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LOLIO-POTENTILLION COMMUNITIES IN BELGIUM AND NORTH-WESTERN FRANCE

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SUMMARY

The ecology and the syntaxonomy of the following Belgian and French *Lolio-Potentillion anserinae* communities are described:

1. *Ranunculo-Alopecuretum geniculati*
2. Basal community of *Agrostis stolonifera*-[*Lolio-Potentillion anserinae*]
   a) *Juncus inflexus-Carex otrubae* type
   b) *Eleocharis uniglumis-Carex otrubae* type
   c) *Trifolium fragiferum-Carex hirta* type
3. *Triglochino-Agrostietum stoloniferae ranunculetosum repentis*
4. *Nasturtio-Alopecuretum geniculati ranunculetosum scelerati*
5. *Agrostio-Trifolietum fragiferi*

a) subassociation *typicum*
b) subassociation *inops*

The syntaxonomical position of *Carex otrubae* and *Eleocharis uniglumis* is discussed, leading to the conclusion that both species are character-species of the association group with *Eleocharis uniglumis*.

The two main ecological factors are elucidated with the help of a P.C.A. ordination diagram.

1. INTRODUCTION

During June and July 1980 Belgium and North-Western France were visited in order to study the *Lolio-Potentillion anserinae* Tüxen 1947. This alliance has been separated from the *Agropyro-Rumicion cripsi* Nordhagen 1940 on floristic and ecological criteria (SÝKORA 1980). It occurs in pastures inundated during winter and spring on nutrient-rich to moderately nutrient-poor soils. The main factors responsible for the internal differentiation of the *Lolio-Potentillion* are the hydrological situation in summer, the influence of salt and the nutrient status of the soil. Communities belonging to the *Lolio-Potentillion* in The Netherlands and in Ireland have been described earlier (SÝKORA 1982a, b). For a detailed description of the synecology of this alliance I refer to these papers.

In Belgium most relevés were made along former creeks now surrounded by reclamations in the Flemish polder area. The French relevés were made on the banks of the rivers Liane, Canche, Authie and Somme, and in the Marais de Balançon and the Marais de Favières.

Eighty five percent of the Flemish polders is old or medium aged. The draining following the reclamation (7th, 8th, 11th and 12th century) caused compaction of the peat and as a consequence the soil level was lowered considerably. This worsened the drainage situation, so that the polders can be utilized as pastures only. After the reclamation the existing creeks and their branches were

used as a basis for the drainage system. The resulting sinuous drains are easily obstructed; besides they are shallow, making drainage less efficient (VANHECKE 1977). Fluctuations of the water-level with 50 cm or more, the high nutrient status of the soil and the presence of cattle explain the frequent occurrence of the *Lolio-Potentillion* along the Flemish creeks. The water of these creeks is sometimes brackish due to the presence of late Atlantic and Subboreal saliferous peat layers on a depth of 1–5 m below Ordnance Datum and the seepage of salt-containing ground water. The salt enrichment of the peat was caused by inundation of it with sea water during transgressions of the sea in the early part of the christian era (DE RIDDER 1957, VISSCHER 1975, BIJHOUWER 1977, BRAND 1978, GUERLESQUIN & WATTEZ (1979), ANONYMUS (1979). The moist grasslands along the creeks have a high ornithological significance (BECUWE 1977, HOUWEN 1977, ANONYMUS 1979).

Because of the hilly character of North-Western France the *Lolio-Potentillion* is restricted to the riversides and the marshes near the mouth of the rivers. The rivers in this area are running from south-east to north-west. As a consequence of the relative shortness of these rivers, the small size of the watersheds and the artificially improved discharge, water fluctuations are considerably less pronounced than in the river-bed of, for instance, the Rhine and the Waal.

As an important part of the riversides are either well drained or ungrazed (resulting in extensive reed-swamps used for shooting water-fowl) the *Lolio-Potentillion* is well developed only locally, for instance along ponds resulting from the cutting of peat, along ditches and drainage furrows and in low lying parts of pastures with impeded drainage. The presence of *Lolio-Potentillion* communities in North-Western France has been previously recorded by GÉHU (1961), GÉHU & WATTEZ (1965), FRILEUX & GÉHU (1975), WATTEZ (1967, 1975), FRILEUX (1976) and BOURNERIAS et al. 1976.

