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SYNTAXONOMY AND SYNECOLOGY OF THE LOLIO-POTENTILLION TÜXEN 1947 IN THE NETHERLANDS*

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SUMMARY

From 1978 to and including 1980 the author studied Dutch pastures inundated in winter and spring. The ecology and taxonomy of the following communities are described in this paper:
Class: *Plantaginetea majoris* R. Tüxen and Preising 1950
Order: *Agrostietalia stoloniferae* Oberdorfer, Müller and Görs 1967
Alliance: *Lolio-Potentillion anserinae* Tüxen 1947
Ranunculo-Alopecuretum geniculati Tüxen 1937
Subassociations: *typicum* subass.nov.
rorippetosum sylvestris subass.nov.
equisetetosum palustris subass.nov.
Nasturtio-Alopecuretum geniculati ass.nov.
Triglochino-Agrostietum stoloniferae Konczak 1968
Subassociations: *ranunculetosum repentis* subass.nov.
juncetosum gerardii subass.nov.
inops subass.nov
Agrostio-Trifolietum fragiferi ass.nov.
Subassociations: *typicum* subass.nov.
festucetosum rubrae subass.nov.
inops subass.nov.
Derivate community of *Festuca arundinacea-[Lolio-Potentillion]*
Basal community of *Agrostis stolonifera-[Lolio-Potentillion]*
Community of *Scirpus maritimus* and *Alopecurus geniculatus*
Class: *Asteretea tripolii* Westhoff and Beeftink 1962
Order: *Glauco-Puccinellietalia* Beeftink and Westhoff 1962
Alliance: *Armerion maritimae* Braun-Blanquet and De Leeuw 1936
Ononido-Caricetum distantis Runge 1966
Juncetum maritimi Bilik 1956
Besides some comments are made on the *Alopecurus arundinaceus* community, observed in Sweden, which is unclear syntaxonomically. The relation of these communities to one another and to the two major environmental factors – salt influence and the position of the ground-water level during the growing season – are discussed on the basis of an ordination diagram.

1. INTRODUCTION

Because of the great difference in floristic composition and habitat the communities of inundated pastures (*Lolio-Potentillion anserinae* Tüxen 1947) and the communities occurring on organic drift material along the coasts of the northern part of Europe (*Agropyro-Rumicion crispi* Nordhagen 1940), previously

*Dedicated to Prof. V. Westhoff on the occasion of his retirement from the University of Nijmegen.

combined in the *Agropyro-Rumicion crispi* Nordhagen 1940 em.Tüxen 1950, have been separated by SÝKORA (1980).

As the *Lolio-Potentillion* had been studied insufficiently (WESTHOFF & DEN HELD 1969, WILMANNS 1978), a study into the syntaxonomy and synecology of the *Lolio-Potentillion* in some countries of Western Europe was started in 1978. Relevés were made in The Netherlands (1978, 1979 and 1980), Ireland (1979), Belgium and the northern part of France (1980), England and Wales (1981) and South Sweden (1978). In order to study the long term dynamics of the hydrology determining the occurrence of the alliance, permanent transects were investigated during these years. Papers about the data from Ireland, Belgium, France and from the transects are in preparation.

2. METHODS

During the analytical phase 428 relevés were made according to the Braun-Blanquet method (WESTHOFF & VAN DER MAAREL 1973). For estimation of the quantitative occurrence of each species the Braun-Blanquet scale as refined by BARKMAN et al. (1964) was used. The location of the sites visited is shown in *fig. 1.* A few relevés from Sweden have been added to the table (column 29). The size of the sample plots varied from 1 to 25 square meters, most of them being 4 square meters or more. According to various sources (see WESTHOFF & VAN DER MAAREL 1973) the minimal area values for pastures (*Lolio-Cynosuretum*) varies between 5 and 10 sq.m. Very often the shape of the plots was oblong, for instance 2 × 10 or 0,5 × 10 m, parallel to the waterline. The sites were selected using the knowledge already existing in phytosociological literature (e.g. PASSARGE 1964, WESTHOFF & DEN HELD 1969, OBERDORFER 1977, ELLENBERG 1978, RUNGE 1980) about the floristic composition and habitat of the *Lolio-Potentillion* and of the adjacent communities belonging to the alliances found on sites with a different hydrology and management (e.g. *Arrhenatherion, Phragmition, Magnocaricion, Bidention*). No relevés were made of the *Poo-Lolietum* D.M. de Vries and Westhoff n.n. apud Bakker 1965 because this association developing out of the *Lolio-Cynosuretum* when excessive manuring with nitrogen is applied, usually with an increase in grazing intensity, should be assigned to the *Lolio-Plantaginion* (FOERSTER 1968, WESTHOFF & DEN HELD 1969). The *Poo-Lolietum* occurs on sites which are too dry for the *Lolio-Potentillion.*

