due to the fact that sample 1141, from the fill of a dwelling pit, was much larger than the other samples. Consequently, the total number of species represented in the four samples from group III is considerably larger than that in groups I and II, both consisting of five samples. The absence of *Juncus gerardii* in Tritsum 1541 may be due to a mistake.

The representation of the Puccinellietum maritimae in the three groups is shown in table 39. The upper four species have their optimum in this plant association, except *Salicornia europaea* (see 4.2.1.2.). The lower five species are concomitant species. The table suggests that the Puccinellietum maritimae would have been present in the Tritsum area at least during periods 1 to 3 (groups I and II), but that during the later stages of habitation (group III) this vegetation type was no longer found here. The disappearance of the Puccinellietum maritimae would indicate that in the first centuries A.D. areas flooded by the sea quite regularly no longer occurred in the vicinity of the mound, pointing to a decreased influence of the sea. As a result of silting up, the coast line would have moved farther away from the Tritsum area.

The decreased influence of the sea did not lead to an expansion of the subass. eleocharitetosum of the Juncetum gerardii (table 40). The presence of this vegetation type depended in the first place on the supply of fresh water (cf. Paddepoel) and this would not have increased.

There are no indications for an increase in grazing of the salt marshes in the final stages of habitation (table 41). The palaeobotanical data could at most point to a somewhat smaller grazing intensity in the periods 1 and 2 (group I), but, again, one should be cautious in drawing this kind of conclusion from the available evidence.

From table 42 it appears that *Puccinellia distans,* a characteristic species of the Puccinellietum distantis, is less well represented in group III than in groups I and II. However, the representation in group III of other species, which are more or less commonly found in the Puccinellietum distantis, does not point to a marked decline of this plant association. The quantitative composition of this vegetation type would have changed in the course of time; particularly the share of *Puccinellia distans* would have decreased.

It is striking that many Scirpo-Phragmitetum species are only represented in group III (table 43). However, it is questionable whether this would point to an increase of Scirpo-Phragmitetum vegetations in the later stages of habitation. Most of the Scirpo-Phragmitetum species which are only represented in group III are confined to a freshwater environment, which would have been found on the mound, in and along ditches and ponds. For that reason one could wonder as to how far the exclusive occurrence of seeds and fruits of these species in group III must be ascribed to the origin of the samples, in other words as to how far the samples from group III are from places near suitable habitats for these Scirpo-Phragmitetum species.

In summary, one must conclude that the quantitative palaeobotanical data

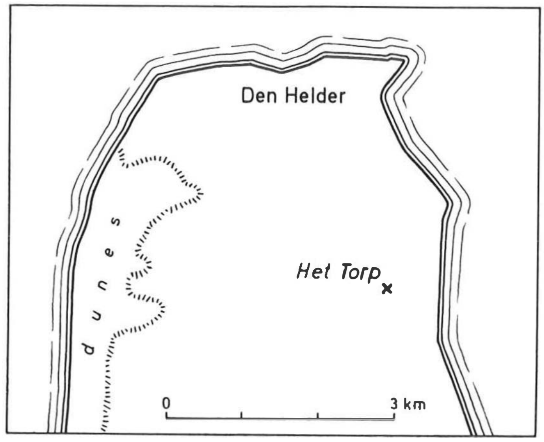

Fig. 4. The location of Het Torp.

from Tritsum point to some changes in the vegetation in the course of the habitation. This implies that in this case it is not wholly justified to combine all the samples as has been done for table 26.

4.2.2.4. *Den Helder-Het Torp* (table 28)

The reconstruction of the vegetation in the vicinity of Het Torp will also be discussed elsewhere (Van Zeist in press). Two main types of environment could be demonstrated for this site. The settlement itself was situated in the brackish environment of the salt marshes, whereas freshwater conditions were encountered in the dunes at some distance from the site (fig. 4).

The site was, again, founded in the area of the Juncetum gerardii, but the Puccinellietum maritimae is better represented than in any of the other sites from a brackish environment included in this study. Seeds and fruits of *Puccinellia maritima*, *Spergularia media*, *Limonium vulgare*, and *Salicornia europaea* were recovered from most of the samples, fairly often in larger numbers. The Puccinellietum maritimae must have been rather wide-spread in the immediate vicinity of Het Torp, implying that up to a short distance from the site the area was flooded by the sea quite regularly.

It is striking that species which would be indicative of grazing of salt marsh vegetations (table 32) are scarcely represented in the samples from Het Torp. Thus, only a few fruits of *Leontodon autumnalis* were found, while *Potentilla anserina* is completely absent. It is likely that grazing took place mainly in the dune area. The subass. eleocharitetosum of the Juncetum gerardii (table 33) would have been of little importance in the Den Helder area. At least *Eleocharis uniglumis/palustris* and *Oenanthe lachenalii* are represented by only one or a few fruits, while *Ranunculus sardous*, *Carex disticha* and *Alopecurus geniculatus* could not be demonstrated.

Puccinellia distans and *Spergularia marina* are very well represented in the samples from Het Torp. It has already been mentioned (4.2.1.3.) that near all sites from a brackish environment the Puccinellietum distantis, the vegetation from places which are frequented by man and animal or where sods have been cut, must have been quite common.

In wet dune valleys, vegetations of the Caricion curto-nigrae and of the Caricion davallianae, both alliances of the Parvocaricetea, would have been found. Indicative of the Caricion curto-nigrae are *Ranunculus flammula*, *Aulacomnium palustre*, and *Calliergon stramineum*. On the other hand, *Drepanocladus vernicosus*, *Camptothecium nitens*, *Scirpus planifolius*, and *Juncus subnodulosus* would point to the presence of the Caricion davallianae. Caricion curto-nigrae vegetations occur in mesotrophic dune valleys which are poor in lime, whereas Caricion davallianae vegetations require fairly eutrophic conditions. In the valley bottoms with somewhat deeper water the Scirpo-Phragmitetum or fragments of it could have been present. It is possible that in the dune area Arrhenatherion elatioris vegetations were also encountered. *Erica tetralix*, which is not shown in table 28, would have found suitable habitats in moist, acid dune valleys.

Fruit stones of *Rosa pimpinellifolia* were met with in four of the six samples, be it in small numbers. This indicates that rose-hips were collected by the inhabitants of the site. *Rosa pimpinellifolia* would have grown in the drier parts of the dunes. Other species which could have been found in similar habitats are *Betula* spec., *Calluna vulgaris*, *Dicranum scoparium*, and *Hypnum cupressiforme*.

Of the species from synanthropic vegetations represented in Het Torp some are found in Secalietea associations: *Agrostemma githago*, *Raphanus raphanistrum*, *Polygnum convolvulus*, and *Sanapis arvensis*, while *Spergula arvensis* and *Rumex acetosella* occur in fields of winter cereals as well as in those of summer crops. It is likely that crop plants were not only grown on the highest parts of the salt marshes, but *Spergula arvensis*, *Rumex acetosella*, and *Raphanus raphanistrum* suggest that fields were also present in the sandy area. One could wonder whether particularly winter cereals were cultivated on the sandy soils, out of the reach of the floods.

4.2.2.5. *Ouddorp-De Oude Oostdijk* (table 29)

It is striking that next to Paddepoel differential species of the subass. eleocharitetosum of the Juncetum gerardii are best represented in Ouddorp (table 33). For Paddepoel the low-lying position of the area and the presence of two

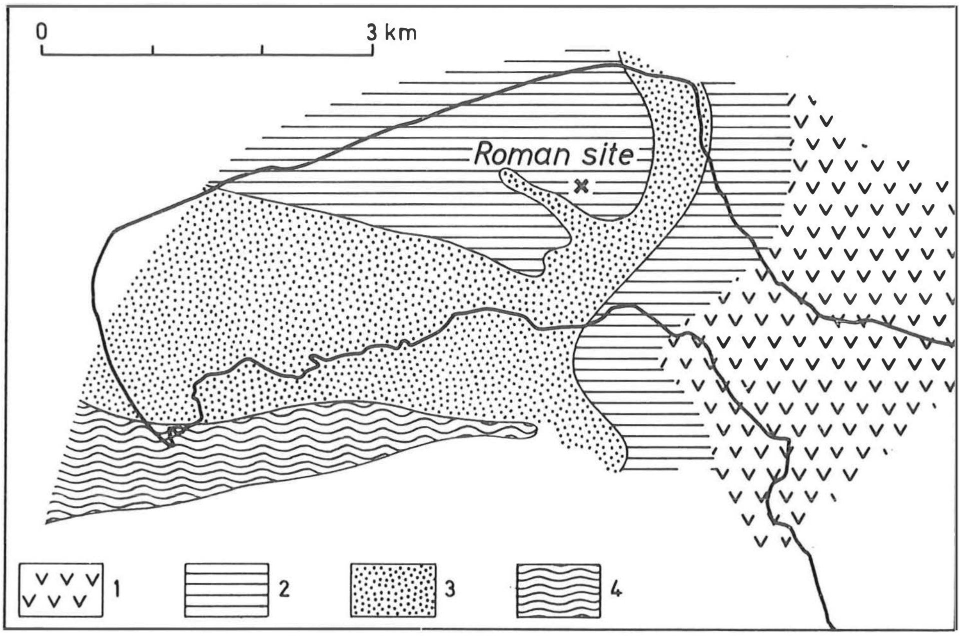

Fig. 5. The Ouddorp site and its environment.
1. peat;
2. clay on peat;
3. sandy sediments covered by clay;
4. tidal channel.

small rivers could be held responsible for the predominantly wet and only slightly brackish conditions (4.2.2.1.). Near the Ouddorp site no river was found, but the geographical position of the site may provide a clue for the presence of suitable habitats for the *Eleocharis* variant of the mud rush vegetation. Fig. 5, which is after Hageman (1964, fig. 9), shows the position of the site with respect to the supposed geographical situation during the first centuries A.D.

During the Pre-Roman (Dunkirk I) transgression large parts of the peat landscape of Goeree had been destroyed by the sea, whereafter marine sediments were deposited in the eroded areas. The marine deposits in these eroded areas consist of sandy sediments which are covered by a 0.50 m thick layer of stiff clay. To the north and the east of the eroded areas clay was deposited on top of the peat, whereas further to the east peat growth could continue. The Ouddorp site was situated in the area where clay had been deposited on top of the peat, probably at a short distance from a former tidal channel which had cut its way through the peat landscape. The creek which had its course along the site would have formed part of the creek system surviving from the Pre-Roman transgression.

The clay cover would have caused a compression of the peat below it. On the other hand, the marine sediments in the eroded areas would not or hardly have been subject to compression because of the sandy character of the deposits below the clay cover. As a result the area with the peaty subsoil became low-lying with respect to the areas where the peat had been replaced by sandy, marine sediments. Just as Paddepoel, the Ouddorp site would have been situated in a low-lying area, which may explain the wet conditions. One must assume that the Ouddorp area was only seldom flooded by salt water, as otherwise the conditions would not have been favourable for the subass. eleocharitetosum of the Juncetum gerardii. The virtual absence of indicators of the Puccinellietum maritimae in the Ouddorp samples (table 34) supports the assumption of a minor direct influence of the sea upon the area.

