Synecology and syntaxonomy of Apium repens (Jacq.) Lag. and Scirpus cariciformis Vest., in particular in the eastern part of Zeeuws-Vlaanderen (Province of Zeeland, the Netherlands)

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ABSTRACT

Relevés of the rare species *Apium repens* and *Scirpus cariciformis* were tabulated and syntaxonomically interpreted.
From the presented table and from the data by FUKAREK & VOIGTLÄNDER (1982) can be concluded that both species occur in two communities of the alliance *Lolio-Potentillion anserinae*, viz. the *Nasturtio-Alopecuretum geniculati* Sýkora 1982, the *Triglochino-Agrostietum stoloniferae* Konckzak 1968, and in related fragmentary communities. Besides *S. cariciformis* grows in the *Agrostio-Trifolietum fragiferi* Sýkora 1982.

Apium repens is considered to be a character-species of the association group with *Eleocharis palustris* ssp. *uniglumis* to which the above mentioned associations belong, while *Scirpus cariciformis* can be seen as a differential species of this association group. *S. cariciformis* occurs in the *Parvocaricetea* too, sometimes with a high presence class, e.g. in the *Caricetum davallianae typicum* (presence class III) and in the subass. *blysmetosum compressi* (IV). For the present, therefore, we do not consider it to be a character-species of any of the *Lolio-Potentillion* communities, nor of the alliance itself. To our opinion the *Blysmo-Juncetum compressi* Br.-Bl. 1918 ex Libb. 1932 can hardly be characterized as a separate unit and should therefore be rejected.

With the help of ordination diagrams made by reciprocal averaging and with the use of indicator values as given by ELLENBERG (1979) the relation was illustrated between on the one hand the relevés and the composing species and on the other hand the main environmental factors, i.e. salt and nutrient content, moisture degree and acidity of the soil.

The general decline of both species can be understood as the consequence of their specific hydrological requirements, viz. their dependence on a shallow flood during winter and spring, followed by a retreat of the surface water and a groundwater level remaining close to the surface during the summer. Their disappearance from mesotraphent grasslands is accelerated by the increase in the eutrophication mainly by modern agricultural practices.

ZUSAMMENFASSUNG

In der vorliegenden Arbeit werden die pflanzensoziologischen und standörtlichen Verhältnisse der in West-Europa seltenen Arten *Apium repens* (Jacq.) Lag. und *Scirpus cariciformis* Vest. (Synonyme: *Blysmus compressus* (L.) Panz. ex Link, *Scirpus planifolius* Grimm) dargestellt, die bisher unklar bzw. umstritten waren. Die beiden Arten finden sich gelegentlich miteinander vergesellschaftet, stimmen aber dennoch in ihrem pflanzengeographischen wie auch ökologischen und pflanzensoziologischen Verhalten nicht ganz überein.

Apium repens zeigt eine westmediterran-atlantisch-subatlantische Verbreitung. Es ist in den letzten Dezennien überall in starkem Rückgang begriffen und jetzt im ganzen Areal bedroht. In den Niederlanden war es bis 1950 von 35 Lokalitäten bekannt, bis 1983 nur von zweien; 1983 wurden jedoch einige (mehr oder weniger zusammenhängende) neue Fundorte in Zeeuws-Vlaanderen (d.h. dem Festlandteil der niederländischen Provinz Zeeland) entdeckt, die beträchtliche Populationen der Art enthalten. *Scirpus cariciformis* zeigt dagegen eine weit größere, eurasiatische Verbreitung und ist insgesamt keine vom Aussterben bedrohte Art. Er ist aber in Deutschland, Belgien und den Niederlanden, wie *Apium repens*, stark zurückgegangen.

Insgesamt sind in der vorliegenden Arbeit 43 Aufnahmen in einer Tabelle geordnet und syntaxonomisch interpretiert. Die Aufnahmen sind meistens in Zeeuws-Vlaanderen erfaßt worden; eine Aufnahme mit *Apium repens* aus Belgien wurde hinzugefügt.

Aus der Tabelle sowie aus dem Schrifttum geht hervor, daß beide Arten in einigen Gesellschaften des Verbandes *Lolio-Potentillion anserinae* R.Tx. 1947 (Syn.: *Agropyro-Rumicion crispi* Nordhagen 1940 em. Tx. 1950 p.p.) auftreten, und zwar im *Nasturtio-Alopecuretum geniculati* Sýkora 1982, im *Triglochino-Agrostidetum stoloniferae* Konckzak 1968, im

Agrostio-Trifolietum fragiferi Sýkora 1982 sowie in diesen nahestehenden Gesellschaftsfragmenten. Sie kommen dagegen nicht oder kaum in der häufigsten und meist bekannten Assoziation jenes Verbandes, dem *Ranunculo-Alopecuretum geniculati* R.Tx. 1937 vor. Die ersteren Gesellschaften gehören der Assoziationsgruppe mit *Eleocharis palustris* ssp. *uniglumis* des *Lolio-Potentillion anserinae* an. *Apium repens* ist als Kennart dieser Assoziationsgruppe zu betrachten, *Scirpus cariciformis* dagegen nur als Trennart, weil er auch in den *Parvocaricetea* auftritt, teilweise auch mit hoher Stetigkeit, z.B. im *Caricetum davallianae typicum* (Präsenz III) und *blysmetosum compressi* (Präsenz IV). Es wird weiterhin erläutert, daß und weshalb das *Blysmo-Juncetum compressi* Br.-Bl. 1918 ex Libb. 1932 u.E. nicht als Assoziation beibehalten werden kann.

Die Beziehungen zwischen den Aufnahmen mit den darin begriffenen Arten und den wichtigsten Umweltfaktoren (Salz- und Nährstoffgehalt, Bodenfeuchte und Bodensäuregrad) werden mit Ordinationsdiagrammen erläutert. Diese Diagramme entstammen dem Vorgang der "reciprocal averaging", mit Einbeziehung der Zeigerwerte nach ELLENBERG (1979).

Der Rückgang der beiden Arten hängt offenbar mit ihren spezifischen hydrologischen Bedingungen zusammen; sie bedürfen nämlich einer leichten Überflutung des Geländes im Winter und Frühjahr sowie eines hohen Sommergrundwasserspiegels dicht unter der Bodenoberfläche. Ihr Verschwinden aus mesotraphentem Grünland wurde von der rezenten agrartechnisch bedingten Eutrophierung beschleunigt.

INTRODUCTION

After the year 1950 *Apium repens* was only known from two hour-squares in the Netherlands (HATTINK 1980). Before 1950 it had been recorded from 35 hour-squares. In 1983 a number of new localities of this species was discovered in the eastern part of Zeeuw-Vlaanderen (province of Zeeland, The Netherlands) by Mr. R. MOOIJ and Mr. G. van ZUYLEN, and in October of the same year some relevês were made (table 1). Some time before a location in Belgium, indicated by the Belgian botanist H. VANNEROM, had been sampled. This relevé (nr. 21) has been added to the table for comparison.

Scirpus cariciformis (syn. *Scirpus planifolius, Blysmus compressus)* which is also rare in the Netherlands, was found in the proximity of *Apium repens* in a number of cases. The species were, however, mostly found separately and under somewhat different habitat conditions. Like *Apium repens*, *Scirpus cariciformis* showed a considerable decline during recent years (WEEDA 1984). For both reasons we also pay attention to *Scirpus cariciformis* in this paper.

A number of relevês were derived from literature (DEN HELD 1982, WESTHOFF et al. 1961). The relevês nr. 18-20 have been added to the table after the construction of the ordination diagrams, which explains their absence in these figures.

Apium repens has a westmediterranean-atlantic-subatlantic distribution and is a threatened species throughout Europe (FUKAREK & VOIGTLÄNDER 1982). On the other hand, *Scirpus cariciformis* does not occur on the list of species which are threatened in Europe and besides has an eurasiatic and consequently more extensive distribution (LUCAS & WALTERS 1976, OBERDORFER 1979). In Germany and Belgium this species is respectively endangered or rare to very rare (KORNECK 1984, DE LANGHE et al. 1978).

METHODS

Relevês were made using the Braun-Blanquet scale as refined by BARKMAN, DOING & SEGAL (1964). After ordinal transformation (VAN DER MAAREL 1979) the table was structured by means of the TWINSPAN computer program (HILL 1979). This program performs a divisive clustering on the basis of reciprocal averaging.

According to the latter method, using the program DECORANA, ordination diagrams were constructed of both the relevês and the species (fig. 2 and 3). In reciprocal averaging, species scores are averages of the stand scores and reciprocally the stand scores are averages of the species scores (HILL 1973). Thus an adequate species ordination is used to derive the stand ordination and vice versa.

Subsequently the ordination diagrams were interpreted by means of the indication values for soil moisture, acidity, nitrogen content and salinity (ELLENBERG 1979). In a few cases values were made up with the help of the habitat descriptions as published by OBERDORFER (1979). In the species ordinations the values were directly filled in on the appropriate places. In the relevé ordinations mean indication values were calculated on the basis of the presence of the species. For a more extensive discussion of the merits and demerits of this method we refer to BOCKER et al. (1983).

The names of the syntaxa are according to WESTHOFF & DEN HELD (1969) and SÝKORA (1983a). The phanerogams are named according to HEUKELS & VAN DER MEIJDEN (1983).