An auger was used to take soil samples in order to determine the soil texture and the organic material content. Besides grazing and poaching intensity, soil moisture, height above and distance from open water and salt influence were recorded.

In the synthetical phase the Tabord program was used for structuring the rough table (VAN DER MAAREL et al. 1978). The scale of BARKMAN et al. (1964) was transformed according to the ordinal transformation (VAN DER MAAREL 1979a, b). The similarity ratio (WISHART 1969) was used to measure similarities between relevés and clusters. The relevés were divided into two tables. In the

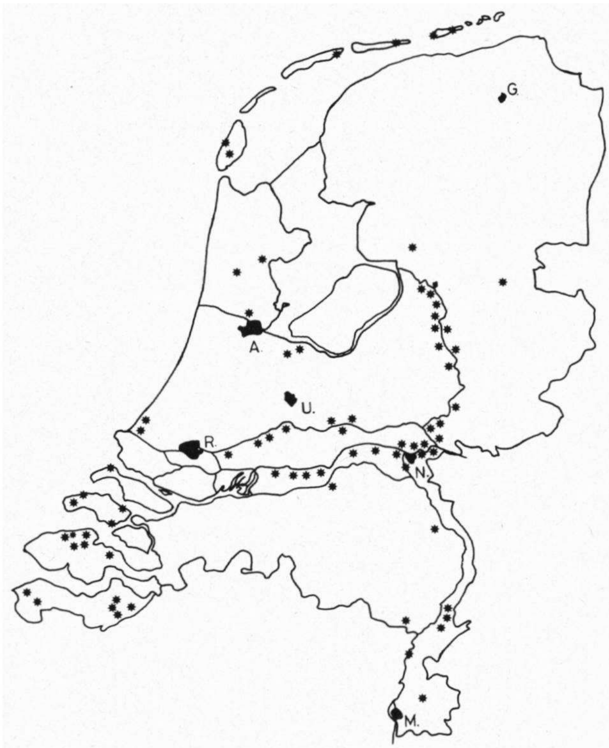

Fig. 1. Map of The Netherlands on which the localities where relevés were made are indicated with an asterix.

Table 1. Synoptic table of communities assigned to the Lolio-Potentillion anserinae Tx. 1947 occurring in The Netherlands as well as some other communities.

1–11	Ranunculo-Alopecuretum geniculati Tx. 1937
1–5	Subass. rorippetosum sylvestris
6	Subass. typicum
7–11	Subass. equisetetosum palustris
12–13	Derivate community of Festuca arundinacea-[Lolio-Potentillion]
14	Nasturtio-Alopecuretum geniculati ass.nov.
15	Community of Scirpus maritimus and Alopecurus geniculatus
16–17	Basal community of Agrostis stolonifera-[Lolio-Potentillion]
18–22	Triglochino-Agrostietum stoloniferae Konczak 1968
18	Subass, inops
19–20	Subass. ranunculetosum repentis
21–22	Subass. juncetosum gerardii
23–25	Agrostio-Trifolietum fragiferi ass.nov.
23	Subass. inops
24	Subass. typicum
25	Subass. festucetosum rubrae

Other communities

26	Ononido-Caricetum distantis Runge 1966
27–28	Juncetum maritimi Bilik 1956
29	Alopecurus arundinaceus community

Table 1. Legend on preceding page.