4.3. THE SITES FROM A FRESHWATER ENVIRONMENT

4.3.1. THE PHYSICAL ENVIRONMENT

The Iron Age sites of Vlaardingen and Schiedam, which will be discussed below, were situated in the freshwater tidal area of the Rhine-Meuse region. In this part of the coastal area the effect of the tidal movements was felt but the water was still fresh. It was only some distance west of the Vlaardingen-Schiedam area, that through the mixing of the fresh water from the rivers and the salt water from the sea, a brackish tidal zone occurred. The physical and biological environment of both Iron Age sites would have been comparable to that of Neolithic Vlaardingen, which has been discussed in detail by Van Regteren Altena *et al.* (1962/1963, see particularly fig. 6 and pp. 23-29, 102-109). As for Neolithic Vlaardingen, the freshwater tidal region of the Biesbosch, as it existed until its open connection with the sea was cut off by dams in the Haringvliet and Volkerak, may make a good parallel for the situation in the Vlaardingen-Schiedam area at the time of the Iron Age habitation (Zonneveld 1960). The main difference from the situation in the Biesbosch would have been the much smaller human influence and the fact that the height of the storm floods was considerably lower, because in the absence of dikes the water could flow out over much larger areas.

The Vlaardingen-Schiedam area would have been dissected by a pattern of larger and smaller water-courses (creeks). At least the main gullies would have been bordered by natural levees, which to a considerable depth were built up of mineral deposits. Behind these river banks somewhat lower-lying areas, the back-swamps, were present. The subsoil of the back-swamp consisted of peat and clayey peat. The situation at the Schiedam-Kethel site indicates that creeks had penetrated into the peaty back-swamps. Along these creeks a thin layer of clay had been deposited on top of the peat. The site of Schiedam was situated near such a creek. In contrast to the Neolithic inhabitants of this area, who constructed their houses on the higher-lying natural levees, the Iron Age people settled in the back-swamps. This could only have been possible in periods during which the riverine as well as the marine influence had decreased considerably. The marine clay on top of the settlements points to renewed transgression activity.

4.3.2. THE VEGETATION TYPES (tables 30 and 31)

4.3.2.1. *Forest vegetations*

The palaeobotanical evidence for the woods on the higher part of the levees is very scarce. A few immature beech cupules and some acorns suggest that *Fagus* and *Quercus* formed part of these woods. The presence of *Fagus* indicates that the higher parts of the river banks would not have been extremely wet.

The alderwood (Carici elongatae-Alnetum) is represented by the following species: *Alnus glutinosa*, *Iris pseudacorus*, *Lycopus europaeus*, *Lythrum salicaria*, *Scutellaria galericulata*, *Peucedanum palustre*, *Carex paniculata*, and *Solanum dulcamara.* The Carici elongatae-Alnetum is found on marshy soils with fairly eutrophic, stagnant to slightly flowing water. Alderwood would have occupied the wet marginal parts of the river banks and the transitional zone between the levee and the back-swamp.

4.3.2.2. *Marsh vegetations of the back-swamps*

The vegetations of the back-swamps can be attributed to three syntaxonomic units, viz. the Scirpo-Phragmitetum, the Magnocaricion, and the Caricetalia nigrae. The distribution of these vegetation types would have depended on the height of the water table and on the nutrient content.

The Scirpo-Phragmitetum would have been well developed in eutrophic places with predominantly shallow open water. Species which would have been found in Scirpo-Phragmitetum vegetations include *Phragmites australis*, *Rumex hydrolapathum*, *Ranunculus lingua*, *Alisma plantago-aquatica*, and *Carex otrubae.* The fact that *Phragmites* fruits were only scarcely met with does not yet imply that reed was a rare plant. Thus, the floor of the house in the Broekpolder near Vlaardingen consisted of a 15 cm thick layer of reed stems. It seems that *Phragmites* is seriously under-represented by its fruits.

Scirpo-Phragmitetum vegetations would also have bordered the creeks. One could wonder whether it was there that *Scirpus maritimus* and *Scirpus lacustris* ssp. *glaucus* were found. Particularly in the larger creeks brackish water could have penetrated during high storm floods, which would have favoured these rush species.

In the natural succession, the Scirpo-Phragmitetum is succeeded by Magnocaricion vegetations. The latter would have occurred in more or less eutrophic places where it was less wet than in the area covered by reed vegetations, although at least during a part of the year the ground water table would have been above the soil surface. From tables 30 and 31 it is clear that Scirpo-Phragmitetum and Magnocaricion vegetations have many species in common.

The characteristic fruits of *Oenanthe fistulosa* were quite frequently met with in the Vlaardingen samples, which could indicate that vegetations of the Nasturtio-Glycerietalia were present in the vicinity of this site. *Oenanthe fistulosa* and *Sium erectum*, which latter species is also represented in Vlaardingen, have their optimum development in vegetations of the Nasturtio-Glycerietalia. The few *Myosotis* fruits encountered in Vlaardingen are most probably of *Myosotis scorpioides*, which is a characteristic species of the Nasturtio-Glycerietalia. Vegetations of the Nasturtio-Glycerietalia are found in places with a fluctuating water level and along ditches with stagnant or slowly flowing, eutrophic water. In Schiedam, *Sium erectum* and *Myosotis* cf. *scorpioides* are represented, but not *Oenanthe fistulosa.*

The highest places of the back-swamps, with a more mesotrophic milieu, would have been covered by vegetations of the Caricetalia nigrae. Species which are indicative of the Caricetalia nigrae include *Hydrocotyle vulgaris*, *Pedicularis palustris*, *Triglochin palustris*, *Myrica gale*, *Potentilla erecta*, *Ranunculus flammula*, *Sphagnum palustre*, and *Aulacomnium palustre.*

The larger number of *Eleocharis* fruits, which were recovered from Vlaardingen and Schiedam, indicate that *Eleocharis palustris* must have been quite common there. According to Reichgelt (1956) this species does not tolerate shade, so that it does not grow in dense vegetations of other species. For that reason more or less open places must have been present in the reed and sedge vegetations where *Eleocharis palustris* could develop. As some pollution of the water is not harmful for this species it is possible that it could also thrive in very wet places in the immediate vicinity of the sites, which might explain the abundance of *Eleocharis* fruits.

4.3.2.3. *Molinietalia*

A fairly large number of species represented in Vlaardingen and Schiedam is found in vegetations which belong to the Molinietalia. The order of the Molinietalia comprises periodically wet meadows and rich herbaceous vegetations on moist soil along rivers, ditches, and forest edges. One must assume that a vegetation type which shows much resemblance to the present-day Valeriano-Filipenduletum (one of the Molinietalia associations) must have been present in the vicinity of Vlaardingen and Schiedam. This vegetation is indicated by *Lythrum salicaria*, *Stachys palustris*, *Eupatorium cannabinum*, *Valeriana officinalis*, *Filipendula ulmaria*, and *Thalictrum flavum*. This association would particularly have occurred in the transitional zone between the Carici elongatae-Alnetum and the reed- and sedge-vegetations of the back-swamps, while it would also have developed in places where the alderwood was cut. It is not possible to establish which other Molinietalia vegetations would have been found, but some kind of meadowland would very probably have formed in the vicinity of the sites as a result of grazing.

4.3.2.4. *Synanthropic vegetations*

A large number of species from Vlaardingen and Schiedam is most common in vegetations which are the result of the interference of man (synanthropic vegetations).

The combination of *Poa annua*, *Plantago major*, *Polygonum aviculare*, and *Capsella bursa-pastoris* points to the presence of the Lolio-Plantaginetum. This association is found in frequently trodden places. In a brackish environment the Puccinellietum distantis develops in consequence of treading (see 4.2.1.3.), in a freshwater milieu it is the Lolio-Plantaginetum. The occurrence of this vegetation type is according to expectation for sites which were inhabited for a longer period.

In Vlaardingen and Schiedam more Bidention species were found than in the sites from a brackish environment. Thus, *Polygonum hydropiper*, *Polygonum minus*, and *Rorippa islandica* are not represented in the latter sites. The better representation of Bidention vegetations in Vlaardingen and Schiedam is not strange, because in the wet conditions in the vicinity of both sites suitable habitats for these vegetations would easily have come into existence.

In other places rich in nitrates vegetations of the Sisymbrietalia would have been present. On dung-hills the Chenopodio-Urticetum urentis may, again, have been found. It is true that *Urtica urens* is not represented in these sites, but the seeds of *Chenopodium ficifolium* are quite common, while also *Atriplex hastata/patula*, *Chenopodium rubrum/glaucum*, and *Chenopodium album* could be demonstrated. On the other hand, the combination of *Poa annua*, *Capsella bursa-pastoris*, *Solanum nigrum*, *Chenopodium rubrum/glaucum*, *Atriplex hastata/patula*, and *Chenopodium album* could point to the presence of the Chenopodietum glauco/rubri, which vegetation is likewise found on dung-hills.

Artemisietalia vulgaris vegetations are indicated by *Arctium pubens*, *Rumex* *obtusifolius*, *Urtica dioica*, and *Cirsium vulgare*. These nitrophilous vegetations are found along roads and fields, near farms, in neglected gardens, and in various other ruderal habitats.

It has already been mentioned that the Sisymbrietalia and the Polygono-Chenopodietalia, which latter order includes weed associations of summer cereals, have many species in common. Nevertheless one may assume that Polygono-Chenopodietalia vegetations were present in the vicinity of these sites. As species from weed associations in fields of winter cereals (Secalietea) are hardly represented, it is likely that only summer crops were grown. The crops themselves will be discussed in chapter 5.

Just as in the sites from a brackish environment, seeds and fruits were found in Vlaardingen and Schiedam of various species which are characteristic of and/or common in Agropyro-Rumicion crispi vegetations, such as *Alopecurus geniculatus*, *Juncus effusus*, *Juncus articulatus*, *Potentilla anserina*, *Ranunculus repens*, and *Rumex crispus*. Consequently, it is very likely that Agropyro-Rumicion crispi vegetations, which are particularly found in transitional zones between two different milieus (see 4.2.1.8.), occurred in the vicinity of these sites.

The origin of the remains of a few species is not clear. It has already been suggested that *Scirpus maritimus* and *Scirpus lacustris* ssp. *glaucus* could have occurred along major gullies. However, the other halophytes which are represented in Vlaardingen and/or Schiedam, viz. *Puccinellia distans*, *Juncus gerardii*, and *Spergularia marina*, are more difficult to place in this freshwater environment.

Erica tetralix could possibly have occurred in a Molinietalia vegetation, but it is very unlikely that *Calluna vulgaris* would have found suitable habitats in the Vlaardingen-Schiedam area. Consequently, at least the seeds of *Calluna vulgaris* would have been of secondary origin.

5. PLANT HUSBANDRY IN THE COASTAL SETTLEMENT SITES

Plant growing by the inhabitants of the coastal area is not only suggested by the seeds and fruits of weeds from fields but also by the remains of the crop plants themselves. In table 44 the numbers of seeds and fruits of crop plants and possible crop plants recovered from the samples of vegetal debris are brought together. Moreover, two charred seed samples from Ouddorp (cf. Van Zeist (1968) 1970, tables 45 and 47) and the small carbonized barley sample Tritsum 81 (period 8) are included in this table. The crop plant remains have been described in chapter 3, but below some additional remarks will be made. The reader is further referred to Van Zeist ((1968) 1970, pp. 154-165).