SYNTAXONOMY AND SYNECOLOGY (table 1)

Apart from nrs. 15 and 21, all relevés with *Apium repens* can be assigned to the association group with *Eleocharis palustris* ssp. *uniglumis* (alliance *Lolio-Potentillion anserinae* R.Tx. 1947), more specifically to the *Nasturtio-Alopecuretum geniculati* Sýkora 1982. The latter unit is characterized by *Plantago major, Potentilla anserina, Poa annua, Sagina procumbens (Plantaginetea), Agrostis stolonifera, Alopecurus geniculatus, Rumex crispus, Juncus inflexus, Poa trivialis* (all. *Lolio-Potentillion), Rumex conglomeratus (Lolio-Potentillion + Bidention), Eleocharis palustris* ssp. *uniglumis, Carex cuprina, Phragmites australis* (all association group with *Eleocharis palustris* ssp. *uniglumis)* and *Glyceria plicata* ssp. *declinata, Ranunculus sceleratus, R. sardous, Veronica catenata, Epilobium parviflorum, Nasturtium microphyllum* (all *Nasturtio-Alopecuretum geniculati).*

Lolio-Potentillion anserinae R.Tx. 1947 is the appropriate and correct name for the syntaxon which is usually named "*Agropyro-Rumicion crispi*". In its proper sense, the *Agropyro-Rumicion crispi* Nordhagen 1940 is a group of Norwegian sea shore communities. TÜXEN (1950) extended this concept to include the inland communities previously described by him under the name *Lolio-Potentillion anserinae.* SÝKORA (1980) has argued, however, that two different alliances are concerned.

The *Lolio-Potentillion anserinae* is found on all kinds of relatively nutrient-rich hydromorphic soils varying from sand to heavy clay soils and from mineral to peaty soils. It is optimally developed on pastures which are inundated during winter and spring. A long limose phase (HEJNY 1960) offers favourable conditions, and secundary flooding during the growing season is tolerated. Concerning the proportion of the species, the date on which the inundation occurs is of great importance for the relative participation of the species in the vegetation (SÝKORA 1983b, SÝKORA in prep.).

Within the *Lolio-Potentillion*, the association group with *Eleocharis palustris* ssp. *uniglumis* is restricted to the stenosaleutic ecotope (KOPECKY 1969). This implies habitats in which the difference between maximum and minimum water level does not exceed 60 cm, thus presenting not very dynamic hydrological conditions with a never desiccating soil surface. The *Nasturtio-Alopecuretum* occurs on very soft, severely poached nutrient-rich sandy clay soils, which are water-logged during almost the whole year. The water level is situated at 10-20 cm above the soil surface during the greater part of the year (SÝKORA 1982a).

The relevés 15 and 21 represent fragmentary communities. In the case of relevé 15 the circumstances are too dry for most of the species characteristic of the *Lolio-Potentillion.* Possibly the intensive trampling also plays an important part here. Relevé 21 has been made in Belgium, namely on the Polterybroek between Halen and Herk-de-stad (Limburg), a commonage pasture which has been constantly managed in the same way since time immemorial. In this relevé the aspect is formed by *Alopecurus geniculatus*, a species with a high fidelity degree concerning the *Lolio-Potentillion.* The species composition does not allow to assign this relevé to one of the associations belonging to this alliance. When the relevé was made *Apium repens* was difficult to find, because only few individuals occurred. In former years, however, the population of the species was much larger here (H. VANNEROM, personal communication). This decline, as well as the syntaxonomical vagueness mentioned above might be the effect of a hydrological "shock". In 1983, the habitat appeared not to belong to the stenosaleutic but clearly to the eurysaleutic ecotope with fluctuations in the water level of more than 60 cm. In October the subsoil water was situated far below the ground surface, while the whole commonage is inundated every winter. Such hydrological conditions (as observed in 1983) are charakteristic of the *Ranunculo-Alopecuretum.*

Table 1. Lolio-Potentillion anserinae with Apium repens and Scirpus cariciformis.

The numbers before the names of the species correspond with the numbers in fig.3a, Species ordination.

Combined estimation: By ordinal transformation the figures 1-9 correspond with the cover-abundance values after the Braun-Blanquet scale (refined by Barkman et al. 1964) as follows: 1 = r; 2 = +; 3 = 1; 4 = 2m; 5 = 2a; 6 = 2b; 7 = 3; 8 = 4; 9 = 5.

Cluster number	1														2	3		4			5	6					7				8						9				10		11
Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
Date: Year (19..)	83	83	83	83	83	83	83	83	83	78	78	78	83	83	83	79	79	83	83	83	83	79	79	79	79	79	79	79	79	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Month	10	10	10	10	10	10	10	10	10	6	6	6	10	9	9	6	6	10	10	10	9	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6	6	7	7	7
Location 2)	C	C	C	C	C	C	C	Ho	GE	GE	GE	VK	C	HV	HV	LM	LM	C	GE	GE	BP	HH	HH	HH	HH	Bz	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	KH	W	W	W
Size in m2	4	4	2½	1½	2	4	3	20	1	20	9	2	2	16	3	300	280	2	1		4	1	4	3	4	4	4	4	4	1	2½	1½	1	1	2	2	4	4	8	1	2	1½	2
Cover of the herb layer	70	60	100	70	100	60	70	90	100	70	70	100	100	76	85	50	85	95	80	95	100	90	95	100	100	100	100	98	95	90	100	100	90	90	100	95	100	70	95	100	100	100	95
Number of phanerogams	23	19	19	17	18	21	26	26	16	29	20	15	27	35	18	42	43	24	14	15	12	27	28	20	31	20	23	28	22	21	21	18	20	20	14	14	23	19	23	31	32	31	20
7 Apium repens	6	6	5	7	6	5	5	2	.	.	.	.	.	2	6	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
129 Scirpus cariciformis	.	.	.	.	.	.	.	.	5	2	3	2	5	2	2	4	5	4	4	4	.	3	4	3	4	2	4	4	5	2	5	5	5	5	9	2	5	2	2	5	7	5	5
Plantaginetea:																																											
97 Plantago major	2	2	.	2	.	3	2	3	2	4	3	2	.	5	2	2	2	.	4	3	.	2	.	.	.	2	2	3	3	.	3	2	.	.	2	.	2	.	2	.	.	.	.
104 Potentilla anserina	.	.	.	.	.	.	2	.	.	3	3	5	2	2	.	.	.	2	.	.	3	6	6	5	4	7	5	7	7	2	2	.	.	.	.	.	2	5	.	.	.	3	.
99 Poa annua	.	.	.	.	.	.	.	.	.	.	.	.	.	2	6	4	3	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
124 Sagina procumbens	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.
14 Capsella bursa-pastoris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lolio-Potentillion:																																											
3 Agrostis stolonifera	3	3	9	.	2	7	7	8	.	8	8	8	4	5	4	4	4	5	4	.	5	5	6	6	5	7	7	5	7	5	2	2	2	2	.	3	7	5	2	.	2	2	.
4 Alopecurus geniculatus	3	3	3	2	.	2	.	.	.	3	5	5	4	.	.	3	3	.	.	.	8	5	6	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
118 Rumex crispus	.	.	.	.	.	.	.	.	.	3	2	.	.	.	.	2	.	.	.	.	2	2	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
71 Juncus inflexus	.	2	2	2	2	.	.	2	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	2	.	.	.	.
101 Poa trivialis 1)	7	6	4	7	8	4	5	4	8	5	5	6	7	.	6	5	6	7	4	7	.	5	.	.	5	.	3	6	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.
Lolio-Potentillion + Bidention																																											
117 Rumex conglomeratus	2	.	3	2	2	2	3	3	2	.	.	.	.	3	.	.	.	.	.	2	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculo-Alopecuretum																																											
23 Carex hirta	2	.	.	.	2	.	2	.	2	2	.	3	.	.	.	4	4	3	4	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
84 Myosotis palustris	4	.	.	.	.	6	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
81 Lysimachia nummularia	2	3	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
136 Taraxacum s. Vulgaria	2	.	.	.	.	2	.	.	.	.	.	.	.	.	.	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
43 Elymus repens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
69 Juncus compressus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
102 Polygonum amphibium	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
59 Glechoma hederacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
61 Glyceria maxima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
92 Phalaris arundinacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
115 Rorippa sylvestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
106 Potentilla reptans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
49 Equisetum palustre	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	5
Association group with Eleocharis palustris ssp.uniglumis																																											
41 Eleocharis palustris ssp.uniglumis	3	.	4	.	3	2	.	.	3	3	3	3	.	2	.	4	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
25 Carex cuprina	.	.	2	.	2	.	2	3	.	.	.	.	.	4	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.
94 Phragmites australis	.	.	2	.	2	.	.	3	.	.	.	2	.	4	.	.	2	.	.	.	.	2	.	3	2	3	.	.	.	3	2	2	3	3	3	.	3	2	5	3	.	.	.
Nasturtio-Alopecuretum																																											
58 Glyceria plicata ssp.declinata	4	.	.	3	.	3	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
113 Ranunculus sceleratus	.	.	.	2	.	2	.	2	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
112 Ranunculus sardous	.	.	.	.	.	.	.	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
144 Veronica catenata	.	.	2	2	.	.	.	2	.	2	2	.	.	2	.	.	.	2	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
46 Epilobium parviflorum	.	.	.	.	.	.	.	2	.	.	2	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
85 Nasturtium microphyllum	.	.	.	.	.	.	.	.	.	2	2	.	.	2	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Triglochino-Agrostietum																																											
68 Juncus articulatus	3	4	.	5	3	4	4	.	2	2	2	3	2	3	2	.	2	4	4	3	3	3	3	5	4	3	3	3	3	2	4	5	5	5	.	3	3	2	4	3	5	3	2
141 Triglochin palustris	2	4	3	.	3	.	.	3	2	3	3	2	2	3	.	3	4	4	.	4	.	3	.	.	3	.	2	3	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
55 Galium palustre	4	4	.	.	.	2	.	.	.	2	.	.	.	.	.	.	2	.	.	.	.	2	5	3	3	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
83 Myosotis laxa	3	4	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2	3	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	2	.
24 Carex nigra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	3	6	7	7	5	.	.	2	.	.	.	.	.	.	.	5	.	5	.	3	3	5
[illegible] Ranunculus flammula																						3	4	3	4			2									3	2	2		3		