Ononido-Caricetum distantis character and differential species																													
Ononis spinosa																								I	I	V	II	I	
Armeria maritima																									II	IV	I		
Lotus corniculatus								II						I		I		II	II		I				I	IV			
Trifolium pratense			I					II	I		I													I	I	III			
Cochlearia danica																										II			
Juncetum maritimi																													
Juncus maritimus																							I		I		IV	V	
Oenanthe lachenalii												I											I				I	V	
Pulicaria dysenterica												I												I				IV	
Alopecurus arundinaceus community																													
Alopecurus arundinaceus																													V
Aster tripolium																									I				III
Sonchus arvensis							I																				I		III
Companion species																													
Trifolium repens	II	III	II	II	I	III	IV	V	IV	IV	IV	III	V	III		IV	II	II	IV	II	II	IV	II	IV	V	V	II		
Ranunculus repens	I	V	IV	IV	IV	V	V	V	V	V	V	III	V	IV		II		II	V	V	II			I					II
Holcus lanatus							I		I	IV	IV	III	IV			II		II	IV		I	I	I	I	V	V		III	
Cirsium arvense	III	V	I	II	IV	II	III	III	II	I	I	III	II	I	II	I			I				I		II	I	I	III	III
Juncus bufonius group				I	II	I	I	II	II	II	I	I	I	III		II	III	II	I	II	III		I	III	II	I			
Mentha aquatica		I		I		I	II	IV	III	I	I	I	II	II	II			I	IV	III	II		I	I	I			III	
Poa pratensis	II	I	I	II	III	I	I	III	I			I				I		I		II	I	I	I	I	IV	V	II	V	IV
Leontodon autumnalis	III	I	II	I		I	I	III	II		I							II	III	IV	III	I		III	III	III			
Eleocharis palustris		I	II	I	III	II	III	II	III	II	II		II	I			I	II		V	I	I							
Cerastium fontanum					I		I	III	I	I	I	III	II	III	I				II	I					III	V			
Glyceria fluitans			I			I	I		IV	V	IV		II	IV		I	I	I	III	II									
Cardamine pratensis						I	II		III	III	II	I	II	I				II	V	IV	III								
Rumex conglomeratus			I	I			I	II	II			I	II	II	III	I				I									
Bellis perennis		I	I	I				V	I	II	I	II	III	II		II			I					III					
Mentha arvensis				II		I	I		I.					I	I.			II		I		III	I		I		I		
Festuca pratensis		II		II		II	II	V	I	III	II		I	I						I									
Plantago lanceolata		I	I	I	I	I		II	I	I						I				II						I			
Atriplex hastata		I	I	I		I			I			I	I	I	II		I						I						
Polygonum hydropiper		I	I	I		I	I	II	I	I	I			I															
Equisetum arvense	III	I	I	III	I		I		I			I								II	I								
Oenanthe aquatica		I		I		I	I	II	I		I			III	I														
Rumex obtusifolius	II	II	I			II			I		I	I	I				I												
Blysmus compressus		I	I			I								I						I	I			I	I			I	
Sagina procumbens											I					I		I	III		III			I	II	II			
Stellaria media		I			III	II	I		I			I	I																
Cynosurus cristatus		I					I					I	I			I								I	I				
Scirpus lacustris ssp.												I	I	III	III				IV				I	II					
tabernaemontani																													
Leontodon taraxacoides																I			I		I			I	II	II	I		
Prunella vulgaris							I	III												I				I		I			
Senecio aquaticus						I			I	I							I		III										
Carex disticha							I		I									I		III	I		I						
Eleocharis quinqueflora																				I		IV	I		I		I		
Urtica dioica		II	I			I	I		I			II																	
Achillea ptarmica	I	I	I			I	I		I																				
Lycopus europaeus							I		I									II	I	II	I								
Equisetum fluviatile						I	I	II	I	III																			
Oenanthe fistulosa								II	II	I										I	I								
Phleum pratense				I		I		II	II			I																	
Ranunculus acris							I	II			I	II												I					
Lotus tenuis																I								III	I			III	
Samolus valerandi																I					I			III					
Iris pseudacorus		II				I	I		I																				II
Veronica scutellata									I					I				II		I	I								
Lychnis flos-cuculi						I		II															I						
Veronica serpyllifolia							I	II	I		I																		
Butomus umbellatus			II			I	I			I																			
Vicia cracca		I				I			I											II									
Stellaria palustris		I					I											II											
Elymus pungens												I				I										II			
Salix repens																							I		I	II			
Berula erecta										I									III										
Epilobium palustre																			II										
Carex serotina							I		I												II								
Anagallis minima																					II								
Juncus effusus																		II	II										
Artemisia vulgaris	II																I												
Daucus carota												I																	II
Carex panicea							I											II											
Hippuris vulgaris														I	II														
Bryophytes																													
Brachythecium rutabulum		I	I	I		I	I	III	I	I	II	I	II	II		I		II	I	I	I	IV	II	III	III	III		I	
Drepanocladus aduncus			I	I		I	I		II	II	I			II		I	I	I	II	II	I	II		IV			I		
Calliergonella cuspidata		I	I		IV	I	I		I	I			I			I		II	I	II	IV				I				