The vegetation of humid grasslands inclusive the *Lolio-Potentillion* has been severely degraded by drainage, intensification of agricultural practices e.g., use of herbicides, overfertilization, overstocking with cattle, termination of grazing, the planting of poplars, the canalization of the rivers and industrialization (WATTEZ 1975, FRILEUX & GÉHU 1975, FRILEUX 1976).

2. METHODS

The methods were the same as described in SÝKORA 1982b (this issue, p. 189)

3. STATUS OF THE ALLIANCE IN BELGIUM AND NORTH-WESTERN FRANCE.

In Western Germany and The Netherlands the most characteristic and best developed association of the *Lolio-Potentillion* is the *Ranunculo-Alopecuretum geniculati.* It is the first association which has been described and it can be considered as the 'type-association' of the alliance. However, none of the communities presented in this paper can be assigned to the *Ranunculo-Alopecuretum.* Only *Carex hirta* (character-species for this association), *Equisetum palustre*

Table 1. Synoptic table of the *Lolio-Potentillion* communities studied in Belgium and North-Western France. In the first column of every cluster the presence class is given (+ = present only in one relevé; I = 1–20%; II = 21–40%; III = 41–60%; IV = 61–80%; V = 81–100%).
In the second column the characteristic coverage is given according to the Braun-Blanquet scale as refined by BARKMAN et al. (1964).
Communities: clusters 1, 2 and 4: Basal community of Agrostis stolonifera-[Lolio-Potentillion anserinae], Eleocharis uniglumis-Carex otrubae type (cluster 1); Juncus inflexus-Carex otrubae type (cluster 2); Trifolium fragiferum-Carex hirta type (cluster 4). Triglochino-Agrostietum stoloniferae ranunculetosum repentis (cluster 3).
clusters 5 and 6: Nasturtio-Alopecuretum geniculati ranunculetosum scelerati, variant with Oenanthe fistulosa (cluster 5) and variant with Juncus gerardi (cluster 6).
clusters 7 and 8: Agrostio-Trifolietum fragiferi, subass. typicum (cluster 7) and subass. inops, variant with Poa trivialis (cluster 8).

cluster number	1		2		3		4		5		6		7		8	
number of relevés	6		12		20		52		15		20		7		5	
Plantaginetea + Lolio-Plantaginetum character-species																
Potentilla anserina	+	2m	V	2m	IV	2m	IV	1	II	1	V	1	III	2m	III	1
Plantago major	III	+	II	+	III	+	IV	+	IV	+	IV	1	V	1	IV	1
Lolium perenne			II	+	II	+	III	1	III	1	I	+	III	+	IV	1
Poa annua							I	1								
Polygonum aviculare			I	+			I	+			I	+				
Lolio-Potentillion, character-species + constant companion																
Agrostis stolonifera	V	2b	V	3	V	3	V	3	V	3	V	3	V	3	V	3
c.c. Poa trivialis	V	2b	IV	2a	IV	2a	V	2b	V	2m	II	2m	III	1	V	1
Alopecurus geniculatus	V	2m	III	1	V	2b	V	2a	V	2b	V	2b	IV	1		
Rumex crispus	V	+	III	+	II	+	III	+	II	+	III	+	III	+	+	+
Juncus inflexus			V	2a	IV	1	II	+	II	2m			III	1		
Ranunculo-Alopecuretum, character- and differential species																
Taraxacum officinale group	IV	1	I	+	I	+	I	+					+	+	+	+
Equisetum palustre			III	+	III	1	I	1					+	+		
Carex hirta			I	2m	IV	1	III	1	I	1	I	2m				
Elymus repens	II	1	I	1			I	1			II	1	+	+		
Lysimachia nummularia			II	1	I	+	I	1	+	1	I	+				
Polygonum amphibium			II	1	II	1	I	1								
Potentilla reptans	+	+	I	1			+	+								
Rorippa amphibia							+	+			+	+				
Phalaris arundinacea							I	+								
Myosotis scorpioides							I	1								
Glyceria maxima							I	1								
Association group with Eleocharis uniglumis; character- and differential species.																
Carex otrubae	V	+	V	1	III	+	II	+	III	1	II	+	V	1	+	+
Phragmites australis	III	2m	V	1	I	1	II	1	III	1	II	1	V	2m		
Eleocharis uniglumis	V	2a	II	2a	+	1	I	2m	+	1	II	1	+	1		
Triglochino-Agrostietum, character- and differential species																
Juncus articulatus	III	1	III	+	V	1	III	1	II	1	II	1	V	2m	+	+
Galium palustre	II	+	IV	+	III	+	III	1	+	+	I	+				
Triglochin palustris			+	1	III	1	I	1	II	1	III	2m			III	1
Ranunculus flammula					III	1	I	1								
Carex nigra					II	1	+	2a								
Hydrocotyle vulgaris					+	1	I	1			II	1				
Myosotis laxa ssp. caespitosa	+	+	+	+	+	+	II	1	I	+						
Nasturtio-Alopecuretum																
Ranunculus sceleratus			+	+			II	+	III	+	III	+	+	+	II	1
Nasturtium microphyllum			II	+	I	1	II	+	II	+	IV	1			+	+
Apium nodiflorum			+	+	III	1	II	1	II	1	III	1	II	+	+	+
Veronica catenata					I	1	I	+	+	+	III	+	II	+		
Ranunculus sardous			I	+	I	+	I	+	III	1	+	1				
Glyceria declinata			+	1	II	1	II	1	III	1	I	1				
Epilobium parviflorum			+	+	II	+	II	+			I	+	II	1		
Agrostio-Trifolietum fragiferi																
Trifolium fragiferum	+	2m	I	1	IV	2m	III	1	IV	1	III	1	V	1	V	2m
Juncus gerardi			I	2m	II	1	I	1	I	2m	IV	1	V	2m	IV	2a
Carex distans					II	+							III	2m	IV	1
Lotus tenuis					II	1							IV	+		
Centaurium pulchellum													II	+		