Triglochino-Agrostietum Ranunculetosum repentis																																											
111 Ranunculus repens	7	5	.	6	2	3	5	2	5	2	.	.	2	4	.	5	.	3	5	4	3	6	2	5	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	2
76 Lolium perenne	.	.	.	.	.	.	.	.	.	.	.	3	.	3	7	.	4	2	4	.	.	3	.	.	2	.	.	2	3	.	.	.	.	.	.	2	.	.	.	.	.	.	.
Agrostio-Trifolietum fragiferi																																											
137 Trifolium fragiferum	.	.	.	.	5	.	.	.	.	.	.	.	3	2	.	.	2	4	.	.	2	5	5	5	5	5	5	5	5	2	.	2	.	.	2	.	5	.	2	.	3	.	.
57 Glaux maritima	.	.	.	.	.	.	.	2	.	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	4	5	4	5	5	4	3	3	3	3	2	3	.	2	2	.	.	.
70 Juncus gerardi	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	3	.	5	7	7	5	8	3	3	3	3	3	2	3	2	5	3	.	.	.
21 Carex distans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	5	5	5	2	5	5	5	2	2	3	3	3	5	.	.	.
31 Centaurium pulchellum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrostio-Trifolietum Festucetosum rubrae																																											
54 Festuca rubra	.	.	.	.	.	.	.	.	.	.	.	.	.	4	7	5	5	.	.	.	.	.	.	.	.	.	3	5	2	2	2	2	5	5	.	5	.	3	.	3	3	5	5
100 Poa pratensis	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	4	.	.	.	.	.	.	.	.	.	.	3	2	.	2	.	.	.	.	.	2	2	.	2	2	3	2	2
32 Cerastium fontanum	.	.	.	.	.	.	.	.	.	2	.	.	.	2	2	.	2	.	3	.	.	.	.	.	.	.	2	2	2	.	.	.	.	.	.	5	.	.	.	2	.	.	.
95 Plantago coronopus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2	.	2	2	.	2	.	.	.	.	.	.	.
98 Plantago maritima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.
50 Odontites verna ssp. serotina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	2	.	.	.	2	.	.	.	.	.	.	.
89 Ononis spinosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	2	.	3	.	.	.	2	.	.	.
140 Triglochin maritima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.
30 Centaurium littorale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
37 Cochlearia danica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
42 Elymus pycnanthus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.
77 Lotus corniculatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	2	.	5
Phragmitetea																																											
39 Eleocharis palustris ssp.palustris	.	.	.	.	.	.	.	4	.	.	.	.	.	5	.	4	3	.	.	.	5	.	5	5	2	4	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.
80 Lycopus europaeus	.	.	.	2	.	.	.	.	2	.	.	.	.	2	.	.	.	.	.	2	.	5	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
60 Glyceria fluitans	.	4	.	.	.	.	.	.	.	2	.	.	.	.	.	4	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
128 Scirpus maritimus	.	3	.	.	.	.	.	.	.	.	2	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
127 Scirpus lacustris ssp.tabernaemontani	.	.	2	.	.	.	.	3	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
86 Oenanthe aquatica	.	.	.	.	.	.	.	2	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
45 Epilobium cf.obscurum	.	.	.	.	.	.	2	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
47 Epilobium cf.tetragonum	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
64 Hippuris vulgaris	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
87 Oenanthe fistulosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2 Acorus calamus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
18 Carex acuta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
26 Carex riparia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
132 Sparganium erectum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
143 Veronica beccabunga	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Molinio-Arrhenatheretea																																											
79 Lychnis flos-cuculi	2	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
139 Trifolium repens	5	6	7	2	7	5	.	4	8	2	2	5	7	3	.	3	5	5	5	7	.	.	2	.	.	.	3	6	2	2	3	2	2	2	.	3	2	.	.	.	.	.	.
10 Bellis perennis	2	.	.	.	2	3	5	3	2	4	3	.	6	5	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	.	.	2	2	.	2	3	2	2	3
65 Holcus lanatus	.	.	.	.	.	.	2	.	3	.	.	.	2	4	.	4	4	4	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	4	3	2	2	.
17 Cardamine pratensis	2	3	.	2	3	.	.	2	2	.	.	.	3	5	6	3	3	4	4	3	.	2	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
96 Plantago lanceolata	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	3	3	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
116 Rumex acetosa	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
20 Carex disticha	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	2	.	.	.	.	.	3	3	3	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
53 Festuca pratensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
93 Phleum pratense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
62 Heracleum sphondylium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
5 Angelica sylvestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
38 Cynosurus cristatus	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	4	4	.	6	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	3	.	5	.
73 Leontodon autumnalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	3	2	2	4	3	3	3	2	3	2	2	3	3	2	2	.	.	.	2	2	.	.
109 Ranunculus acris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	2	3	3	.
138 Trifolium pratensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	2	.	.	.	2	.	2	.
6 Anthoxanthum odoratum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.
1 Achillea millefolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
145 Viccia cracca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
107 Prunella vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	5	.
29 Centaurea jacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	3
12 Briza media	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	5	.
35 Cirsium palustre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	3	.

Nanocyperion																																											
67 Juncus bufonius s.l.	.	.	3	2	.	2	3	3	.	4	5	2	2	4	3	5	.	3	.	.	.	5	.	.	4	.	3	2	5	2	.	.	.	.	.	.	.	.	.	.	.	.	.
123 Sagina nodosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.
Caricion davallianae																																											
40 Eleocharis quinqueflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	5	4	.	5	7	7	5	5	5	.	2	.	.	2	5	.	.
22 Carex flacca	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	3	5	7	7	5	5	3	2	.	3	5	5	5
134 Taraxacum limnanthes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	2	2	2	2	.	.	.	.	.	3	.	.
91 Parnassia palustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	4	2	3	.
27 Carex trinervis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.
56 Galium uliginosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Violion caninae																																											
131 Danthonia decumbens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	5
125 Salix repens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2
105 Potentilla erecta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
146 Viola canina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
Remaining species																																											
82 Mentha aquatica	2	3	3	.	.	2	2	4	6	3	.	.	2	4	2	.	.	2	4	5	.	5	5	6	5	2	.	2	.	.	.	.	.	.	.	.	3	2	3	2	3	2	.
52 Festuca arundinacea	2	3	.	2	2	3	5	.	.	.	.	.	2	.	.	.	.	2	.	.	.	.	.	.	.	.	2	2	2	.	2	.	2	2	2	.	5	3	5	2	2	2	.
88 Oenanthe lachenalii	.	.	2	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	3	3	.	.
9 Atriplex prostrata	.	.	2	.	.	.	.	2	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
126 Samolus valerandi	.	.	2	.	.	.	.	2	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
8 Aster tripolium	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
44 Epilobium hirsutum	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
33 Chenopodium rubrum	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
103 Polygonum persicaria	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
114 Rorippa palustris	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
121 Rumex palustris	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
133 Symphytum officinale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
16 Cardamine hirsuta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
51 Festulolium x loliaceum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
119 Rumex obtusifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
120 Rumex cf. x schreberi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
142 Tussilago farfara	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eleocharis palustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
11 Bidens tripartita	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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74 Leontodon saxatilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	2	2	2	3	3	.	4	.	.	.	2	3	2	.
78 Lotus tenuis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	2	.	.	2	2	.	.	.	.	.	2	.	.	.
75 Linum catharticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2	2	.	.	.	.	.	2	.	2	.
63 *Hippophae rhamnoides*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	.	.	.	.	.	2	.	2	.	.	2	.	.
36 Cirsium vulgare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
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13 Bromus hordeaceus ssp.hordeaceus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
28 Desmazeria marina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
72 Juncus maritimus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
135 Taraxacum species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	2	.	2	3
108 Pulicaria dysenterica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.
130 Senecio jacobaea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
19 Carex arenaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2

1) Constant companion of the Lolio-Potentillion anserinae.