Cluster 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
number of relevés	5	16	15	11	7	39	30	4	31	8	14	12	9	16	9	16	17	14	12	11	10	4	28	12	17	14	10	6	4
Plantaginetea + Lolio-Plantaginetum																													
Potentilla anserina	IV	II	IV	IV	II	IV	III	III	III	I	II	III	II	III	III	V	IV	V	III	V	V	V	V	II	V	V	V	IV	III
Plantago major	II	V	IV	III	IV	V	III	V	IV	II	III	II	IV	IV	II	V	II	I	IV	I	II		II	IV	II			I	
Lolium perenne	I	I	I	III	II	II	I	V	II	I	III	IV	II	II	II	IV	I		III	II			I	II	I		I		
Poa annua	II	III	IV	II	I	I	III	III	I	I	II	I	I	I		I	II	I	I	I	I		I	I	I				
Polygonum aviculare	I	I	II	II	I	II	I		I	I				I		I													
Lolio-Potentillion character species + constant companion																													
Agrostis stolonifera	V	IV	IV	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	IV	V	V	V	V	V	V	V
c.c. Poa trivialis	I	V	IV	III	V	V	V	V	V	V	V	IV	V	V	III	V	I	I	V	III	I	IV	I	III	I			I	
Alopecurus geniculatus		II	V	V	IV	V	III	II	V	IV	V	II	IV	V	IV	IV	V	III	V	IV	I	II	II						
Rumex crispus	V	V	V	V	III	V	V	IV	IV	III	III	III	IV	III	I	I	I	I	I	III			I						V
Carex otrubae						I	I	II	I			II	III	II	II	I	I						I	III				I	
Juncus inflexus						I	I	II	I			I		I		I													
Ranunculo-Alopecuretum character and differential species																													
Phalaris arundinacea	IV	V	IV	II	II	V	IV	III	III	I	I	I	I	I			I							I					
Polygonum amphibium	II	III	III	I		IV	IV	IV	IV	II	I			I				I	I	II				I					
Potentilla reptans	III	IV	V	IV	V	II	II	III	I		I							I		I	I		I						
Taraxacum officinale group	II	V	III	II	I	III	II	III	II	I	III	I	III	I			I	I		I						I			
Elymus repens	V	V	V	V	V	IV	III	II	II	I	III	IV		I	I	I	I	I	I				I						
Carex hirta	I	I	II	IV	V	II	IV	III	III	II	III		III	II		I	I						I						
Lysimachia nummularia		II	I	I			III	V	III	I			I						II										
Myosotis scorpioides		I	I	II	V	II	III	IV	V	III	I																		
Rorippa sylvestris	IV	IV	V	II	V	IV	I		II		I																		
Rorippa amphibia		I	II	I	II	III	II	II	II	I			I																
Juncus compressus			I	II	IV	I	II	II	I		I																		
Alopecurus pratensis	I	IV	I	II		II	II		I		I	I																	
Equisetum palustre						II	IV	III	I	IV	II		II	I				I											
Glechoma hederacea		II				II	II	III	I																				
Glyceria maxima						I	I	III	IV	IV	I																		
Mentha pulegium					IV																								
Inula britannica						I	I																						
Association group with Eleocharis uniglumis character and differential species.																													
Phragmites australis						I	I		I	I		II	I	II	II	II	I	I	III	V	IV	III	II	IV	II	II	I	IV	III
Eleocharis uniglumis						I			I	I		I	III	III	IV	III	I	II	II	IV	III	III	IV	V	I	III	I	I	
D.o. Festuca arundinacea- Lolio-Potentillion																													
Festuca arundinacea	I	I		I					I			V	V	II	II	III	I	I	III				II	III	II	I	II	V	IV
Nasturtio-Alopecuretum character and differential species																													
Ranunculus sceleratus			I	I	II	I	I		I	I				V	III	II	I		II		I								