TABLE 44. CROP PLANTS AND POSSIBLE CROP PLANTS

	Hordeum vulgare	*Hordeum rachis internodes*	*Triticum dicoccum*	*Triticum aestivum*	*Avena*	*Panicum miliaceum*	*Linum usitatissimum*	*Camelina sativa*	*Brassica campestris*	*Daucus carota*	*Vicia faba var. minor*	*Vicia sativa ssp. obovata*	*Papaver somniferum*
Paddepoel IIA	1	—	—	—	—	—	2	—	1/2	3	—	—	—
124	1	—	—	—	—	—	1/2	—	—	—	—	—	—
224	10	2	2	—	3	—	—	—	—	—	1	—	—
246	—	—	—	—	1	—	2 1/2	—	—	—	—	—	—
248	1	—	—	—	—	—	12	1	—	—	—	—	—
272	—	—	—	—	—	—	2	2 1/2	—	—	—	—	—
274	—	—	—	—	—	—	12	100	—	—	—	—	—
299	6	—	—	—	1	—	2	—	3	8	—	—	—
300	—	—	1	—	—	—	1	—	—	41	—	—	—
Ezinge A	—	—	—	—	—	—	7	4 1/2	3	—	—	—	—
B	—	—	—	—	—	—	32	—	1/2	—	—	—	—
Tzummarum 77	3	—	—	—	—	—	—	—	1	—	—	—	—
70	3	—	—	—	—	—	—	—	1	—	—	—	—
80	2	8	—	—	—	—	—	—	16	—	—	—	—
79	8	—	—	—	—	—	—	—	2	—	—	—	—
Leeuwarden I	—	—	—	—	—	—	4	1 1/2	—	—	—	—	—
II	—	—	—	—	—	—	13	1/2	—	—	—	—	—
Tritsum 3266	—	—	—	—	—	—	7	—	—	1	—	—	—
2998	1	—	—	—	—	—	2	1	—	—	—	—	—
2763	1	—	—	—	—	—	4	—	1	—	—	—	—
3234	—	—	—	—	—	—	2	1	—	—	—	—	—
3013	—	—	—	—	—	—	20	—	5	—	—	—	—
2981	—	—	—	—	—	—	4	3	21	1	—	—	—
2986	—	—	—	—	—	—	—	—	—	6	—	—	—
2988	—	—	—	—	—	—	20	25	3	—	—	—	—
2994	—	—	—	—	—	—	1	—	—	115	—	—	—
3094	—	—	—	—	—	—	—	15	6	17	—	—	—
3280	1	—	—	—	—	—	—	—	70	—	—	—	—
2984	—	—	—	—	—	—	2	—	—	2	—	—	—
1141	11	—	—	—	—	—	4	—	—	—	—	—	—
2762	—	—	—	—	—	—	21	—	—	—	—	—	—
81	62	—	—	—	—	—	—	—	—	—	—	—	—
Sneek 1	1	—	—	—	—	—	—	—	—	—	—	—	—
Den Helder 865	—	—	—	—	—	—	—	—	1	—	—	—	—
867	1	—	—	—	—	—	—	—	—	—	—	—	—
919	3	—	—	—	—	—	—	—	—	—	—	1	—

TABLE 44. CROP PLANTS AND POSSIBLE CROP PLANTS (cont'd)

	Hordeum vulgare	*Hordeum* rachis internodes	*Triticum dicoccum*	*Triticum aestivum*	*Avena*	*Panicum miliaceum*	*Linum usitatissimum*	*Camelina sativa*	*Brassica campestris*	*Daucus carota*	*Vicia faba* var. *minor*	*Vicia sativa* ssp. *obovata*	*Papaver somniferum*
Ouddorp 1	—	—	—	1	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	1	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	1
6	—	—	—	1	—	—	—	—	$1\frac{1}{2}$	—	—	—	—
7	—	—	—	—	—	—	—	$2\frac{1}{2}$	—	1	—	—	—
1959	many	—	—	3	11	—	—	—	—	—	$\frac{1}{2}$	—	—
51	3	—	—	many	$3\frac{1}{2}$	—	—	—	—	—	—	—	—
Vlaardingen I	—	—	—	—	—	—	36	50	1	—	—	—	—
II/III	1	—	—	—	—	1	125	189	—	—	—	—	—
IV	—	—	—	—	—	1	1	25	—	—	—	—	—
V	—	—	—	—	—	—	2	1	—	—	—	—	—
VI	—	—	—	—	—	1	10	—	1	—	—	—	—
VII	—	—	—	—	—	—	37	18	3	—	—	—	—
VIII	—	—	—	—	—	—	85	2	—	—	—	—	—
Schiedam 119	—	—	—	—	—	—	1	—	—	—	—	—	—
178	—	—	—	—	—	—	—	—	515	—	—	—	—
191	1	—	—	—	—	—	54	—	—	—	—	—	—
203	—	—	—	—	—	—	48	—	—	—	—	—	—

5.1. REMARKS ON SOME CROP PLANTS AND POSSIBLE CROP PLANTS

5.1.1. HORDEUM VULGARE

Most of the sites yielded one or more charred grains of *Hordeum vulgare*. Moreover, a part of the subfossil *Hordeum* caryopses may have originated from *Hordeum vulgare*. One should take into consideration that in samples of vegetal debris barley and other cereal species are probably poorly represented by their charred grains. Thus, no carbonized grains of *Hordeum vulgare* were found in samples Ouddorp 1 to 7, although from this site a fairly large charred barley sample could be secured (Ouddorp 1959).

5.1.2. AVENA CF. SATIVA

The few charred oat grains from Paddepoel constitute a problem. Small numbers of *Avena* fruits were encountered in charred seed samples from various sites in the Netherlands, dating from the Neolithic to Early Medieval times (Van Zeist (1968) 1970, table 63). When it was possible to identify the species – in case flower bases had been preserved – it appeared to be wild oat (*Avena fatua*), except for sample 5194 from the Roman castellum of Valkenburg in which one flower base of *Avena sativa* was found. The earliest unmistakable evidence for the cultivation of *Avena sativa* in the Netherlands is from Early Medieval Dorestad.

As for the oats from Paddepoel, the ratio of 5 *Avena* to 23 *Hordeum* does not point to a quantitatively insignificant admixture of wild oat in barley fields. The comparatively large number of oat grains rather suggests that this species was cultivated, in which case *Avena sativa* must be concerned. In this connection it should be remembered that much *Avena sativa* was found on the Feddersen Wierde (Körber-Grohne 1967, p. 123) indicating that there it was a common crop plant.

The *Avena* fruits in the charred grain samples Ouddorp 51 and 1959 are most probably of *Avena fatua.*

5.1.3. PANICUM MILIACEUM

It should be stressed here that an earlier statement that *Panicum miliaceum* was represented in Paddepoel and Schiedam (Van Zeist (1968) 1970, table 60) is not correct. The alleged *Panicum* fruits turned out to be of *Echinochloa crus-galli.* The cultivation of millet could only be ascertained for Vlaardingen.

5.1.4. PULSES

Seeds of leguminous crop plants were very seldom encountered. Paddepoel and Ouddorp both yielded one celtic bean (*Vicia faba* var. *minor*), while Beijerinck (1929, p. 44) reports one specimen for both Jelsum and Arum. From the scarce representation of celtic bean it may not yet be concluded that this crop plant was of no importance. Thus, at the Feddersen Wierde stems of celtic bean occurred in more or less thick layers, but only small numbers of carbonized seeds were found (Körber-Grohne 1967, p. 174).

Vicia sativa ssp. *obovata*, one seed of which was found in Den Helder, is at present grown as fodder for animals. However, the seeds of this vetch would also have been used for human consumption (H. Gams in: Hegi IV/3, 1924).

5.1.5. BRASSICA CAMPESTRIS

Brassica campestris is represented in most of the sites. Larger numbers of seeds and some pods of this species were recovered from the Feddersen Wierde (Körber-Grohne 1967, pp. 183-189). Körber-Grohne is of the opinion that *Brassica campestris* occurred in the vicinity of the site as a weed in fields. *Brassica* *campestris* would not have been cultivated by the inhabitants of the Feddersen Wierde, nor would this species have been gathered wild. It is generally assumed that *Brassica campestris* is not an indigenous species in western Europe, but that it escaped from cultivation. In other words, it would have reached western Europe as a cultivated plant, and it was not until later that this species became part of the weed flora. Consequently, the present author is inclined to believe that the *Brassica campestris* from the coastal sites in the Netherlands and northwestern Germany was cultivated. This species could have been grown because of its oleaginous seeds as well as for the turnips. Particularly if other oil plants (*Linum usitatissimum*, *Camelina sativa*) were already cultivated, one could wonder whether turnips would have been the primary purpose of the growing of *Brassica campestris*. On the other hand, the inhabitants of Tzummarum, for which site no flax or gold-of-pleasure could be demonstrated, may have grown *Brassica* because of the seeds.

5.1.6. DAUCUS CAROTA

The characteristic split fruits of *Daucus carota* were recovered from Paddepoel, Tritsum, and Ouddorp. This species is a cultivated (ssp. *sativus* (Hoffm.) Arcang.) as well as a wild plant. Unfortunately, it is not possible to distinguish between the fruits of wild and cultivated carrots. One could wonder whether the wild species, which at present is particularly met with along the great rivers (fluviatile district), would have found suitable habitats in the coastal area of the north of the Netherlands. This would plead in favour of the assumption that carrots were cultivated.

5.2. THE SITES FROM A BRACKISH ENVIRONMENT

5.2.1. PLANT CULTIVATION

The presence of seeds and fruits of crop plants in sites from the former salt marsh area does not necessarily imply that the species concerned were grown there. One could imagine that vegetal food was acquired from the farmers in the adjacent sandy districts in exchange for stock-breeding products. However, the farmers on the higher sandy soils would never have been able to meet the demand for vegetal food of the relatively large population of the coastal area. Moreover, the vegetal remains themselves point to plant cultivation in the coastal area. From Paddepoel remains of flax capsules and pods of *Camelina sativa* were recovered. Beijerinck (1929, p. 39, fig. 35) found capsule remains of flax in Ezinge. This indicates that these species had been threshed on the site. If these plants had been grown elsewhere the threshed seeds would have been imported, which are considerably less bulky than pods and capsules. The flax stems which are reported for various sites (see Van Zeist (1968) 1970, p. 162) point likewise to the cultivation of this species in the salt marsh area. The carbonized rachis internodes of *Hordeum vulgare* met with in Paddepoel 224 and Tzummarum 80 (table 44) and in the Burmannia *terp* at Ferwerd (Beijerinck 1929, p. 30) suggest that barley was grown near the site. It is likely that in the future more threshing remains will be brought to light, in particular if proper attention is paid to them in the field; Körber-Grohne (1967) discovered many threshing remains on the Feddersen Wierde.

Fields could have been present on the *terps*, but plant growing at a somewhat larger scale could only have taken place outside the settlement sites proper. At first sight it may seem strange that crop plant cultivation is possible in a brackish environment. However, it is usual to grow crop plants in polders in the coastal area shortly after the embankment, when the soil is still slightly saline. In particular some *Brassica* species and cereals would give satisfactory yields on brackish soils (see Körber-Grohne 1967, pp. 209-210).

In contrast to the polders mentioned above, the unprotected salt marsh area is exposed to inundations with salt water. It is true that most of the storm floods which reach the higher parts of the salt marsh area take place in the autumn and winter, but in the spring and summer exceptionally high floods also occur from time to time. In connection with the question as to how far crop plants can be grown in the unprotected salt marshes Körber-Grohne (1967, pp. 209-231) carried out an agricultural experiment. During two successive years (1960, 1961) crop plants which are represented in the Feddersen Wierde were grown on brackish terrain outside the dike. The plants were cultivated in two fields, both situated in the Juncetum gerardii vegetation zone. One field had been laid out on the highest part of the salt marsh, the other field was about 30 cm lower. The sowing was carried out in April.

In both years flooding killed nearly all the plants from the lower-lying field. The plants on the higher-lying field, which had been exposed to salt water during shorter periods, could survive, but for some species the flooding caused strongly reduced yields. Körber-Grohne arrived at the conclusion that *Hordeum vulgare* and *Camelina sativa* are least sensitive to an occasional flooding. On the other hand, *Avena sativa*, *Vicia faba* var. *minor*, and *Linum usitatissimum* would stand an inundation with salt water less well, resulting in a partial or complete crop failure. The fact that flax was flowering at the time of the flooding may have aggravated the effect of the salt water.