2) Location:
(ZH = Province Zuidholland; Z-Vl = Zeeuws-Vlaanderen, Province Zeeland)
Ba = Bankpolder (ZH)
BP = Belgium, Polterbroek
C = Canisvliet (Z-Vl)
GE = Groot Eiland (Z-Vl)
Ho = Hontenisse (Z-Vl)
HH = Hoek van Holland, Haakpad (ZH)
HV = Hontenisse, Kreek "de Vogel" near Hengstdijk (Z-Vl)
LM = Leidschendam, Molenvaart (ZH)
VK = Vlaamse Kreek (Z-Vl)
W = Westhoofd, Goeree (ZH).

Mosslayer (not or insufficiently studied in a number of cases):

Drepanocladus aduncus: rel.2 (cover ?), 4(2), 6(2), 10(2), 11(2), 13(2), 18(?), 19(?), 21(8), 23(5), 25(3), 30(3), 31(5), 32(3), 33(2), 35(3), 36(5), 37(3), 41(2);
Calliergonella cuspidata: 2(?), 5(2), 11(2), 18(?), 19(?), 20(?), 23(5), 24(2), 25(3), 26(2), 37(5), 38(2), 39(2), 41(7);
Brachythecium rutabulum: 6(2), 9(2), 10(2), 11(2), 13(5), 20(?), 23(2), 24(2);
Amblystegium serpens: 1(6), 4(5), 13(2), 19(?), 20(?), 36(2);
Campylium polygamum: 30(5), 33(5), 34(5), 37(9);
Bryum capillare: 6(3), 7(3);
Leptobryum pyriforme: 4(3), 13(2);
Dicranella heteromalla: 6(5), 18(?);
Brachythecium albicans: 32(?), 36(3);
Bryum pseudotriquetrum: 42(3), 43(5);
Eurhynchium praelongum: 2(?);
Leptodictyum kochii: 3(6);
Bryum spec.: 13(2);
Ceratodon purpureus: 18(?);
Leptodictyum riparium: 18(?).

OBERDORFER (1983, p. 345) mentioned an "*Apium repens*-Gesellschaft" for Western Germany, as a nowadays rare community, which he assigned to the *Agropyro-Rumicion crispi* (i.e. *Lolio-Potentillion anserinae).*

FUKAREK & VOIGTLÄNDER (1982) also concluded that *Apium repens* is characteristic of the *Agropyro-Rumicion crispi* (by which they mean the *Lolio-Potentillion anserinae).* However, they do not succeed in assigning the 57 relevés, which they made in Mecklenburg (GDR), to one of the associations which as yet have been described. Both authors consider the interweaving of associations to be characteristic of the habitat of *Apium repens* and they therefore refrain from attaching a fixed syntaxonomic status to this species.

The habitat of *Apium repens* has been described by them as follows: the main factor is soil moisture. Within this general condition *Apium* only occurs in ecotones, viz. under a disturbance regime by trampling and grazing or under the influence of a fluctuating water level. It is exactly under these conditions that the *Lolio-Potentillion* is found.

Closer examination of the table published by FUKAREK & VOIGTLÄNDER shows *Apium repens* to occur under various circumstances, in each case accompanied by different species. For instance, *Apium repens* is found in species-poor, regularly trampled and flooded grasslands on banks near bathing-places and landing stages. Like in the case of the relevés 15 and 21 from our table this is a fragmentary community showing much resemblance to the relevê made in Belgium (nr. 21). *Alopecurus geniculatus* is totally absent, however.

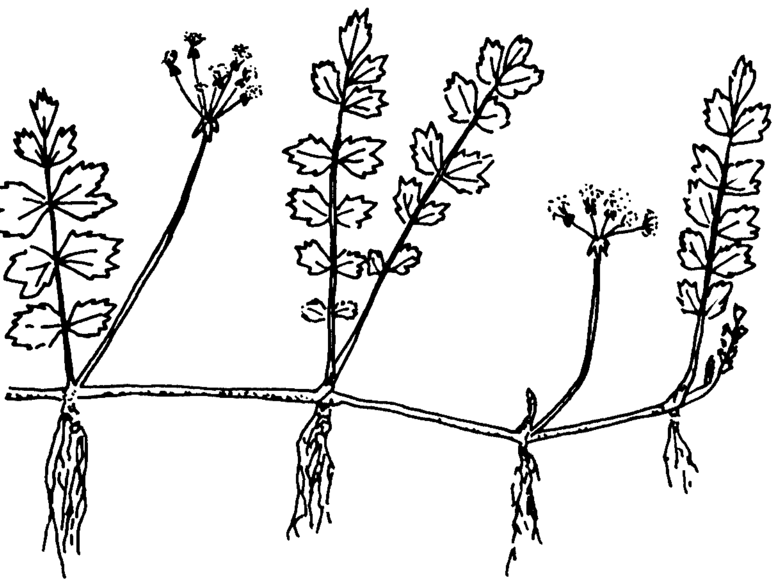


Fig. 1: *Apium repens* (after R. PRAKKEN, 1923).

The remaining more species-rich relevês originated from grazed banks, most of them clearly from transitions between a stand of the *Triglochino-Agrostietum stoloniferae* Konckzak 1968 and a stand of the *Ranunculo-Alopecuretum geniculati* R.Tx. 1937, with a preponderance of the former association. One of the units distinguished by FUKAREK & VOIGTLÄNDER undoubtedly belongs to the *Triglochino-Agrostietum* and in the field situation it was indeed found in contact with a *Parvocaricetea*-community.

The *Triglochino-Agrostietum,* which also belongs to the association group with *Eleocharis palustris* ssp. *uniglumis,* is characterized by the character-species *Triglochin palustris* and the differential species *Juncus articulatus, Galium palustre, Ranunculus flammula, Hydrocotyle vulgaris, Carex nigra, Myosotis laxa.* This association occurs on pastures without any or with hardly any manuring, on relatively nutrient-poor and moderately acid soils. It consequently shows a certain floristic affinity to the *Caricion curto-nigrae (Parvocaricetea).*

Recapitulating we can state that *Apium repens* grows as well in the *Nasturtio-Alopecuretum* as in the *Triglochino-Agrostietum* and in grasslands which are disturbed by excessive trampling and/or unfavourable hydrological conditions; the latter stands form a transition between those associations and the *Ranunculo-Alopecuretum.* As relevés which can be clearly assigned to the *Ranunculo-Alopecuretum* are absent, *Apium repens* is probably a character-species of the association group with *Eleocharis palustris* ssp. *uniglumis.*

Like in our table 1, *Scirpus cariciformis* appears to occur regularly together with *Apium repens* in the relevês made by FUKAREK & VOIGTLÄNDER (l.c.). From table 1 it appears that the former species grows in the *Nasturtio-Alopecuretum* (cluster 1), the *Triglochino-Agrostietum* (cluster 6) and the *Agrostio-Trifolietum fragiferi* (cluster 8 and 9; see also SÝKORA 1982a).

Like *Apium repens, Scirpus cariciformis* also occurs in a fragmentary *Triglochino-Agrostietum* (cluster 4) and in a community being transitional between the *Triglochino-Agrostietum* and the *Ranunculo-Alopecuretum geniculati* (cluster 3). The co-occurrence of rather numerous species on the one hand of the *Molinio-Arrhenatheretea* and on the other hand of the *Phragmitetea* suggests inhomogeneity of both relevés from cluster 3 which have been derived from literature (DEN HELD 1982). The size of these samples, respectively 10 x 30 m and 4 x 70 m, which is very large especially for communities like those of the *Lolio-Potentillion,* points to the same conclusion. Although such relevés can be useful for other purposes, they are less suitable for syntaxonomic interpretation.

Relevés 41, 42 and 43 can hardly be assigned to the *Lolio-Potentillion* since species characterizing this alliance are almost absent. *Carex nigra, Ranunculus flammula,* and *Hydrocotyle vulgaris,* although differentiating for the *Triglochino-Agrostietum* are characteristic of the *Parvocaricetea.* The latter is also true for *Eleocharis quinqueflora, Carex flacca, C. trinervis,* and *Galium uliginosum* which occur in these relevés.

The *Parvocaricetea* are indicative for nitrogen-poor (never manured), moderately acid to basic, wet peaty soils, sometimes rich in lime, in which the water level is always in close vicinity of the soil surface. On these sites which are too nutrient-poor for the *Triglochino-Agrostietum, Scirpus cariciformis* is still abundant. The decline in the nutrient content is once more indicated by the presence of species of the *Violion caninae* (syn.: *Nardo-Galion saxatilis). Scirpus cariciformis* is regularly found in the *Caricion davallianae (Tofieldietalia, Parvocaricetea),* especially in the *Carictum davallianae typicum* with presence class III and in the subassociation mentioned after this species even with presence class IV (OBERDORFER 1977).

Regarding to the data published by SÝKORA (1983a) it is a character-species of the *Lolio-Potentillion* or of one of its lower units. The existence of a *Blysmo-Juncetum compressi* Br.Bl. 1918 ex Libb. 1932 could not be demonstrated. On the basis of the present paper *Scirpus cariciformis* can be considered a differential species for the association group with *Eleocharis palustris* ssp. *uniglumis.* This is in accordance with observations made by the present authors on Gotland and Öland (Sweden), where in a number of cases in which the *Lolio-Potentillion* bordered on the *Parvocaricetea, Scirpus cariciformis* occurred in transitional communities in between (WESTHOFF et al. 1983, table 7, relevés 5, 6 and 7), as well as in pure *Parvocaricetea* stands.