cluster number	1	2	3	4	5	6	7	8
Glaux maritima					I 1	+ 1		III 2m
Festuca rubra		+ 1	I 1					III 2m
Triglochin maritima								+ +
Further differentiation								
Festuca pratensis	V 1	I +	II +	I +	+ +	+ +		
Glyceria fluitans	V 1	II 1	II 1	II 1		I 2m	II +	
Oenanthe fistulosa	V 1	+ 1	II +	II 1	III 1	I +	+ +	
Bromus racemosus	II +							
Cardamine pratensis	IV 1	III +	IV 1	I +				
Carex disticha			II 1					
Bellis perennis			I +	I +	+ +		V 1	
Carex flacca				I 1			IV 1	
Pulicaria dysenterica		II 1	II +	I +			IV +	
Leontodon autumnalis			+ +	I +			III +	
Salix repens							III +	
Festuca arundinacea	+ +	+ +	+ +	+ +				V 2a
Companion species								
Ranunculus repens	V 2a	V 1	V 2a	V 2a	IV 1	III 1	IV 1	+ +
Trifolium repens	IV 2m	III 1	I 1	V 1	II 1	II +	IV 1	IV 2m
Juncus bufonius group	+ 1	+ 1	I 2m	II 1	II 1	II 1	III 1	II 1
Drepanocladus aduncus	III 2a	+ +	III 2a	I +	I +	I 1	V 2m	+ 1
Mentha aquatica		IV 1	III +	III 1	I +	I 2m	V 1	+ +
Rumex conglomeratus	+ +	III +	III +	II +	I 1	I 1		
Scirpus maritimus		I 1	I 2m	I 1	II 1	III 1		IV 1
Cerastium fontanum	+ +		I +	II +	+ +		+ +	
Holcus lanatus	III 1	II +	II +	II 1				+ +
Eleocharis palustris		I 1	III 2m	II 2m		III 2m	I 1	
Atriplex hastata				I 1	I +	III 1		II +
Equisetum arvense		+ +	I +	+ +			II 1	
Phleum pratense	II +		I 1	I +		+ +		
Senecio aquaticus		+ +	II +	I +		+ +		
Odontites verna ssp. serotina		II 1	I +	I 1				
Veronica beccabunga			I 1	II +	+ +			
Brachythecium rutabulum	III 1			I +				
Calliergonella cuspidata			II +	I 1				
Chenopodium rubrum				I +	II +	II 1		