In 1969, Mr. T. C. van Hoorn (Ulrum), Dr. S. Bottema, and the present author started to grow crop plants in the unprotected salt marsh near the Westpolder (see fig. 1). At first oats, barley, flax, gold-of-pleasure, and celtic bean were grown, later (in 1973) millet and bread wheat were added. A report on this experiment, which is still continuing, is scheduled for 1975. The results obtained so far for the Westpolder agree with those of Körber-Grohne. From these experiments the following conclusions may be drawn. If during the growing season no inundations with salt water take place, *Hordeum*, *Linum usitatissimum*, *Camelina sativa*, *Vicia faba* var. *minor*, and probably also *Avena sativa* give satisfactory yields. A flooding during the seedling stage kills nearly all the plants and the same happens when at a later stage of development the plants are immersed in salt water for a longer period, for instance some hours during each of a few successive high tides. A short inundation of the fields would be less harmful to full-grown plants, although it may cause a reduced seed production. Moreover, at the flowering stage the plants would be extra sensitive to inundation with salt water.

From Körber-Grohne's experiment it is clear that only on the highest part of the unprotected salt marsh could crop plants have been grown by the earlier inhabitants of the coastal area. Besides, one must assume that during the growing season exceptionally high floods were certainly not more frequent than at present, as otherwise plant growing would have been too risky. In this respect it may be remarked that before the construction of the dikes the water would probably have risen less during storm floods than nowadays.

The weeds from fields suggest that only summer crops were grown in the salt marshes (4.2.1.10). As during the autumn and winter season one or more storm floods would generally have occurred, the area was not suitable for the cultivation of winter crops. In this connection it should be remarked that it is not known whether in Iron Age times winter crops were grown by the farmers of the hinterland. Only for Den Helder do the weeds from fields seem to point to the growing of winter crops, and in this case it is assumed that the latter were cultivated on the sandy soils, at some distance from the site (4.2.2.4.).

Table 44 shows that the number of crop plants and possible crop plants which could be demonstrated for each site varies considerably. The palaeobotanical evidence seems to point to a reduction in the number of cultivated species in the course of time. However, sites for which information on crop plants is available are still too few to draw conclusions of this kind.

As for the presence of one seed of *Papaver somniferum* in Ouddorp 5, one should take into consideration that this was a Roman site. Seeds of opium poppy may have been imported.

5.2.2. PLANT COLLECTING

Wild fruits and nuts, such as hazelnuts, beech-nuts, crab-apples, strawberries, blackberries, and other berries, did not grow in the salt marsh area. That the inhabitants of this area appreciated hazelnuts (*Corylus avellana*) is demonstrated by the broken shells of this species found in Ezinge, Rasquert, and Ferwerd (Beijerinck 1929, p. 32). These hazelnuts must have been imported from the higher sandy soils to the south of the coastal area. A fruit stone of *Prunus spinosa* (blackthorn) is reported for Ezinge (Beijerinck 1929, p. 43).

Of the seeds of wild plants which could have replaced cereal grains to some extent, only those of *Atriplex hastata/patula* seem to come into consideration for the sites from a brackish environment. *Atriplex* seeds were often found in larger numbers, indicating that orache must have been a common plant in and near the settlements. It is true that orache is not reported as a possible prehistoric food plant, but until recently the seeds of *Chenopodium album*, a relative of *Atriplex hastata* and *A. patula*, were eaten by man in times of serious food shortage. The seeds were ground and the flour was mixed with that of cereals (Neuweiler 1905, Helbaek 1960).

There is fairly good evidence that in prehistoric times the seeds of *Polygonum lapathifolium* were harvested intentionally. Thus, a vessel containing almost 1000 cc of pure *Polygonum lapathifolium* seeds was found in a burnt-down house from the first century A.D. near Alrum on Jutland (Helbaek 1960). However, only Paddepoel 299 and 327 yielded somewhat larger numbers of seeds of this species, suggesting that in general *Polygonum lapathifolium* would not have contributed essentially to the nutrition of man.

Apium graveolens (celery) could have been used for flavouring. The (young) plants of various species, such as *Glaux maritima*, *Salicornia europaea*, *Triglochin maritima*, *Sonchus oleraceus*, and *Urtica dioica*, can be eaten as vegetables. Of the species to which curative proporties are attributed and which are represented in the sites from the salt marsh area, we may mention here: *Althaea officinalis*, *Capsella bursa-pastoris*, *Plantago major*, *Polygonum aviculare*, *Potentilla anserina*, and *Urtica dioica*. In the woods of the hinterland a much greater number of medicinal plants was available.

It should be stressed that it is usually impossible to determine what use was made of wild plants by prehistoric man.

5.3. THE SITES OF VLAARDINGEN AND SCHIEDAM

For the two sites from a freshwater environment the following crop plant species could be demonstrated (table 44): *Hordeum vulgare*, *Panicum miliaceum*, *Linum usitatissimum*, *Camelina sativa*, and *Brassica campestris*. The fact that in Vlaardingen many pods of *Camelina sativa* and also capsule remains of *Linum usitatissimum* were found may, again, be considered as evidence that these species, and other crop plants, were grown there. It is unlikely that the inhabitants of the Vlaardingen site cultivated crops on the peat. They must have had their fields on the levees, which were somewhat higher than the back-swamps and which were built up of mineral deposits. To obtain arable land a part of the forest had to be cleared. The inhabitants of the hamlet of Schiedam-Kethel could perhaps have grown crops on the thin clay cover on top of the peat (see 4.3.1.), but agriculture on the levees is more likely.

Except for a few immature beech cupules there is no palaeobotanical evidence for the collecting of fruits and nuts in the forests on the levees. Nevertheless, one may assume that wild fruits and nuts were gathered. *Atriplex* and *Polygonum lapathifolium* were common in the vicinity of the sites, so that the seeds of these species could have supplemented the human diet in times of food shortage.

6. SUMMARY

In this paper the palaeobotanical examination is discussed of 10 settlement sites in the coastal region of the Netherlands, viz. Paddepoel-Groningen, Ezinge, Tzummarum, Leeuwarden, Tritsum, Sneek, Den Helder-Het Torp, Vlaardingen-Broekpolder, Schiedam-Kethel, and Ouddorp-De Oude Oostdijk (fig. 1). These sites, which are dated to the Iron Age and Medieval times, include habitation mounds as well as settlement remains covered by marine clay. The quantitative results of the examination of samples secured from the sites mentioned above are shown in tables 1 to 10. Altogether 37 moss species and 183 types of seeds, fruits, and other remains of flowering plants could be ascertained. The plant remains are briefly discussed in chapter 3.

The main objective of this study is the reconstruction of the vegetation in the vicinity of the sites concerned. This reconstruction is primarily based on the results of phytosociological investigations. The palaeobotanical data demonstrate that most of the sites were situated in the brackish environment of the salt marshes. Only Vlaardingen and Schiedam were founded in a freshwater environment. In tables 22 to 31 it is indicated which vegetation types (syntaxonomic units) have been postulated for the various sites.

The sites from a brackish environment. The Juncetum gerardii, the vegetation from the higher parts of the salt marshes, is well represented in the sites from a brackish environment. Two subassociations of the Juncetum gerardii are distinguished, viz. the subass. leontodontetosum autumnalis and the subass. eleocharitetosum. The subass. leontodontetosum autumnalis (table 32) would

have been induced by grazing. The subass. eleocharitetosum (table 33) would have been found in places which were usually wet with a low salt content. For this vegetation type no modern analogue has been described so far.

The representation of the Puccinellietum maritimae, the plant community from the lower parts of the salt marshes, varies considerably for the various sites (table 34). On the other hand, the Puccinellietum distantis, which occurs in places which are trodden or where sods have been cut, must have been present in the vicinity of all the sites from a brackish environment (table 35). Aquatic vegetations (Ruppion maritimae, Potametea) are scarcely represented, but the Scirpetum maritimi must have been a common vegetation type near most of the sites. Freshwater species would have found suitable habitats along ditches and ponds on the habitation mounds.

Various species which could be demonstrated for the sites from the former salt marsh area occur in Agropyro-Rumicion crispi vegetations. Further, vegetations from ruderal habitats are represented: Bidention vegetations are found in wet places with a high nitrate content, while on muck-heaps the Chenopodio-Urticetum urentis would have occurred. The weeds from fields point to the cultivation of summer crops (Polygono-Chenopodietalia); only in Den Helder is a slightly larger number of Secalietea species (weeds in fields of winter crops) represented.

For Tritsum it could be shown that some changes in the vegetation took place in the course of the habitation (500 B.C. to 200 A.D.).

The sites from a freshwater environment. The sites of Vlaardingen and Schiedam were situated in a freshwater tidal area. The palaeobotanical evidence for the forest on the highest parts of the levees is very scarce, but the Carici elongatae-Alnetum is represented by a larger number of species. In the back-swamps vegetations of the Scirpo-Phragmitetum, the Magnocaricion, and the Caricetalia nigrae would have been found. The presence of Molinietalia vegetations, in particular the Valeriano-Filipenduletum, is likewise suggested by the palaeobotanical data. Further, various synanthropic vegetations are represented: Lolio-Plantaginetum, Bidention, Sisymbrietalia, Polygono-Chenopodietalia, Artemisietalia vulgaris, and Agropyro-Rumicion crispi.

Various crop plants, such as *Hordeum vulgare*, *Linum usitatissimum*, and *Camelina sativa* (table 44), were grown by the inhabitants to the coastal area. It is suggested that *Brassica campestris* and *Daucus carota* were also cultivated. Small-scale agricultural experiments in the salt marsh have shown that *Hordeum*, *Linum*, *Camelina*, *Avena sativa*, and *Vicia faba* var. *minor* can give satisfactory yields on somewhat saline soils.