According to SÝKORA (1983a) *Juncus compressus* is a character-species of the *Ranunculo-Alopecuretum,* while because of its rarety, *Scirpus cariciformis* was only found in very few of the samples made all over the Netherlands. Besides, like stated above, the latter species appears to occur also in other associations of the *Lolio-Potentillion.*

In the table on page 216 of OBERDORFER (1983), the *Blysmo-Juncetum compressi* is subdivided into a subassociation with *Blysmus compressus (= Scirpus cariciformis)* and a "reine Ausbildung" in which *Scirpus cariciformis* is totally absent. On this ground and for reasons mentioned before it is not acceptable to consider this species as a character-species of the *Blysmo-Juncetum.* Besides, this community is poorly characterized to such a degree that it cannot be considered an association and that its name should be rejected.

The decline of *Apium repens* and of *Scirpus cariciformis* can be explained by the specific hydrologic requirements of both species. They depend on a water regime characterized by a very small, but constant annual fluctuation ("rhythm stability" sensu ODUM). In winter the water level is situated just above and in summer just below the soil surface. As in Europe the last two decades have witnessed a very impressive increase in field drainage, making it one of the leading factors in rural environmental change (GREEN 1980), these habitats disappeared on a large scale, with understandable consequences for sensitive species. Besides the increase in the eutrophication of the landscape probably plays a part in the disappearance of these species from formerly mesotrophic grasslands.

THE ORDINATION DIAGRAMS (fig. 2 and 3)

The main differentiating environmental factors can be detected by means of ordination diagrams.

The average salt figure (fig. 2b) decreases towards the top of the vertical axis while the reaction figure (fig. 2c) increases in this direction. As can be expected the highest average salt figures are found in the *Agrostio-Trifolietum fragiferi*. In the *Nasturtio-Alopecuretum* these figures are generally lower, so that concerning the salt figures the axis is oblique. In the relevés of the *Caricion curto-nigrae*, only low average salt figures occur. The same applies for cluster 3, relevés 16 and 17.

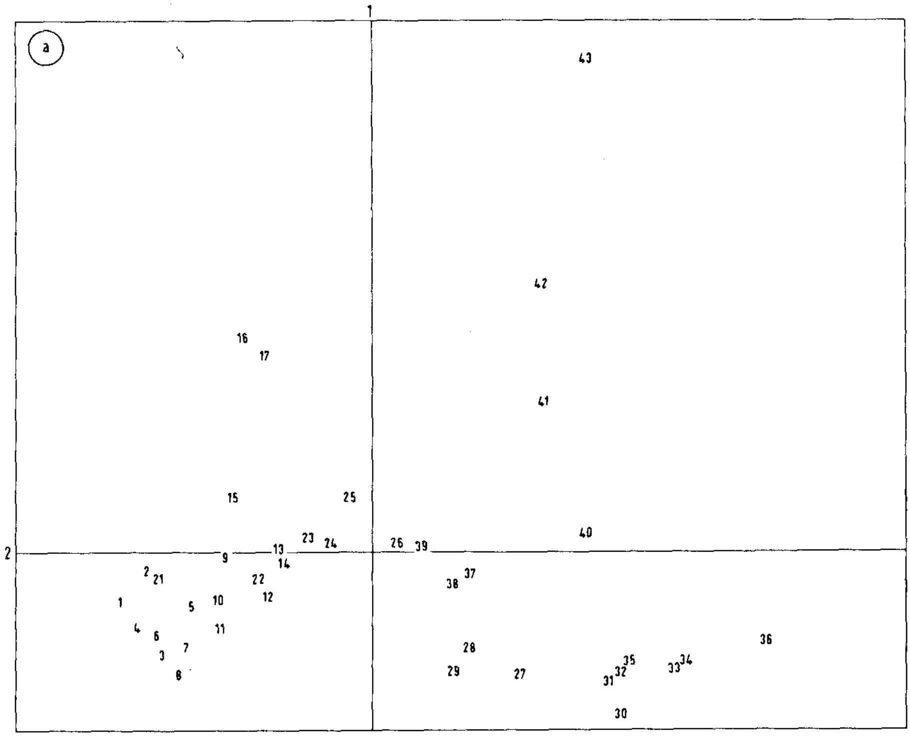
The acidity varies from a mean value of 7.6 to 5.5 or 5.6, i.e. from neutral or basic soils to weakly acid soils. Such average values (7.2 - 7.6) are for instance found in the *Bidention*, *Arction*, *Senecionion*, *Phragmition*, *Sparganio-Glycerion*, and *Mesobromion* and on the other hand (5.5 - 5.6) in the *Calthion* and the *Lolio-Cynosuretum*. The average reaction figure for well-developed communities of the *Caricion curto-nigrae* amounts 3.8 (BÖCKER et al. 1983).

This picture is affirmed by the ordination diagrams of the species (fig. 3). Species mostly occurring on saline soils are indicated on the right lower side of the diagram. In the left lower side this category is only scarcely represented, while salt-tolerant species which are more frequent on non-saline soils are especially found here. The latter are replaced by real glycophytes in the upper part of the diagram (fig. 3b). Although species indicative for basic soils occur in the lower part, a number of species indicating acid soils are given in the upper part (fig. 3c).

From the left to the right side the horizontal axis corresponds with a reduction of both the moisture degree and the nitrogen content of the soil (fig. 2e and 2d). The highest mean nitrogen figures are found in the *Nasturtio-Alopecuretum* and especially in a number of relevés in which *Apium repens* is present but *Scirpus cariciformis* is lacking (fig. 2d). These figures indicate soils which are "moderately nitrogen-rich" to "nitrogen-rich". Corresponding average values are found in o.a. *Tanaceto-Artemisietum*, *Lolio-Plantaginetum*, *Phragmition*, *Sparganio-Glycerion*, and *Filipendulion*. The lower values as occurring in the *Triglochino-Agrostietum*, *Agrostio-Trifolietum* and *Caricion curto-nigrae* in the right side of the diagram indicate nitrogen-poor to intermediate soils. Examples of other communities occurring on comparable soils are *Molinion*, *Calthion*, and *Arrhenatherion* communities.

Although the contrast is only slight, as can be expected considering the hydrological demands of the discussed communities, nevertheless the average moisture figures are declining from the left side to the right (fig. 2e). The higher values indicate a nearly wet soil, the low values a moist soil. Comparable values are found on the one hand (high values) in the *Bidention*, *Nanocyperion*, *Caricion curto-nigrae*, *Caricion davallianae*, and *Calthion*, and on the other hand (low values) in the *Convolvulion*.