Species with presence class I or +: Alisma plantago-aquatica (cluster number 6), Arrhenatherum elatius (2), Aster tripolium (4, 6, 8), Atriplex patula (4), Berula erecta (2, 4), Bidens cernua (4), Bidens tripartita (6, 4), Carex acutiformis (4), Carex riparia (5, 4), Catabrosa aquatica (4), Cirsium arvense (2, 6, 4, 1), Cynosurus cristatus (4), Epilobium hirsutum (2), Epilobium obscurum (3), Epilobium palustre (2), Equisetum fluviatile (4), Filipendula ulmaria (4, 3), Hippuris vulgaris (4, 6), Hordeum secalinum (5, 6, 4), Iris pseudacorus (2, 4), Juncus acutiflorus (4), Juncus effusus (4), Lychnis flos-cuculi (4), Lycopus europaeus (2, 6, 3), Lythrum salicaria (7, 6), Medicago lupulina (6), Myosoton aquaticum (4), Oenanthe aquatica (5, 7, 6, 4), Poa pratensis (8), Polygonum hydropiper (4), Polygonum mite (2, 6, 4, 3), Prunella vulgaris (4, 3), Puccinellia distans (6, 4), Ranunculus acris (4, 3), Rhynchostegiella curviseta (4), Rumex obtusifolius (4), Rumex palustris (5, 6), Sagina procumbens (4), Samolus valerandi (2, 6, 4, 8), Scirpus lacustris ssp. tabernaemontani (5, 6, 4, 3), Scirpus setaceus (4), Solanum dulcamara (2, 4), Spergularia marina (6), Stellaria alsine (4), Stellaria media (2, 4), Symphytum officinale (6, 4), Trifolium pratense (2, 4), Urtica dioica (2, 4).

and *Taraxacum officinale* group (differential species) are present with presence class III or more. The character-species *Potentilla reptans, Rorippa sylvestris, Juncus compressus, Inula britannica, Mentha pulegium* and the differential species *Phalaris arundinacea, Polygonum amphibium, Elymus repens, Lysimachia nummularia, Myosotis scorpioides, Rorippa amphibia, Alopecurus pratensis, Glechoma hederacea* and *Glyceria maxima* are absent or are present with presence class II or less.

The ecological explanation for this phenomenon can be found in the hydrology of the Flemish creeks and the French riversides. Because of insufficient fluctuation of the water-level, no sites with prolonged inundation followed by desiccation of the soil – a condition for the occurrence of the *Ranunculo-Alopecuretum* – have been encountered in the studied area. Because of the same rea-

son, no relevés of this association could be made in Ireland either (SÝKORA 1982b). The *Lolio-Potentillion* communities occurring in the studied area, the basal community of *Agrostis stolonifera*-[*Lolio-Potentillion*], the *Triglochino-Agrostietum stoloniferae*, the *Nasturtio-Alopecuretum geniculati* and the *Agrostio-Trifolietum fragiferi*, are discussed in section 4.

4. THE PLANT COMMUNITIES

4.1. Basal community of *Agrostis stolonifera*-[*Lolio-Potentillion anserinae*]. (*Table 1*, clusters 1, 2 and 4.)

As the coena presented in clusters 1, 2 and 4 cannot be assigned to one of the associations of the *Lolio-Potentillion* because character-species and sufficient differential species are lacking, they are described here as three different types of the basal community of *Agrostis stolonifera*-[*Lolio-Potentillion*]. A basal community can develop out of a coenologically saturated community under an increase of the environmental (mostly anthropogenic) dynamics resulting in the disappearance of sensitive species (KOPECKÝ & HEJNÝ 1974, 1978).

The *Eleocharis uniglumis-Carex otrubae* type (cluster 1) is characterized by the presence of *Carex otrubae* (V), *Eleocharis uniglumis* (V), *Taraxacum officinale group (IV)*, *Festuca pratensis* (V), *Glyceria fluitans* (V), *Oenanthe fistulosa* (V) and *Bromus racemosus* (II). It has been recorded from a pasture with a soggy, heavy clay soil, irregularly grazed by horses and on a bank of a creek with a comparable soil.

The *Juncus inflexus-Carex otrubae* type (cluster 2) is characterized by the presence of *Juncus inflexus* (presence class V), *Equisetum palustre* (III), *Carex otrubae* (V), *Phragmites australis* (V) and *Mentha aquatica* (IV). It has been found on higher parts of pastures with impeded drainage, collapsed creek banks and drainage furrows, mostly on severely poached clay and in a few cases on sand.