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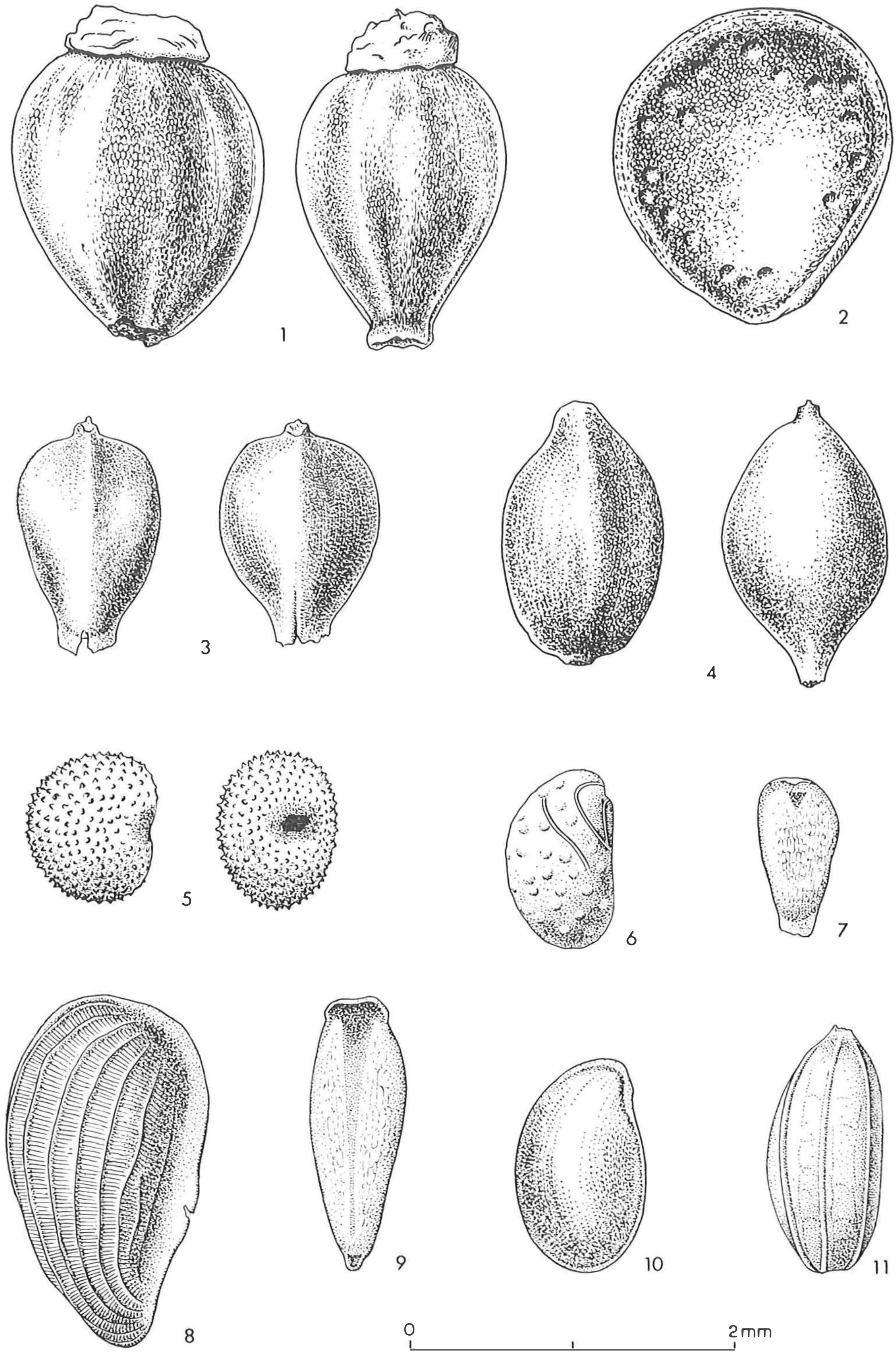

Fig. 6. 1: Eleocharis uniglumis/palustris (Paddepoel)
2: Ranunculus sardous (Tritsum)
3: Carex serotina-type (Paddepoel)
4: Carex paniculata (Schiedam)
5: Lychnis flos-cuculi (Vlaardingen)
6: Potentilla reptans (Ouddorp)
7: Lythrum salicaria (Vlaardingen)
8: Odontites verna/litoralis (Paddepoel)
9: Epilobium palustre (Vlaardingen)
10: Linum catharticum (Paddepoel)
11: Apium graveolens (Ezinge)

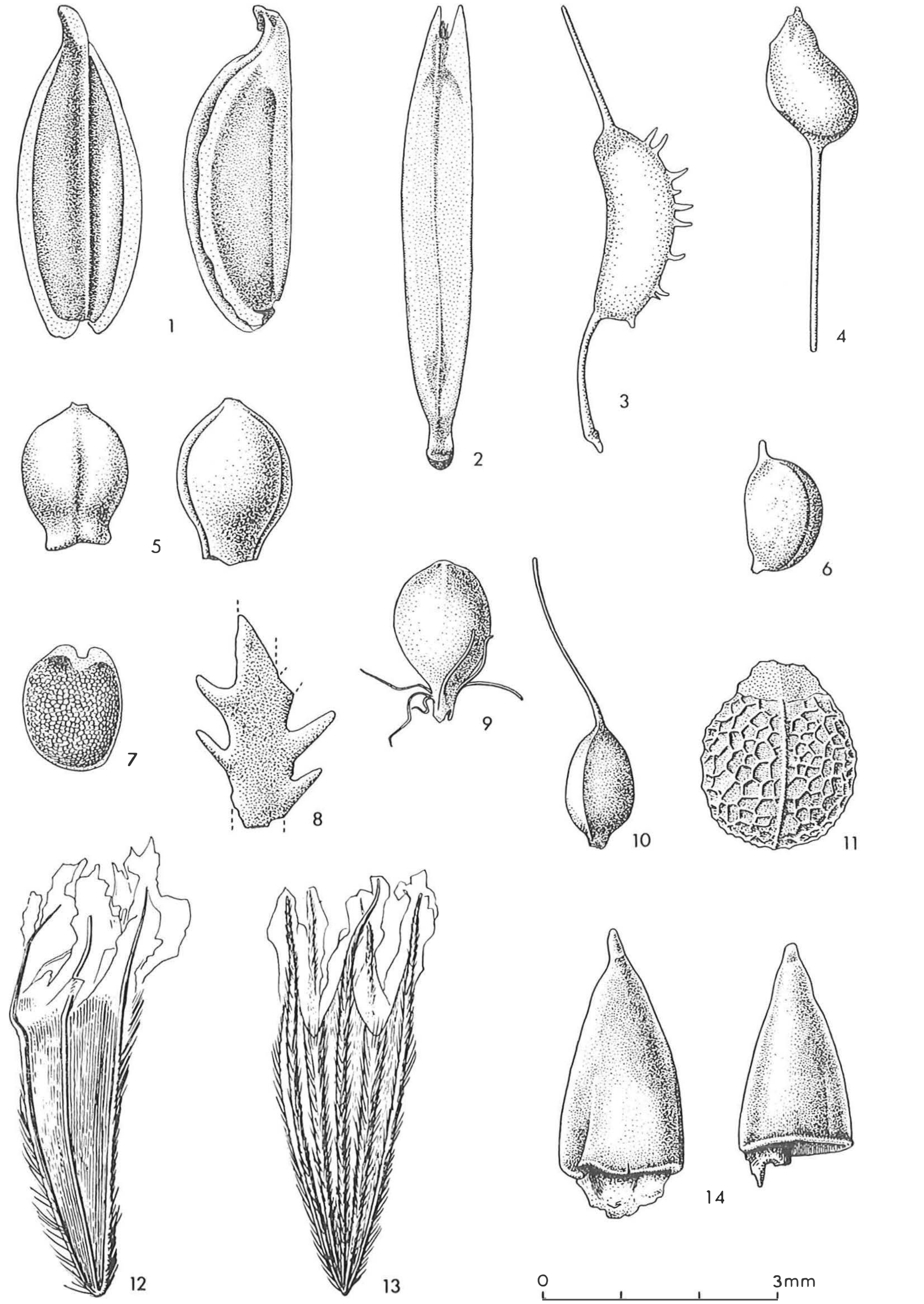

Fig. 7.
1: Triglochin maritima (Paddepoel)
2: Triglochin palustris (Vlaardingen)
3: Zannichellia palustris ssp. pedicellata (Ouddorp)
4: Ruppia maritima (Ouddorp)
5: Cladium mariscus (Sneek)
6: Potamogeton pusillus (Paddepoel)
7: Rorippa islandica (Vlaardingen)
8: Myriophyllum cf. spicatum (Paddepoel)
9: Scirpus planifolius (Den Helder)
10: Carex pseudocyperus (Tritsum)
11: Euphorbia helioscopia (Tzummarum)
12: Limonium vulgare (Den Helder)
13: Armeria maritima (Den Helder)
14: Plantago maritima, capsule lids (Den Helder)

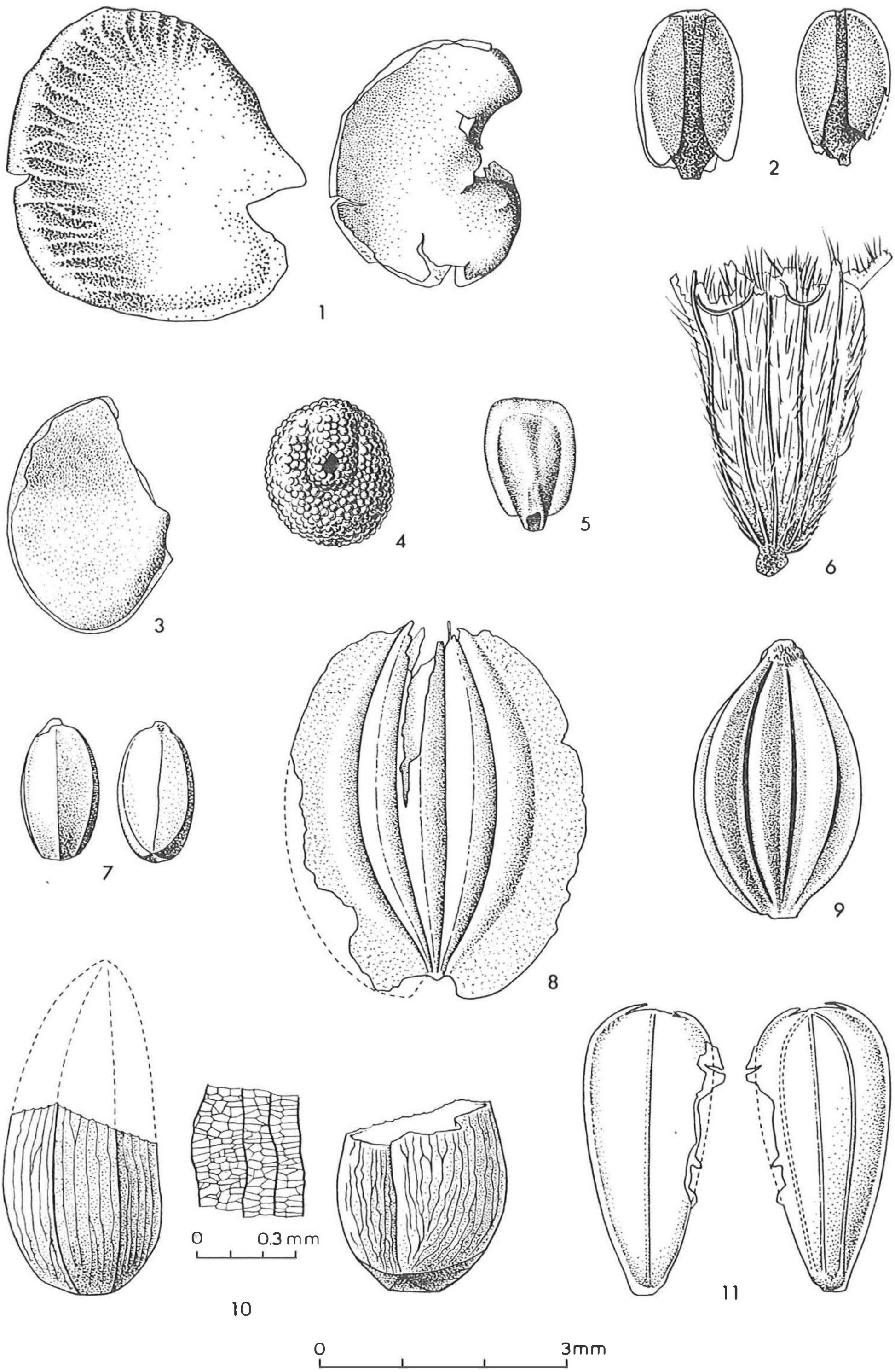

Fig. 8. 1: Althaea officinalis (Ezinge)
2: Prunella vulgaris (Paddepoel)
3: Rhinanthus spec. (Paddepoel)
4: Scutellaria galericulata (Vlaardingen)
5: Lycopus europaeus (Vlaardingen)
6: Trifolium pratense (Tritsum)
7: Sium erectum (Vlaardingen)
8: Peucedanum palustre (Vlaardingen)
9: Aethusa cynapium (Tritsum)
10: Conium maculatum (Ouddorp)
11: Valeriana officinalis (Vlaardingen)