Species ordination gives a comparable picture (fig. 3d and fig. 3e). While species from nitrogen-rich to very nitrogen-rich, frequently inundated wet soils are especially given on the left; on the contrary species from poor, moderately dry soils mainly occur on the right side. The occurrence of the *Agrostio-Trifolietum fragiferi festucetosum rubrae* on drier soils with higher salinity than the *Nasturtio-Alopecuretum* and the *Triglochino-Agrostietum* is in accordance with SÝKORA (1982a, b and c).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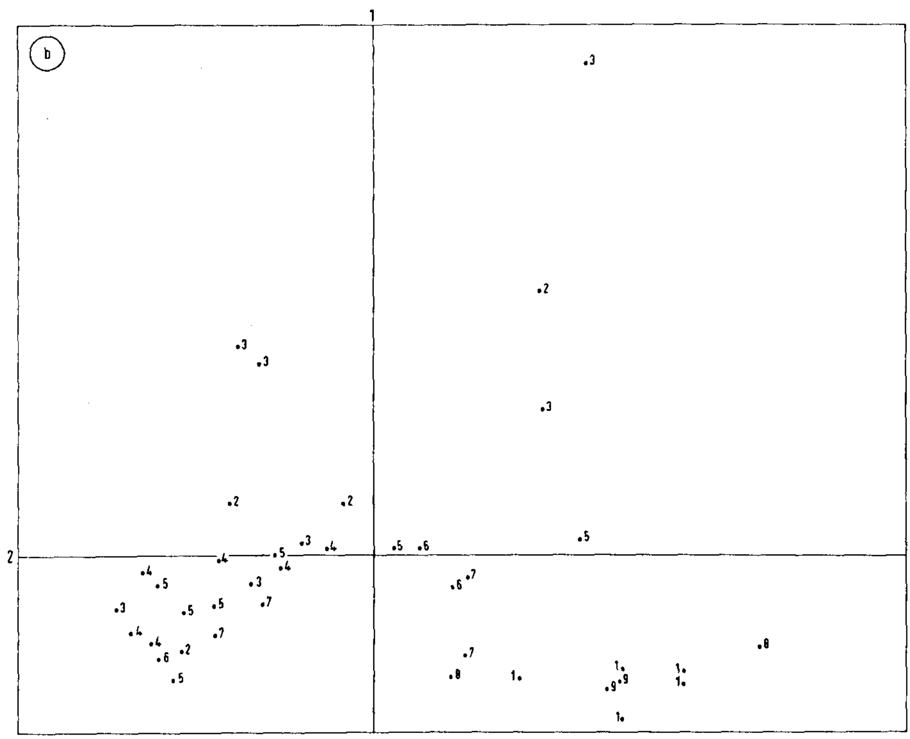
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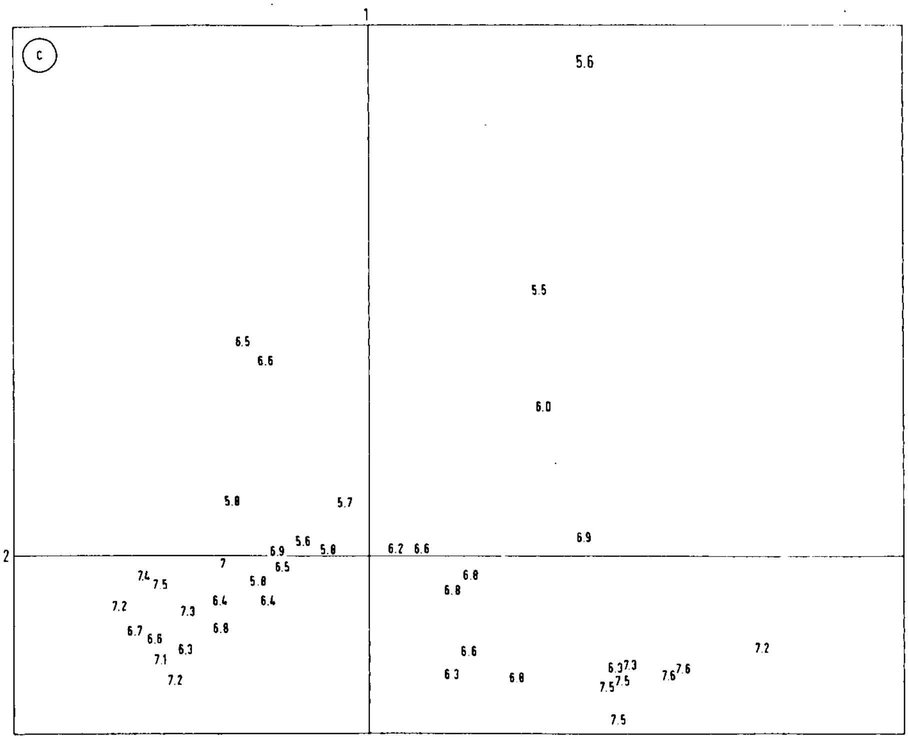
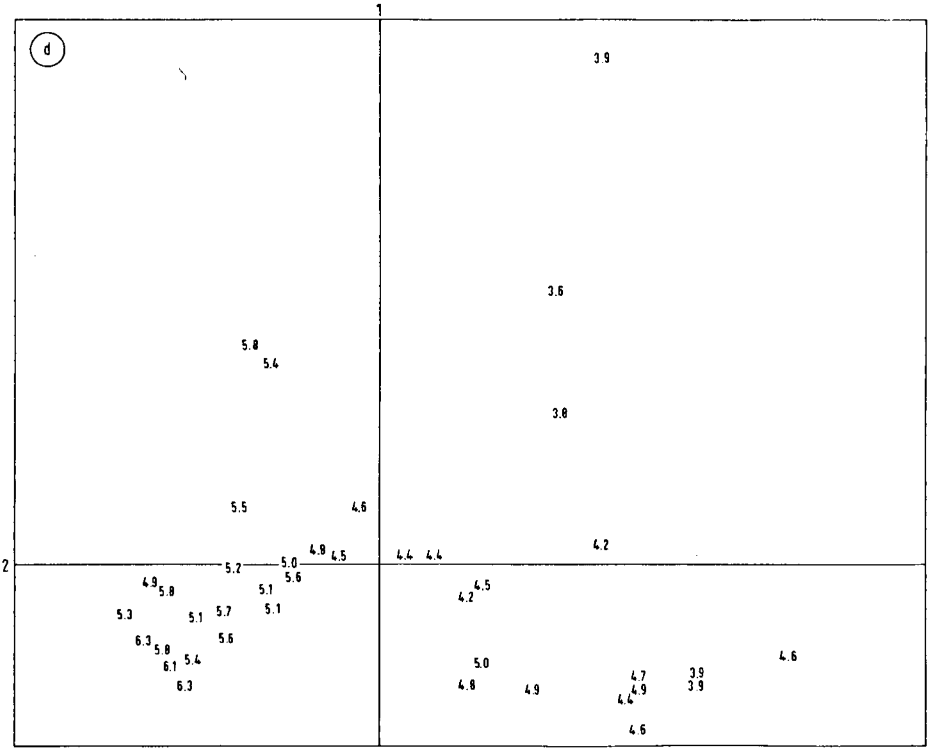


Fig. 2a: Ordination (reciprocal averaging) of the relevês.
The numbers correspond with the numbers of the relevés in table 1.

Fig. 2b: Average salt figures (occurrence in relation to the salt concentration of the soil), based on the following figures:
O = glycophyte
1 = salt tolerant, but more frequent on non-saline soils
2 = facultative halophyte, mostly on saline soils
3 = obligatory halophyte, never on non-saline soils.
The figures are given in decimal places;
in the diagram e.g. .5 means O,5 and 1. means 1,O.

Fig. 2c: Average reaction figure (occurrence in relation to soil reaction).
1 = only on very acid soils
3 = mostly on acid soils
5 = mostly on weakly acid soils
7 = mostly on neutral soils, but also on acid and basic ones
9 = only on neutral or basic soils.
The figures in between (2,4 etc.) correspond with intermediate conditions.



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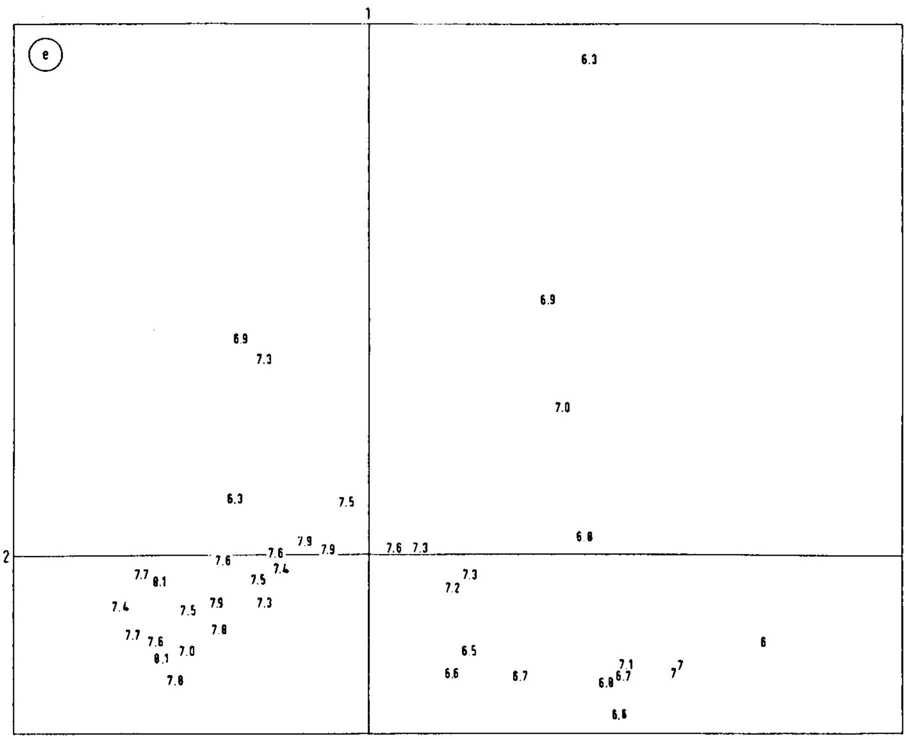

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REFERENCES

BARKMAN, J.J., DOING, H., SEGAL, S. (1964): Kritische Bemerkungen und Vorschläge zur quantitativen Vegetationsanalyse. - Acta Bot. Neerl. 13: 394-419.

BÖCKER, R., KOWARIK, I., BORNKAMM, R. (1983): Untersuchungen zur Anwendung der Zeigerwerte nach Ellenberg. - Verhandl. Ges. f. Ökologie 4: 35-56.

ELLENBERG, H. (1979): Zeigerwerte der Gefäßpflanzen Mitteleuropas. 2. erw. Aufl. - Scripta Geobot. 9. Göttingen. 106 p.

- (1982): Vegetation Mitteleuropas mit den Alpen in ökologischer Sicht. 3. verb. Aufl. - Ulmer, Stuttgart. 989 p.

FUKAREK, F., VOIGTLÄNDER, U. (1982): Zur Verbreitung von Apium repens im Norden der D.D.R. - Bot. Rundbrief f.d. Bez. Neubrandenburg 13: 1-81.

GREEN, F.H.W. (1980): Current field drainage in Northern and Western Europe. - Journ. Environm. Mangagement 10: 149-163.

HATTINK, Th.A. (1980): Apium repens (Jacq.) Rchb. f. - In: MENNEMA, J., QUENÉ-BOTERENBROOD, A.J., PLATE, C.L. (ed.): Atlas van de Nederlandese flora 1. - Kosmos, Amsterdam. 226 p.

HEJNÝ, S. (1960): Ökologische Charakteristik der Wasser- und Sumpfpflanzen in den slowakischen Tiefebenen (Donau und Teissgebiet). - Slow. Akad. Wiss., Bratislava. 487 p.

HELD, A.J. den (1982): Een vondst van Scirpus planifolius Grimm. in het Hafdistrict van Zuid-Holland. - Gorteria 11(2): 44-45.