The *Trifolium fragiferum-Carex hirta* type (cluster 4), characterized by *Carex hirta* (III) and *Trifolium fragiferum* (III) occurred in lower-lying parts of pastures, formed by the remnants of former creeks, along ditches, on the bottom of a silted-up waterway, on creek banks, in a pasture bordering a *Betuletum pubescentis* (Hueck 1929) Tüxen 1937, on the collapsed margins of pools (étangs) along the rivers of North-Western France and in drainage furrows. The severely poached, moist soil consisted of a) grey reduced sand, rich in shells and organic material, b) sandy clay, c) soft saturated, dark brown to black heavy clay, also rich in shells and organic material or d) peat. The pools along the studied rivers are the result of former excavation of peat, which explains the high content of organic material. The soil was always severely poached and in some cases the use of herbicides could be proved.

Four more types of the basal community of *Agrostis stolonifera*-[*Lolio-Potentillion*] have been described from The Netherlands and from Ireland (SÝKORA 1982a, b). In The Netherlands the *Trifolium fragiferum-Ranunculus sardous* type, characterized by *Trifolium fragiferum* (IV), *Ranunculus sardous* (III),

Juncus gerardi (III) and *Festuca arundinacea* (III) and also the *Scirpus maritimus-Juncus bufonius* type, characterized by *Scirpus maritimus* (III), occur on slightly brackish, nutrient-rich, moist soils under the disturbing influence of intensive grazing, herbicides and/or overfertilization by for instance herring-gulls, the former type being less severely disturbed than the latter.

In Ireland the *Juncus inflexus-Rumex obtusifolius* type, characterized by *Juncus inflexus* (III), *Rumex obtusifolius* (III) and *Elymus repens* (III), and the *Juncus effusus-Holcus lanatus* type, characterized by *Juncus effusus* (V) and *Holcus lanatus* (V) were found. Whereas the former is indicative for nutrient-rich, basic soils with a rather dry top soil during summer, the latter can be found on moderately acid soils with a low nutrient status and a moist top soil, even in summer.

4.2. *Triglochino-Agrostietum stoloniferae* Konczak 1968 (cluster 3), subassociation *ranunculetosum repentis*

The *Triglochino-Agrostietum stoloniferae ranunculetosum repentis* has been recorded only in extensively grazed pastures in North-Western France, in the Marais de Balançon, the Marais de Favières and in the river-valley of the Somme. In the Flemish polder area it disappeared, due to the intensification of cattle-breeding accompanied by abundant use of fertilizers. The association is restricted to unimproved pastures with a low nutrient status and is consequently very sensitive to fertilization. The character-species *Triglochin palustris* is nowadays rare to very rare in the Belgian polder area (TANGHE 1975, DE LANGHE et al. 1978, VAN ROMPAEY & DELVOSALLE 1972). Apart from the character-species *Triglochin palustris* the association is characterized by the differential species *Juncus articulatus, Galium palustre, Ranunculus flammula, Carex nigra, Hydrocotyle vulgaris* and *Myosotis laxa* spp. *caespitosa*. In Belgium and North-Western France the last two species occur in one relevé only. *Apium nodiflorum*, a species lacking in the Dutch *Triglochino-Agrostietum*, probably because this species reaches its northern limit in The Netherlands, is present in the Belgian as well as in the Irish community with presence class III (SÝKORA 1982b). The variant observed in France is differing from the Dutch and Irish variants by the high presence (IV or more) of *Juncus inflexus, Equisetum palustre, Carex hirta* and *Rumex conglomeratus*. It was found on peaty, dark brown clay. Only a few relevés were very slightly influenced by salt.

The presence of *Juncus inflexus* (presence class IV) in the French *Triglochino-Agrostietum*, usually a community of moderately acid soils, indicates a slight calcium influence. This also may explain the low presence class of *Carex nigra* and the absence of *Hydrocotyle vulgaris* in all but one relevé. Both species belong to the *Parvocaricetea* and are indicative for acid soils. *Juncus inflexus* is a species of alkaline to subneutral soils (DE LANGHE et al. 1978). According to REICHGELT (1954) it grows on basic to neutral soils, whereas it has been reported as a calcicole species in Ireland (WEBB 1952).