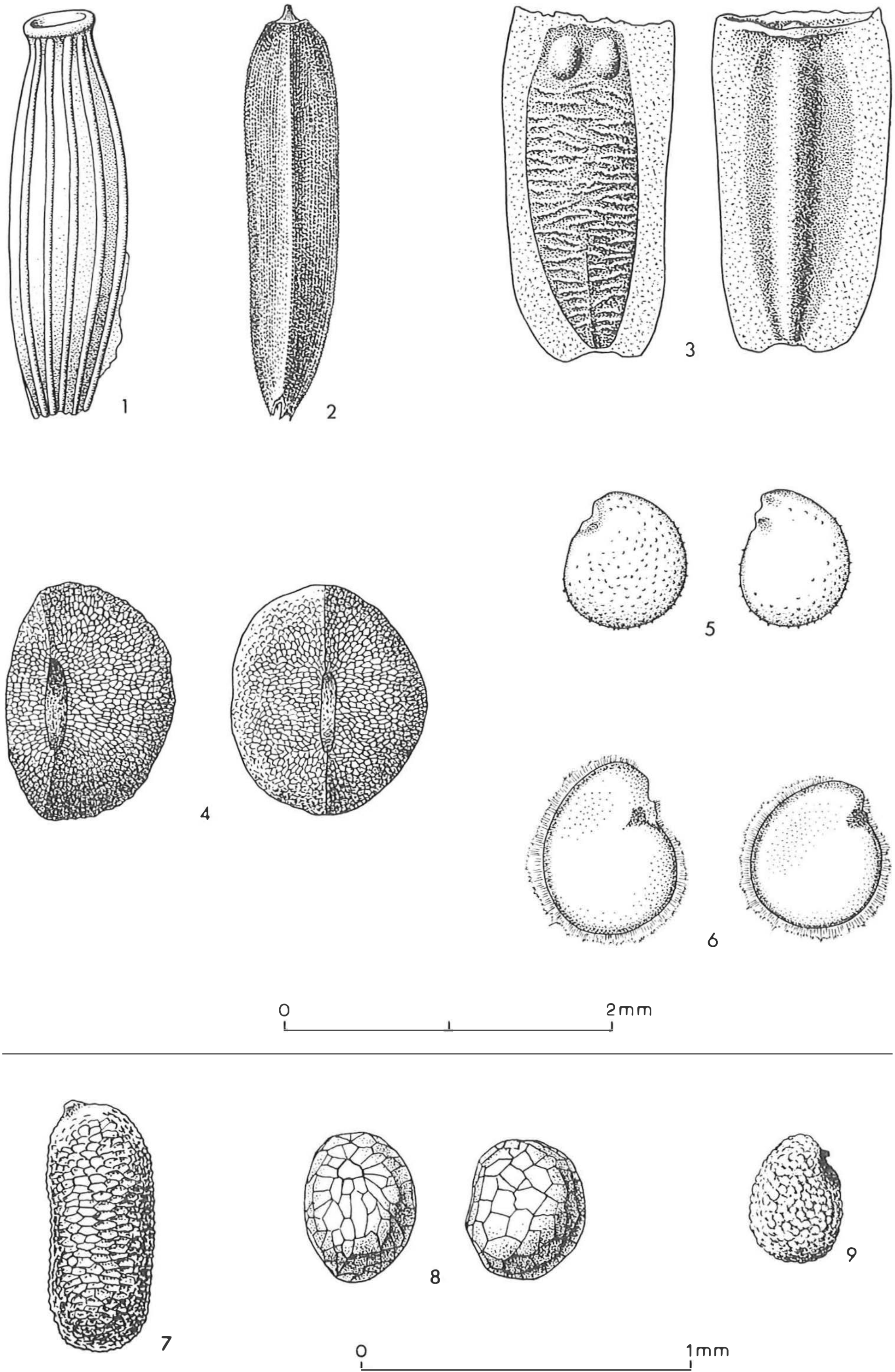

Fig. 9. 1: Senecio cf. vulgaris (Den Helder)
2: Eupatorium cannabinum (Leeuwarden)
3: Matricaria maritima ssp. inodora (Paddepoel)
4: Glaux maritima (Paddepoel)
5: Spergularia marina (Den Helder)
6: Spergularia media (Den Helder)
7: Hypericum spec. (Leeuwarden)
8: Centaurium spec. (Tzummarum)
9: Sagina spec. (Paddepoel)

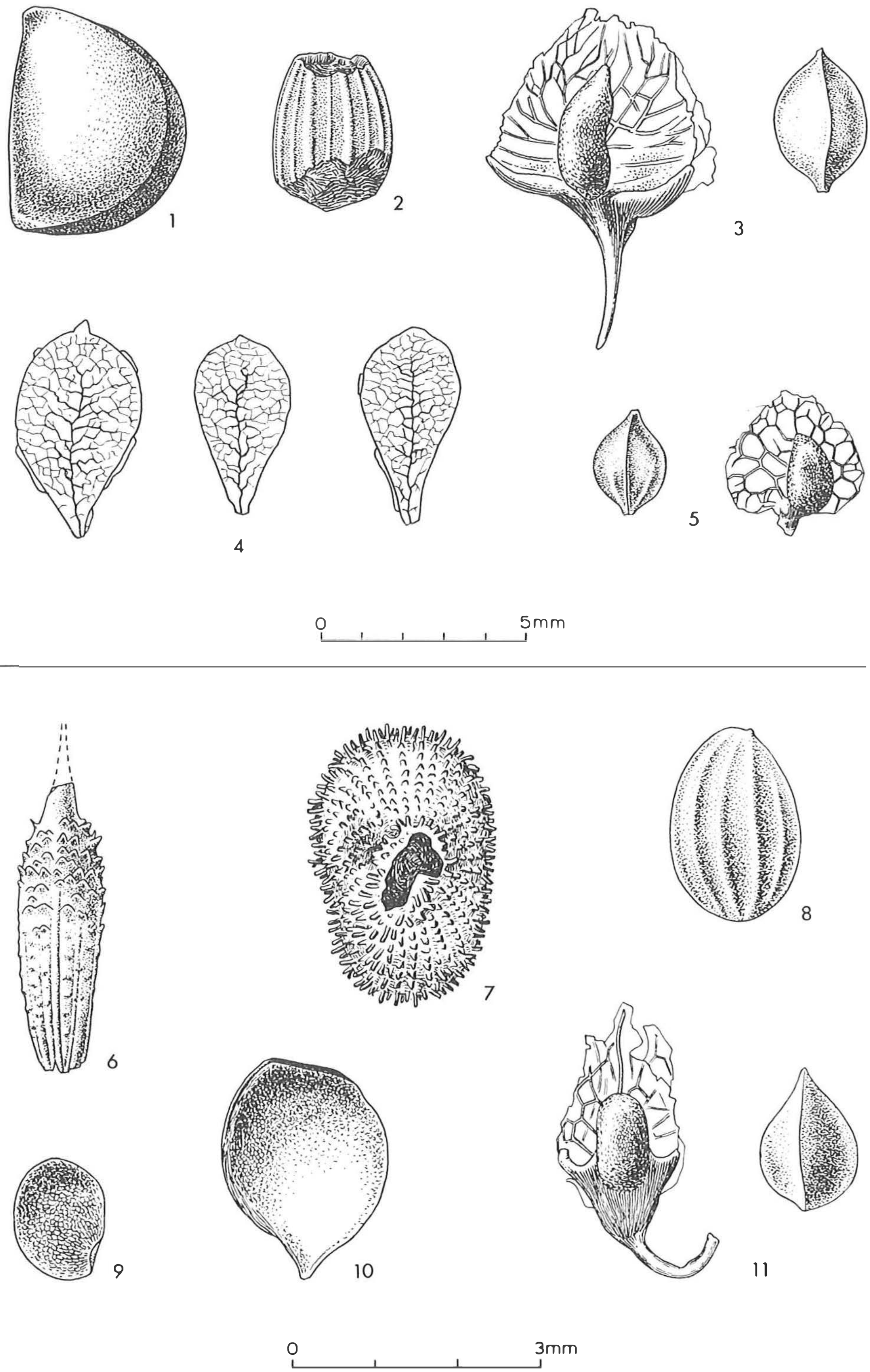

Fig. 10. 1: Potamogeton cf. pectinatus (Ezinge)
2: Raphanus raphanistrum (Den Helder
3: Rumex hydrolapathum (Vlaardingen)
4: Camelina sativa, pods (Vlaardingen)
5: Rumex crispus (Tritsum)
6: Taraxacum spec. (Paddepoel)
7: Agrostemma githago (Ouddorp)
8: Thalictrum flavum (Vlaardingen)
9: Ranunculus flammula (Schiedam)
10: Ranunculus lingua (Vlaardingen)
11: Rumex obtusifolius (Schiedam)

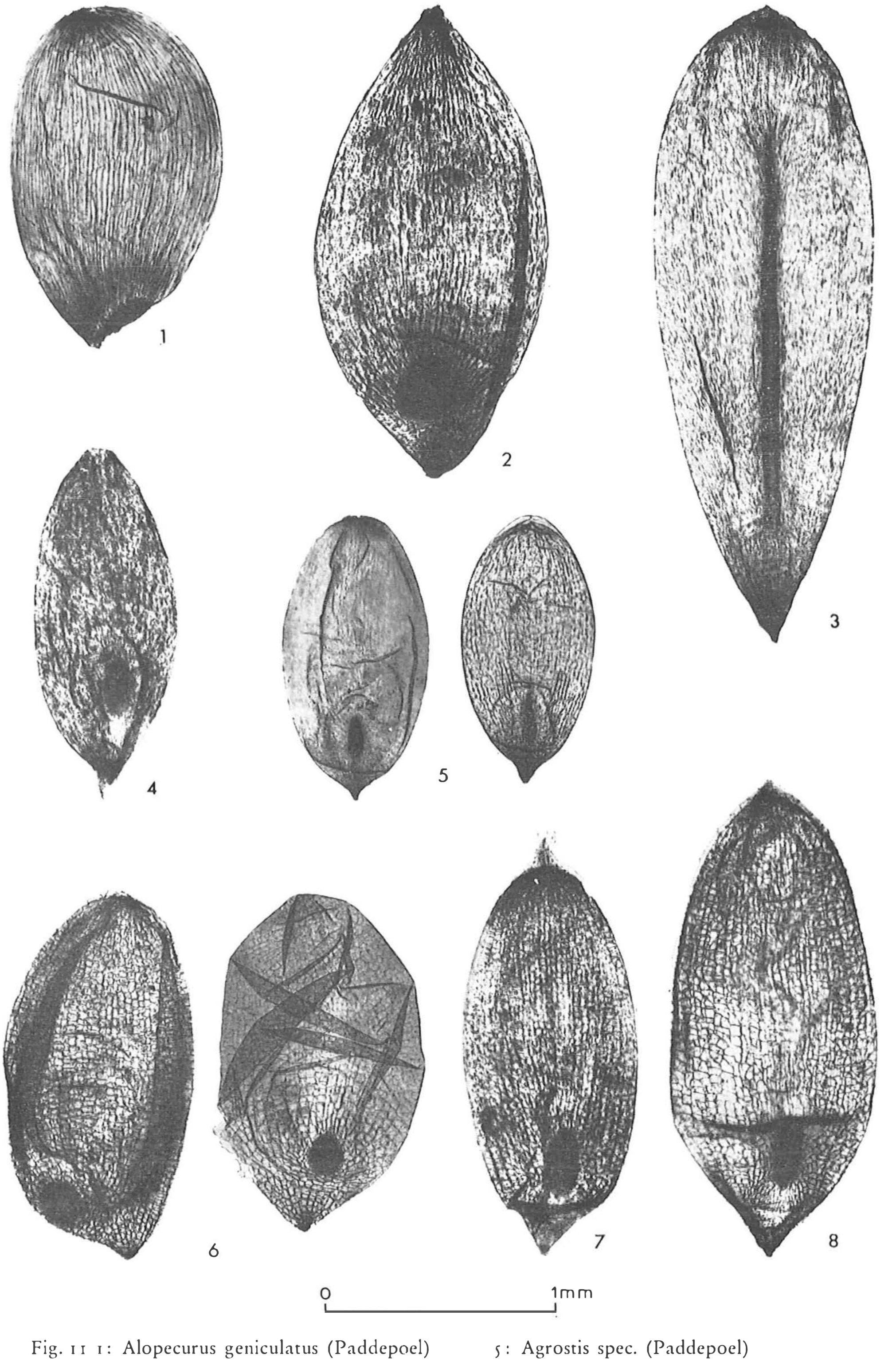

Fig. 11 1: Alopecurus geniculatus (Paddepoel)
2: Poa pratensis/trivialis (Paddepoel)
3: Festuca rubra (Paddepoel)
4: Phragmites australis (Sneek)
5: Agrostis spec. (Paddepoel)
6: Poa annua (Paddepoel)
7: Puccinellia distans (Den Helder)
8: Puccinellia maritima (Den Helder)