HILL, M.O. (1973): Reciprocal averaging, an eigenvector method of ordination. - J. Ecol. 61: 237-249.

- (1979): Twinspan. A Fortran program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. - Ecology and Systematics, Cornell University, Ithaca. New York 14850.

KOPECKÝ, K. (1969): Klassifikationsvorschlag der Vegetationsstandorte an den Ufern der tschechoslowakischen Wasserläufe unter hydrologischen Gesichtspunkten. - Arch. Hydrobiol. 66(3): 326-347.

KORNECK, D. (1984): Rote Liste der Farn- und Blütenpflanzen (Pteridophyta et Spermatophyta). - In: (BLAB, J., NOWAK, E., TRAUTMANN, W., SUKOPP, H., ed.): Rote Liste der gefährdeten Tiere und Pflanzen in der Bundesrepublik Deutschland. Naturschutz aktuell 1: 128-148.

Fig. 2d: Average nitrogen figure (occurrence in relation to ammonia or nitrate supply).
1 = only on soils very poor in mineral nitrogen
3 = mostly on poor soils
5 = mostly on intermediate soils
7 = mostly on soils rich in mineral nitrogen
8 = nitrogen indicator
9 = only on soils very rich in mineral nitrogen (indicating pollution, manure deposits or the like).

Fig. 2e: Average moisture figure (occurrence in relation to soil moisture or water level).
3 = on dry soils
5 = on fresh soils, i.e. under intermediate conditions
7 = on moist soils, which do not dessicate
9 = on wet, often not well aerated soils
10 = on frequently inundated soils.

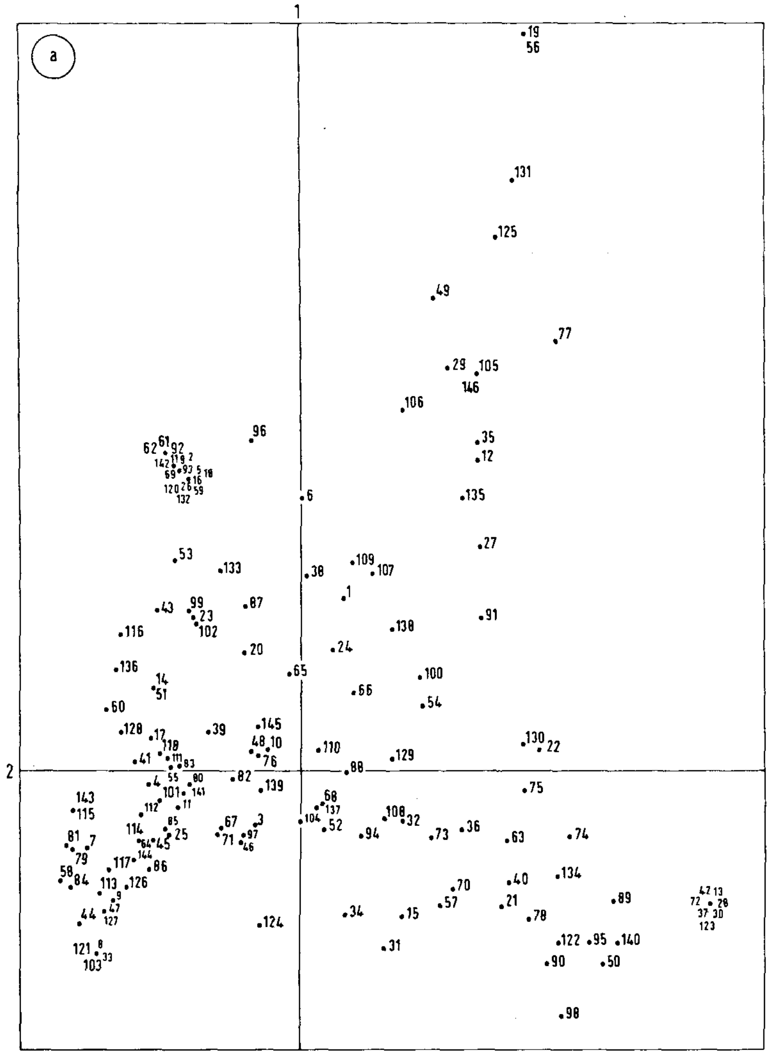

Fig. 3a: Species ordination.
The numbers correspond with the numbers of the species in table 1.

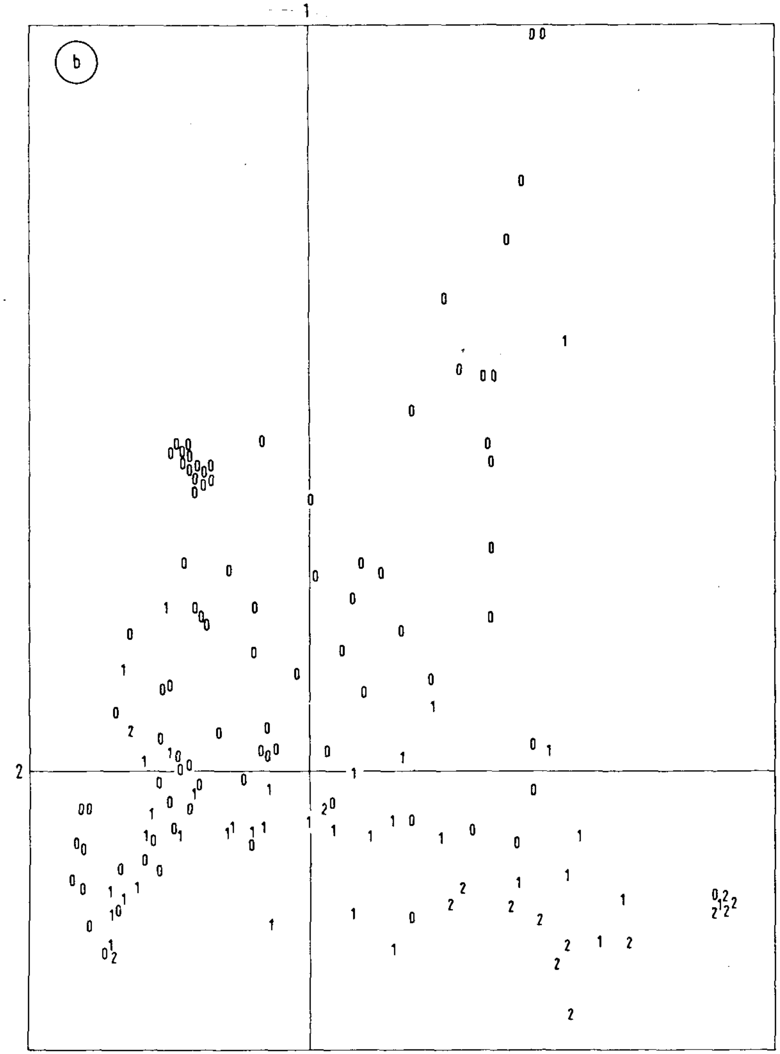

Fig. 3b: Salt figures (see fig. 2c).

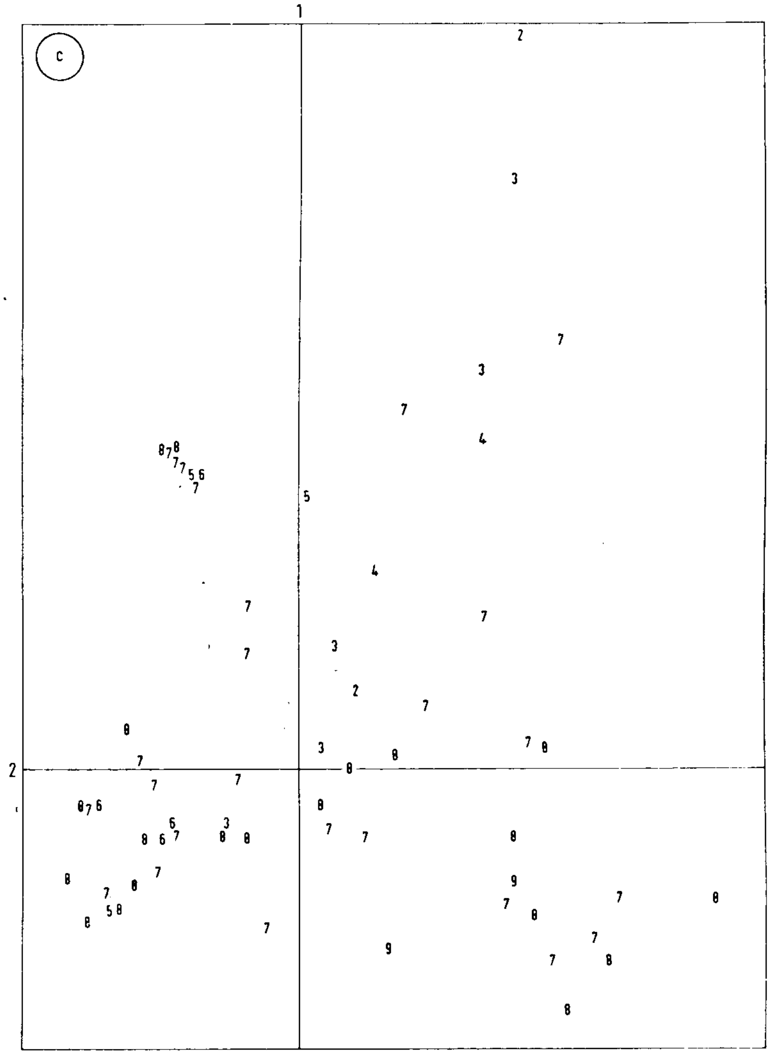

Fig. 3c: Reaction figures (see fig. 2c).