4.3. Nasturtio-Alopecuretum geniculati Sýkora 1982 (clusters 5 and 6)

Because of the presence of *Ranunculus sceleratus, Nasturtium microphyllum, Apium nodiflorum, Veronica catenata, Ranunculus sardous* and *Glyceria declinata,* the clusters 5 and 6 should be assigned to the *Nasturtio-Alopecuretum geniculati ranunculetosum scelerati* (SÝKORA 1982a). The association occurs on very soft, severely poached soils which are waterlogged throughout the year. The subassociation *ranunculetosum scelerati* is indicative for nutrient-rich, basic soils remaining very moist during the summer season. In Belgium two variants can be distinghuished: the variant with *Oenanthe fistulosa* (cluster 5) and the variant with *Juncus gerardi* (cluster 6). The variant with *Juncus gerardi,* differentiated by *Juncus gerardi, Potentilla anserina, Atriplex hastata* and *Eleocharis palustris,* is confined to more brackish soils than the variant with *Oenanthe fistulosa.* The latter is differentiated by *Oenanthe fistulosa, Lolium perenne* and *Poa trivialis.* The low presence degree of *Veronica catenata* in the variant with *Oenanthe fistulosa* and the low presence degree of *Ranunculus sardous* and *Glyceria declinata* in the variant of *Juncus gerardi* is remarkable.

Oenanthe fistulosa has its optimal occurrence in the *Nasturtio-Glycerietalia* Pignatti 1953. *Veronica catenata* is a character-species of the *Glycerio-Sparganion* Br.-Bl. & Siss. apud Boer 1942, while *Glyceria declinata* is differential for this alliance (WESTHOFF & DEN HELD 1969). I have no explanation for the alternating near absence of these species in the two variants. The variant with *Oenanthe fistulosa* was found on very soft, soaked clay along the margins of creeks. The variant with *Juncus gerardi* occurred along ditches, along creeks and drinking pools on dark brown to black, waterlogged, peaty clay mixed with shells.

4.4. *Agrostio-Triofolietum fragiferi* Sýkora 1982 (clusters 7 and 8)

From the *Agrostio-Trifolietum fragiferi,* characterized by *Trifolium fragiferum* (character-species) and *Juncus gerardi, Carex distans* and *Centaurium pulchellum,* three subassociations have been described (SÝKORA (1982a). The association is restricted to slightly brackish soils. Cluster 7 should be assigned to the subassociation *typicum* because of the presence of its differential species *Plantago major* (presence class V), *Poa trivialis* (III), *Carex otrubae* (V), *Phragmites australis* (V) and *Lotus tenuis* (IV). The subassociation has been found in a drainage furrow, along a creek and in a pasture on the bottom of an extensively grazed clay pit. The soil consisted of 10–25 cm of clay, mixed with organic material on grey reduced sand. The presence of *Juncus inflexus* (III) and *Carex flacca* (IV) is indicative for an alkaline (pH water >7) and calcium-rich soil (KRUYNE et al. 1967, OBERDORFER 1970, ELLENBERG 1978). *Carex flacca* prefers dry to moderately moist soils.

Cluster 8 can neither be assigned to the subassociation *typicum* nor to the *festucetosum rubrae.* Although *Festuca rubra* is present, the other differential species like *Holcus lanatus, Poa pratensis, Plantago coronopus, Odontites verna* ssp. *serotina, Plantago maritima, Cerastium fontanum* and *Centaurium litorale,*

are absent. Contrary to the *festucetosum rubrae, Plantago major, Lolium perenne* and *Poa trivialis* are frequent. From this and from the absence of further differentiating species it can be concluded that cluster 8 belongs to a variant of the subassociation *inops* which is less influenced by saline water than the subassociation *inops* as it has been described for The Netherlands (SÝKORA 1982a). The Dutch variant, called variant with *Eleocharis uniglumis,* occurring on the higher salt marshes, is inundated by salt water from the sea during high water spring tides and is grazed very extensively. The variant with *Poa trivialis* as recorded in Belgium, was found on a very moist soil, composed of about 8 to 15 cm of silt, mixed with organic material, on grey, reduced sand, containing shells. It occurred along a creek and was extensively grazed by horses, which explains the presence of *Festuca arundinacea* with a characteristic coverage of 2a. Because it is separated from the sea by a dyke, there is no inundation with salt water.