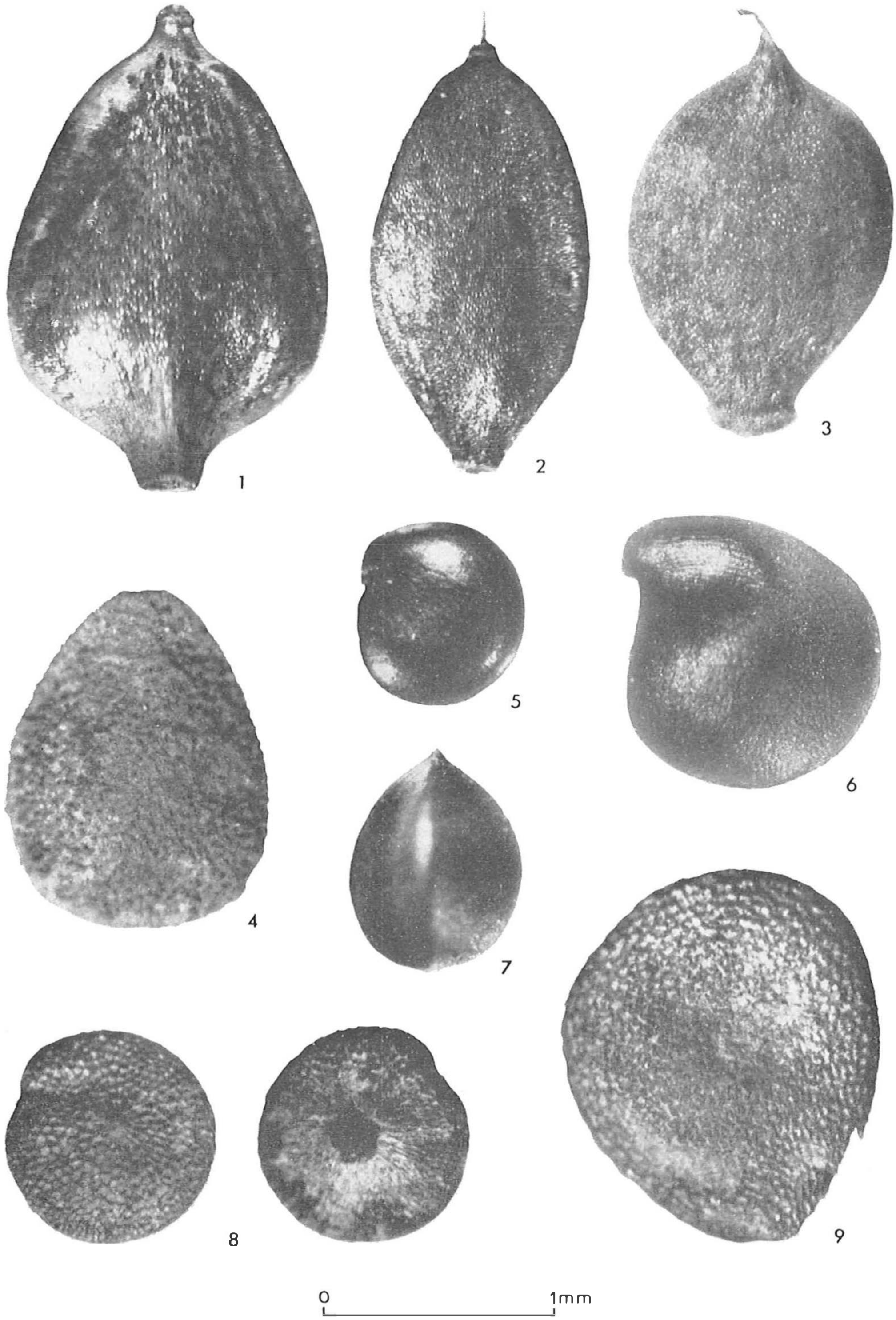

Fig. 12. 1: Carex otrubae (Paddepoel)
2: Carex disticha (Paddepoel)
3: Carex acuta-type (Paddepoel)
4: Urtica urens (Paddepoel)
5: Chenopodium rubrum/glaucum (Vlaardingen)
6: Suaeda maritima (Tzummarum)
7: Rumex acetosella (Ouddorp)
8: Chenopodium ficifolium (Paddepoel)
9: Solanum nigrum (Paddepoel)

Fig. 13. 1: Scirpus maritimus (Paddepoel)
2: Carex rostrata/vesicaria (Paddepoel)
3: Scirpus lacustris ssp. glaucus (Paddepoel)
4: Panicum miliaceum (Vlaardingen)
5: Alisma plantago-aquatica (Tritsum)
6: Linum usitatissimum (Tritsum)
7: Linum usitatissimum (Vlaardingen)
8: Pedicularis palustris (Vlaardingen)

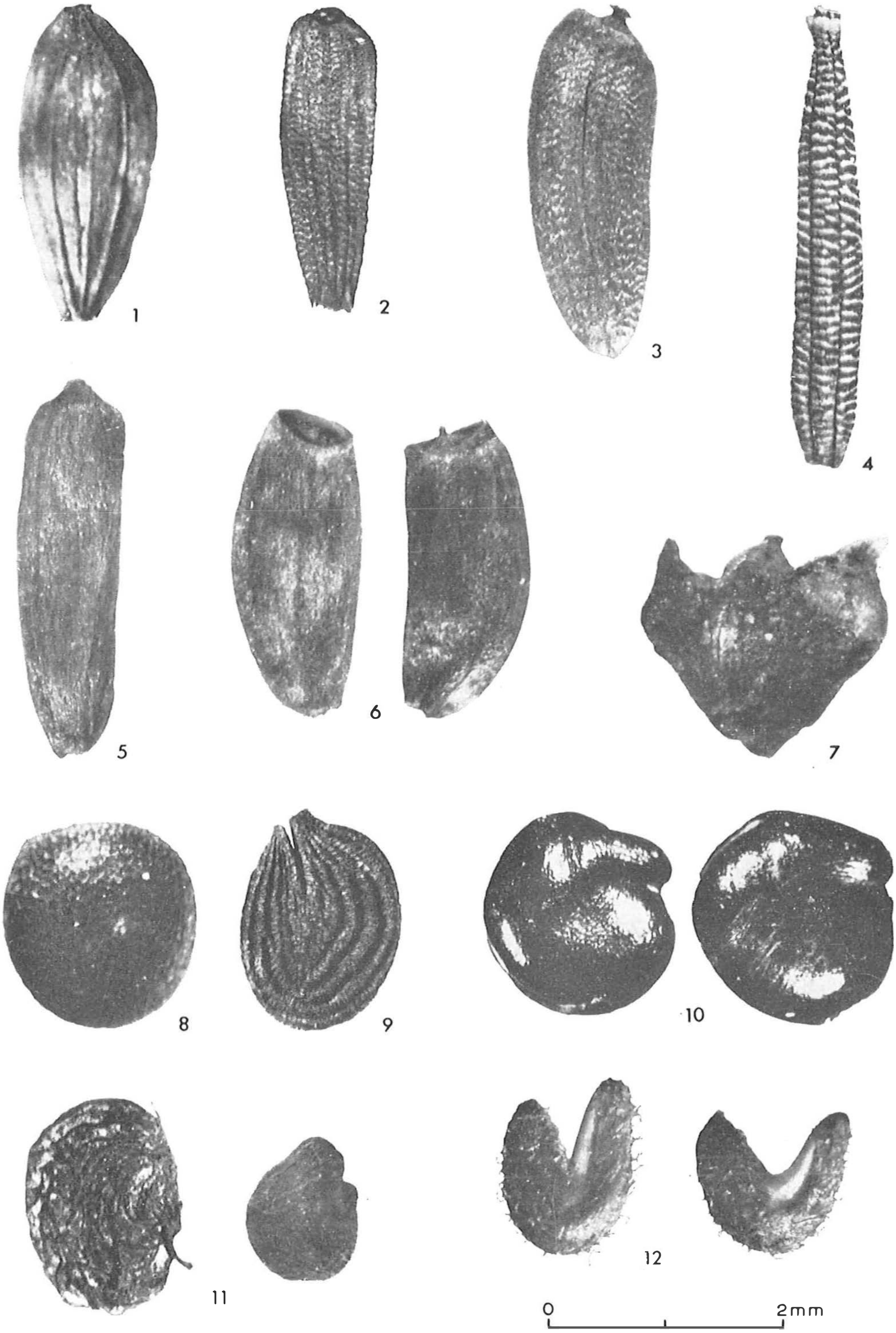

Fig. 14. 1: Sonchus asper (Paddepoel)
2: Sonchus oleraceus (Paddepoel)
3: Carduus crispus (Tritsum)
4: Leontodon autumnalis (Paddepoel)
5: Aster tripolium (Tritsum)
6: Cirsium arvense (Paddepoel)
7: Myrica gale (Vlaardingen)
8: Brassica campestris (Tritsum)
9: Thlaspi arvense (Paddepoel)
10: Atriplex hastata/patula (Tritsum)
11: Medicago lupulina (Tritsum)
12: Salicornia europaea (Tritsum)