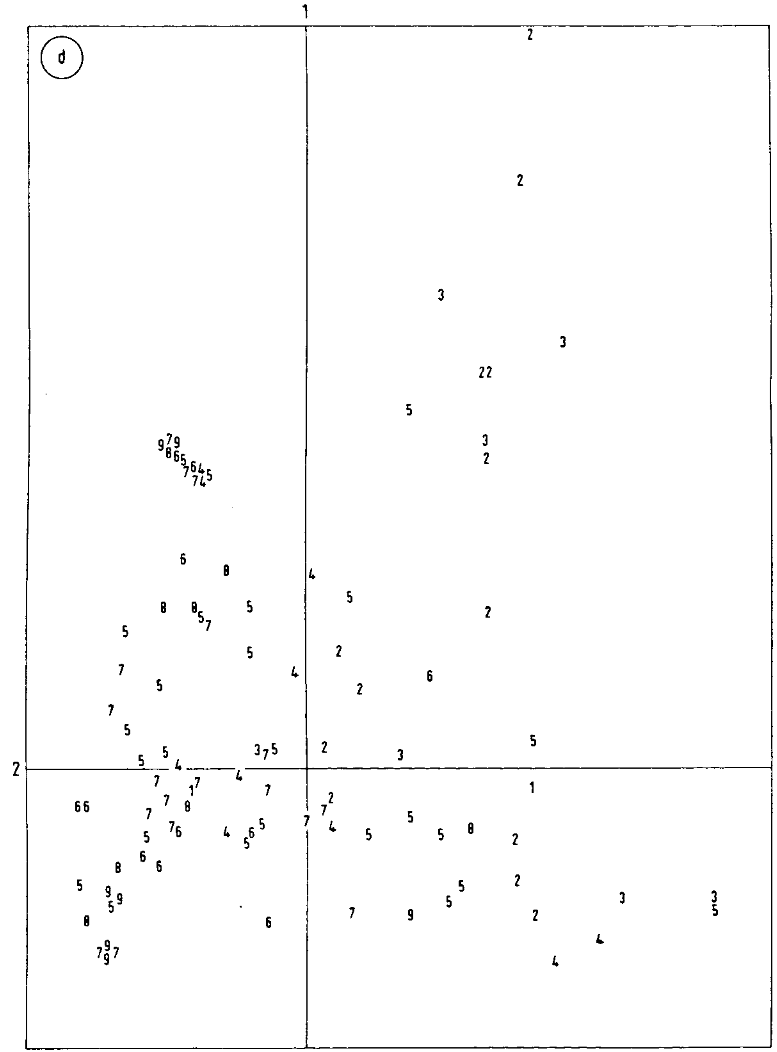

Fig. 3d: Nitrogen figures (see fig. 2d).

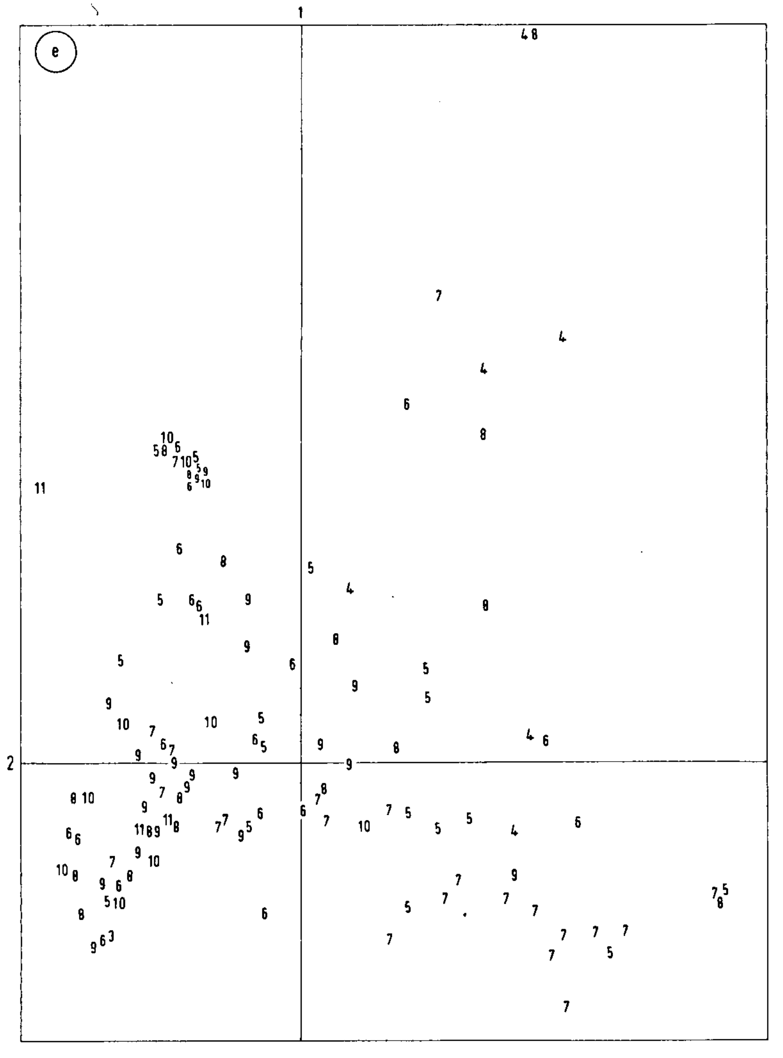

Fig. 3e: Moisture figures (see fig. 2e).

LANGHE, J.E. de, DELVOSALLE, L., DUVIGNEAUD, J., LAMBINON, J., VANDEN BERGHEN, C. (1978): Nouvelle Flore de la Belgique, du Grand-Duché de Luxembourg, du Nord de la France et des régions voisines. 2[me] éd. - E. du Patrimoine du Jardin botan. nat. de Belg. Meise. 899 p.

LUCAS, G.L., WALTERS, S.M. (1976): List of rare, threatened and endemic plants for the countries of Europe. - IUCN Threatened Plants Committee. Kew.

MAAREL, E. van der (1979): Transformation of cover-abundance values in phytosociology and its effects on community similarity. - Vegetatio 39: 97-114.

OBERDORFER, E. (1977): Süddeutsche Pflanzengesellschaften, 2. Aufl. Teil I. - G. Fischer, Stuttgart. 311 p.

- (1979): Pflanzensoziologische Exkursionsflora. 4. erw. Aufl. - Ulmer, Stuttgart, 997 p.

- (1983): Süddeutsche Pflanzengesellschaften. 2. Aufl. Teil III. - G. Fischer, Stuttgart. 455 p.

FRANKEN, R. (1923): Het Enterveen. - De Levende Natuur 27: 321-325.

SÝKORA, K.V. (1980): A revision of the nomenclatural aspects of the Agropyro-Rumicion crispi Nordhagen 1940. - Proc. Kon. Ned. Akad. Wet. Ser. C. Biol. Med. Sci. 83(4): 355-361.

- (1982a): Syntaxonomy and synecology of the Lolio-Potentillion R. Tüxen 1947 in the Netherlands. - Acta Bot. Neerl. 31(1/2): 65-95.

- (1982b): Lolio-Potentillion communities in Ireland. - Acta Bot. Neerl. 31(3): 185-199.

- (1982c): Lolio-Potentillion communities in Belgium and north-western France. - Acta Bot. Neerl. 31(3): 201-213.

- (1983a): The Lolio-Potentillion anserinae R. Tüxen 1947 in the northern part of the Atlantic domain. - Diss. Nijmegen. 119 p.

- (1983b): A synecological study of the Lolio-Potentillion anserinae R. Tüxen 1947 by means of permanent transects I: Brackish stenosaleutic habitats. - Proc. Kon. Ned. Akad. Wet. Ser. C. 86(4): 525-566.

- (in prep.): The relation between the hydrological dynamics and the occurrence particularly of Pulegium vulgare.

WEEDA, E.J. (1984): Scirpus cariciformis Vest. - In: MENNEMA, J., QUENÉ-BOTERENBROOD, A.J., PLATE, C.L., VAN DER HAM, R.W.J.M., HEUKELS, P., WEEDA, E.J.: Atlas von de Nederlandse Flora 2. (in prep.).

WESTHOFF, V., DEN HELD, A.J. (1969): Plantengemeenschappen in Nederland. - Thieme, Zutphen. 324 p.

- , VAN LEEUWEN, C.G., ADRIANI, M.J. (1961): Enkele aspecten van vegetatie en bodem der duinen van Goeree, in het bijzonder de contactgordels tussen zout en zoet milieu. - Jaarboek 1961 Wet. Genootsch. Goeree-Overflakkee: 46-92.

- , SCHAMINÉE, J., SÝKORA, K.V. (1983): Aufzeichnungen zur Vegetation der schwedischen Inseln Öland, Gotland und Stora Karlsö. - Tuexenia 3: 179-198.

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