5. THE SYNTAXONOMICAL POSITION OF *Carex otrubae* AND *Eleocharis uniglumis*

Summarizing the data as given in the Dutch, Irish and Belgian/French tables the following can be concluded as regards *Carex otrubae* and *Eleocharis uniglumis*: *Carex otrubae* occurs with presence class III or more in the following communities: the derivate community of *Festuca arundinacea*-[*Lolio-Potentillion*], *Alopecurus* geniculatus type (presence class III); the *Agrostio-Trifolietum fragiferi typicum* (III and V); the *Triglochino-Agrostietum ranunculetosum repentis* (III) and *juncetosum gerardii* (III); the *Nasturtio-Alopecuretum geniculati ranunculetosum scelerati,* variant with *Oenanthe fistulosa* (III) and the basal community of *Agrostis stolonifera*-[*Lolio-Potentillion*], *Eleocharis uniglumis-Carex otrubae* type (V) and the *Juncus inflexus-Carex otrubae* type (V).

Like *Carex otrubae, Eleocharis uniglumis* has been found with presence class III or more in the derivate community of *Festuca arundinacea-* [*Lolio-Potentillion*], *Alopecurus geniculatus* type (III), *Nasturtio-Alopecuretum geniculati ranunculetosum scelerati* (III), *Triglochino-Agrostietum ranunculetosum repentis* (IV) and *juncetosum gerardii* (III); the *Agrostio-Trifolietum fragiferi typicum* (V) and the basal community of *Agrostis stolonifera-* [*Lolio-Potentillion*], *Eleocharis uniglumis-Carex otrubae* type (V). Besides *Eleocharis uniglumis* occurs in the *Agrostio-Trifolietum fragiferi* subassociation *inops* (IV) and in the basal community of *Agrostis stolonifera-* [*Lolio-Potentillion*], *Trifolium fragiferum-Ranunculus sardous* type. The occurrence of both species is highly correlated and I consider them to be character-species of the association group with *Eleocharis uniglumis,* further differentiated by *Phragmites australis* (see *table 1).* The associations belonging to this group, the *Triglochino-Agrostietum stoloniferae,* the *Nasturtio-Alopecuretum geniculati* and the *Agrostio-Trifolietum fragiferi,* have a common hydrology, i.e. the top soil remains moist throughout the year. As a consequence the top soil is often rich in organic material. As *Carex*

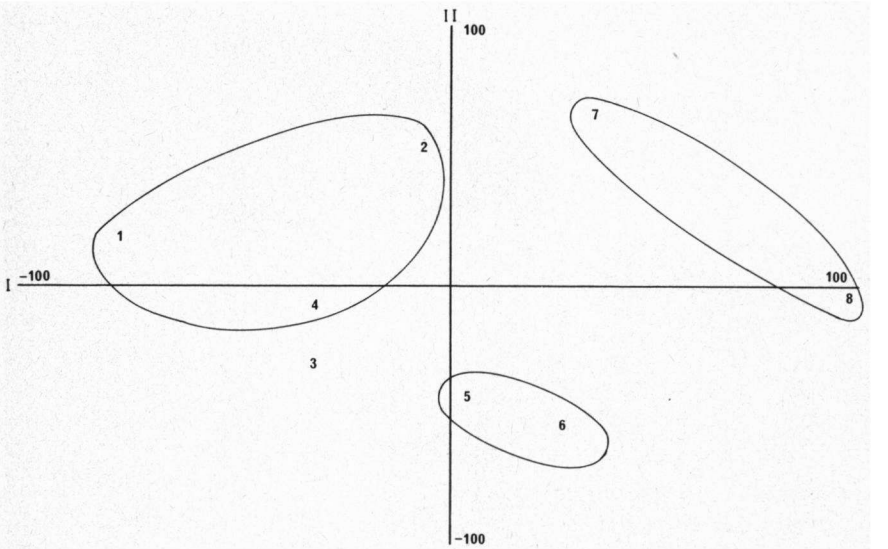

Fig. 1. Ordination diagram of the cluster centroids. Cluster numbers refer to column numbers in *table 1*.

Fig. 2. The cattle-pond is a remnant of a former creek. The poached bank is covered by the Nasturtio-Alopecuretum geniculati.