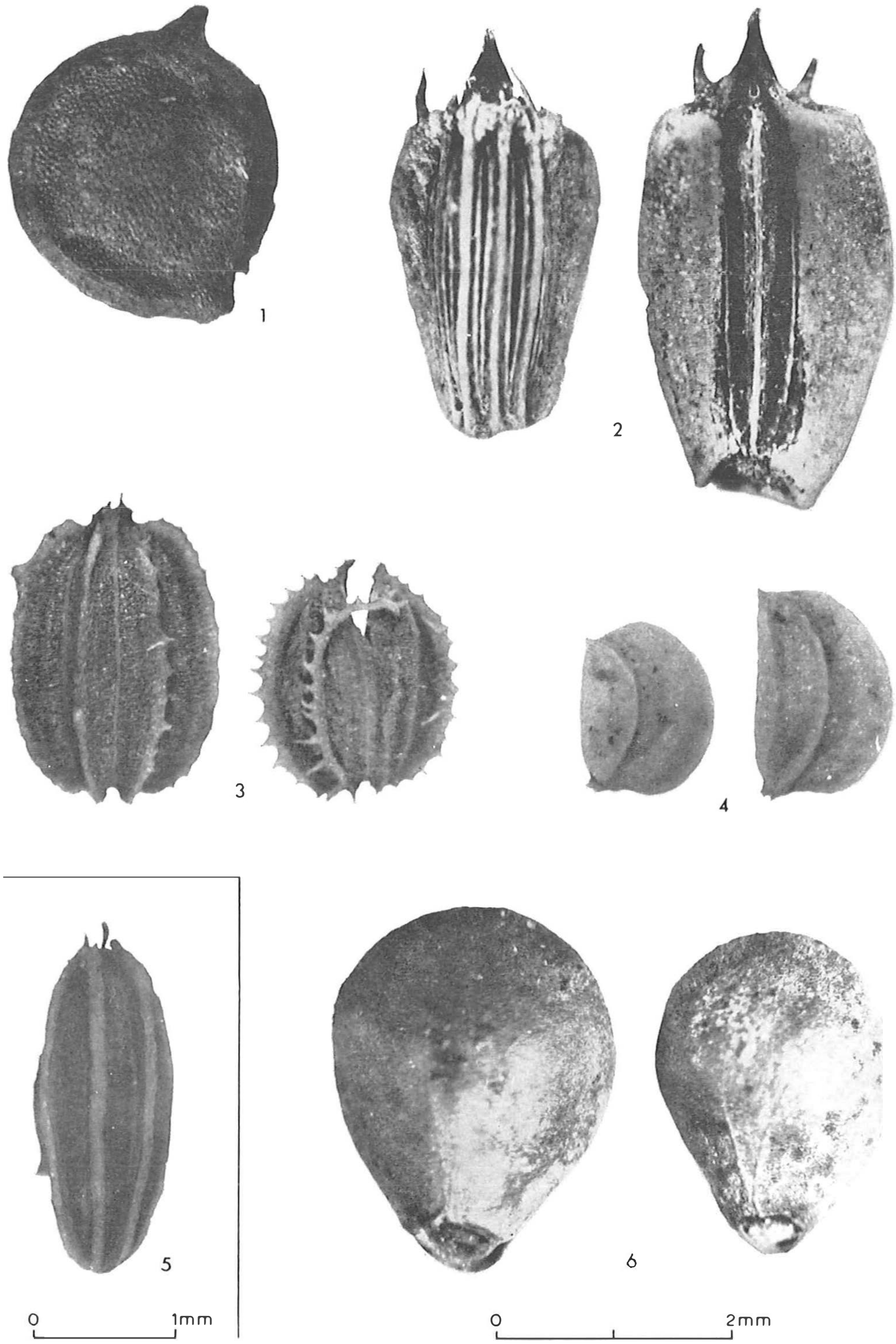

Fig. 15. 1: Ranunculus repens (Paddepoel)
2: Oenanthe fistulosa (Vlaardingen)
3: Daucus carota (Paddepoel)
4: Hydrocotyle vulgaris (Leeuwarden)
5: Oenanthe lachenalii (Tzummarum)
6: Galeopsis tetrahit/speciosa (Paddepoel)

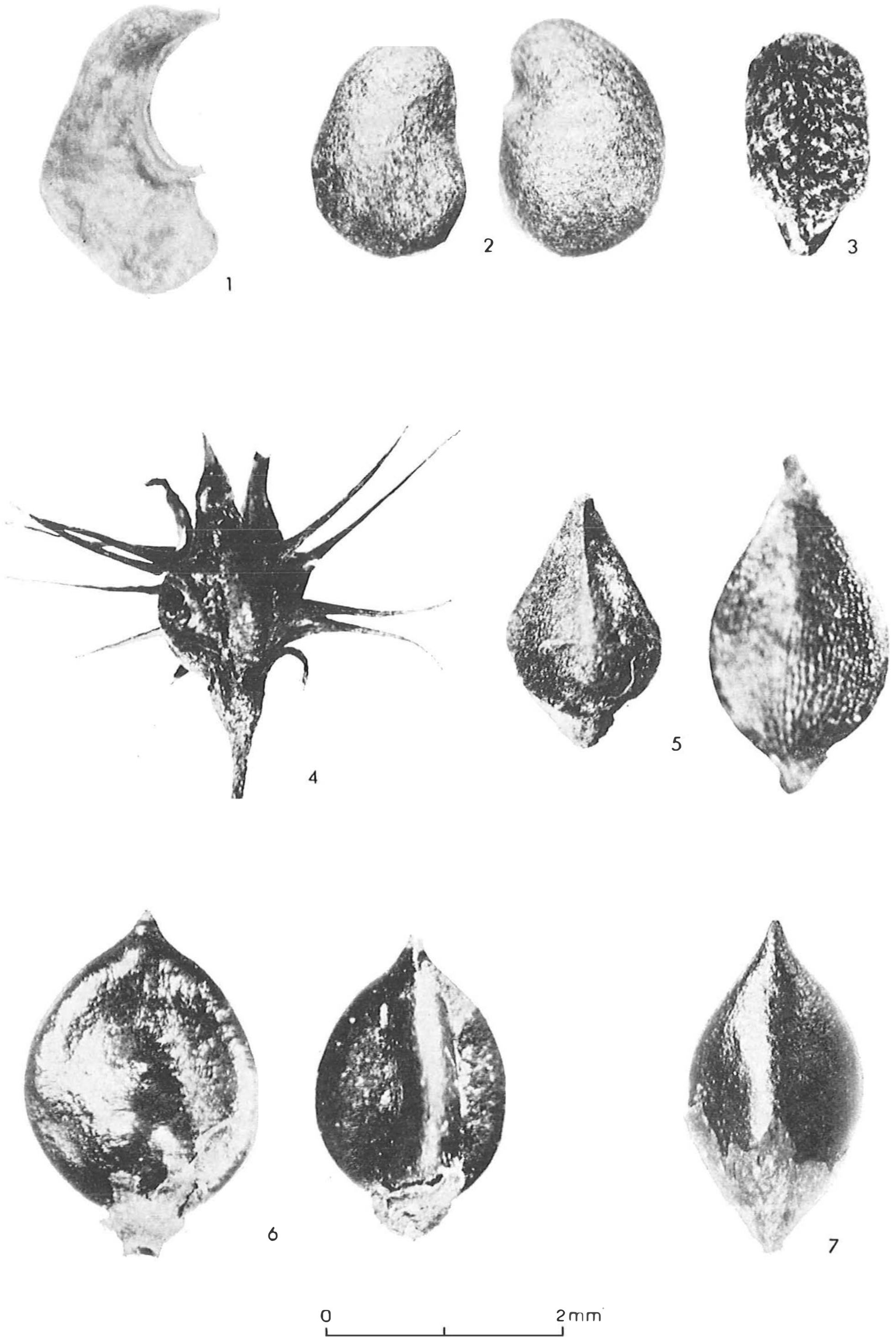

Fig. 16. 1: Filipendula ulmaria (Vlaardingen)
2: Potentilla anserina (Paddepoel)
3: Lamium purpureum (Paddepoel)
4: Rumex maritimus (Vlaardingen)
5: Polygonum aviculare (Paddepoel)
6: Polygonum persicaria (Paddepoel)
7: Polygonum hydropiper (Vlaardingen)

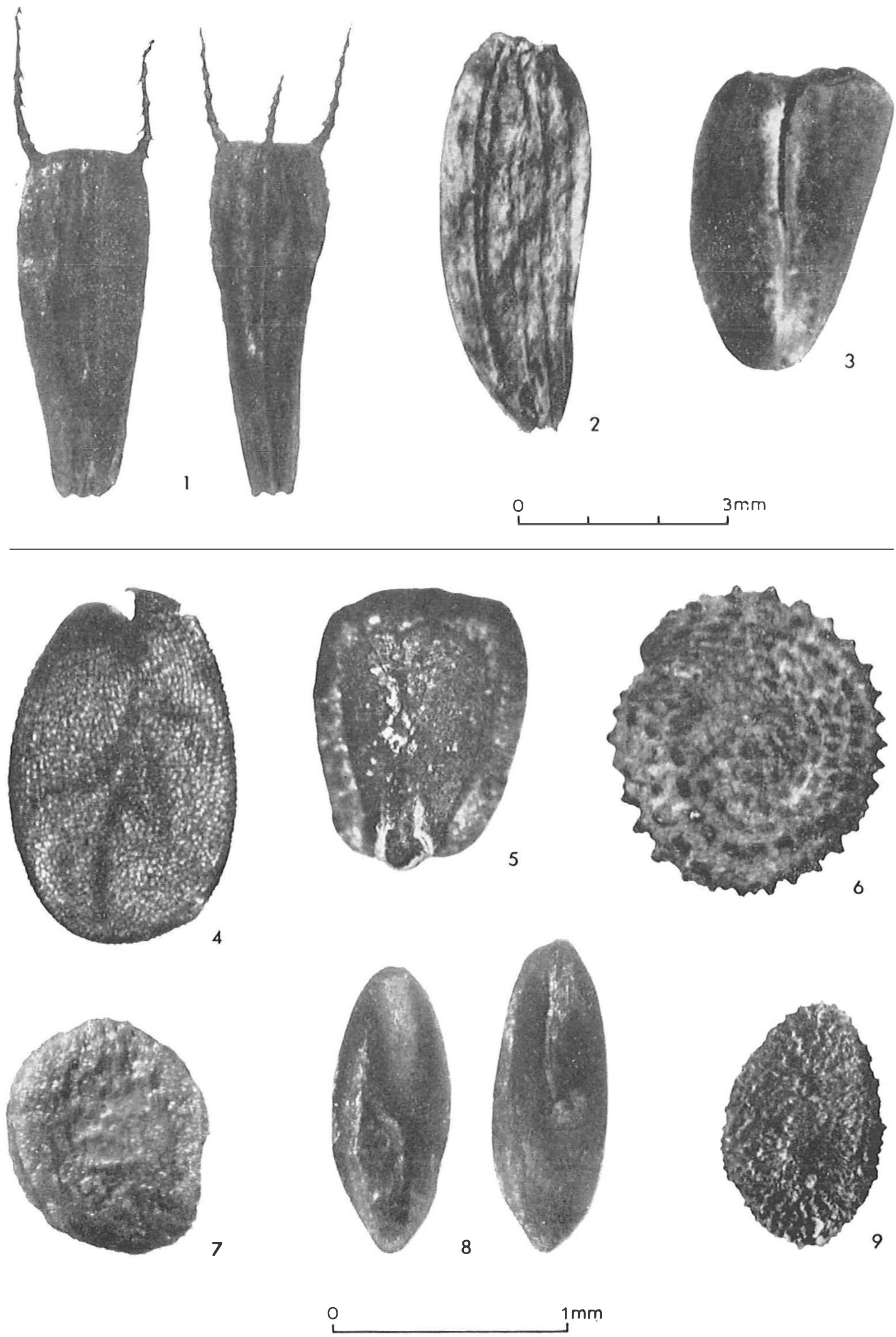

Fig. 17. 1: Bidens tripartitus (Vlaardingen)
2: Arctium cf. pubens (Schiedam)
3: Rosa pimpinellifolia (Den Helder)
4: Camelina sativa (Vlaardingen)
5: Lycopus europaeus (Vlaardingen)
6: Stellaria media (Paddepoel)
7: Ranunculus sceleratus (Paddepoel)
8: Plantago maritima (Den Helder)
9: Plantago major (Tritsum)