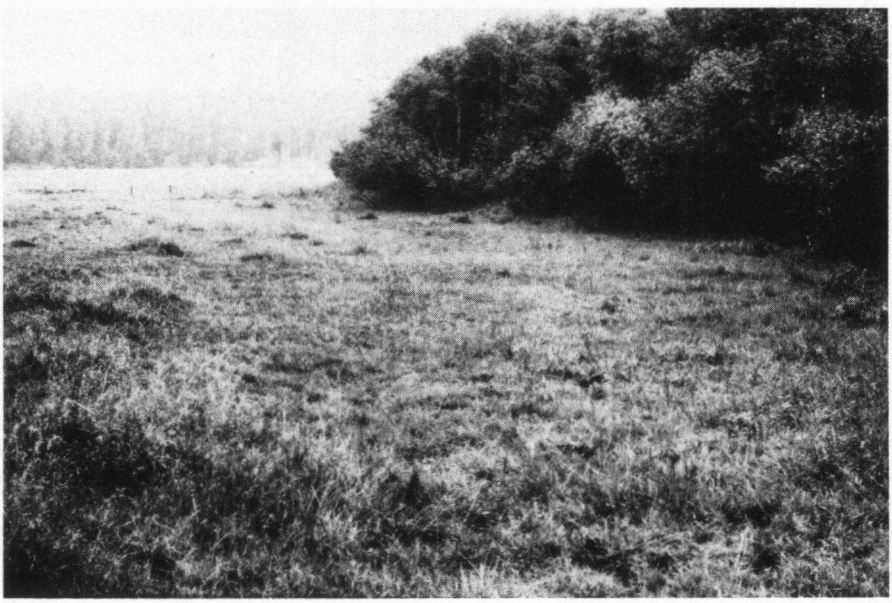

Fig. 3. The Lolio-Potentillion in the lower part of a pasture bordering a Betuletum pubescentis.

otrubae and *Eleocharis uniglumis* are salt tolerant, they both occur on fresh and on brackish soils.

6. PRINCIPAL COMPONENTS ANALYSIS

In the principal components analysis ordination of the separate relevés, the hydrological axis is clearly presented as a spiral. The production of curvilinear distortions of coenoclines is one of the disadvantages of the principal components analysis (WHITTAKER & GAUCH 1973). At the same time interpretation is difficult due to the character of the environment in which the *Lolio-Potentillion* communities have been recorded in Belgium and North-Western France. This environment, being relatively uniform, represents a mesic gradient without extreme habitats. On the other hand, ordination of the cluster centroids, i.e. the mean of the transformed cover abundance values of each species belonging to one cluster, produces axes which are clearly interpretable (*fig. 1*). Like in The Netherlands and in Ireland, the two main environmental factors are salt influence (dimension 1) and the extent to which the top soil is desiccating in summer (dimension 2). The percentage extracted variance values of these axes are respectively 31 and 20. In the basal community of *Agrostis stolonifera* (clusters 1, 2 and 4), the *Triglochino-Agrostietum stoloniferae ranunculetosum repentis* (cluster 3) and the *Nasturtio-Alopecuretum geniculati ranunculetosum scelerati* variant with *Oenanthe fistulosa* (cluster 5), the influence of salt is absent to nearly absent. The other communities occur on brackish soils with an

Fig. 4. On the bank of a former creek, poaching resulted in the formation of numerous hummocks.

increase in salt influence from the *Nasturtio-Alopecuretum ranunculetosum sce-lerati,* variant with *Juncus gerardi* (cluster 6) through the *Agrostio-Trifolietum fragiferi typicum* (cluster 7), to the *Agrostio-Trifolietum fragiferi subassociation inops* (cluster 8).

The sequence from communities on very wet soils to communities from moist soils as presented in the second axis is *Nasturtio-Alopecuretum geniculati* (cluster 5 and 6), *Triglochino-Agrostietum stoloniferae ranunculetosum repentis* (cluster 3) and the three types of the basal community of *Agrostis stolonifera* (clusters 1, 2, and 4). From the brackish communities the *Agrostio-Trifolietum fragiferi typicum* (cluster 7) was found on drier sites than the subassociation *inops* variant with *Poa trivialis* (cluster 8). Cluster 4 has actually been found to occur in the field situation as an altitudinally higher zone above clusters 5 and 6, cluster 3 has been found above cluster 6 and cluster 2 above cluster 5.

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