Nasturtium microphyllum						I	I		I		I		II	IV	II	I				I									
Veronica catenata		I	I	II	III	II	I	II	II	I	I			IV	II		I			I	I		I						
Ranunculus sardous											I	II	III	III	II	III	I						I						
Epilobium parviflorum									I			I		III	I	I			I					I					
Glyceria declinata											I		I	II					I										
Community of Scirpus maritimus and Alopecurus geniculatus																													
Scirpus maritimus						I						I	II	I	V	II	III		I				II	III			I	I	V
Triglochino-Agrostietum character and differential species																													
Juncus articulatus			I	I	III	I	I	IV	IV	IV	II	I	II	III		II	II	IV	V	V	V	V	I	III	II	I	I		
Galium palustre			I	I	I	I	II	II	IV	II				I				IV	V	V	IV	II	II	I				I	II
Triglochin palustris						I			I	I			I	II	II	I	II		V	III	II	IV	I	II	II				
Ranunculus flammula							I		I		I			I			I	IV	III	V	III	V			I				
Hydrocotyle vulgaris																		IV	III	V	V	II	I		I	I			
Carex nigra									I					I		I		V		V	V	V	I		II	I	I		
Myosotis laxa ssp.caespitosa			I			I	I	II	I	I	I			I				I	IV	V	III								
Agrostio-Trifolietum fragiferi character and differential species																													
Juncus gerardi						I						I	I	I	III	III	I	I	II	I	V	V	V	V	V	V	V	IV	
Glaux maritima												I		II	II	II	I	I			IV	V	IV	V	II	V	IV	II	
Trifolium fragiferum					I	I	I		II		I	I	II	II		IV	I	I		I		V	I	V	III	II	I		
Triglochin maritima																I	I		I		I	II		II	II	I	II		II
Carex distans																I	I						I	IV	IV	V	II	IV	
Centaurium pulchellum																	I				II		I	V	III		II		
Agrostio-Trifolietum fragiferi festucetosum rubrae and Ononido-Caricetum																													
Festuca rubra		I		I								I				I	I	I	I	I			I		V	V	V	V	II
Plantago coronopus																							I	I	III	III			
Odontites verna ssp. serotina									I				I		I						I		II		III	III	III		
Plantago maritima																							I	I	III	III	IV		II
Centaurium littorale																													

definite table the treshold value was 0.35 in both tables, the fusion level 0.67 and 0.77 respectively. After removing the rest group and the clusters clearly belonging to associations from other alliances (*Lolio-Cynosuretum, Sagino maritimae-Cochlearietum danicae*), 401 relevés remained. Only the synoptic table is presented here (*table 1*). Apart from this general table, four synoptic tables of lower units were constructed in order to show their internal structure (*tables 2, 4, 5* and *6*).

The cluster centroids, that is the mean of the transformed cover abundance values of each species belonging to one cluster, were used in a principal components analysis. For this ordination the Ordina program (ROSKAM 1971, see also VAN DER MAAREL 1979a) was used.

Names of phanerogams are according to the Flora Europaea (TUTIN et al. 1964–1980). The mosses are named according to LANDWEHR (1966).

3. RESULTS

3.1 THE ALLIANCE *Lolio-Potentillion* Tüxen 1947.

Synonym: *Agrostion stoloniferae* Görs 1966, *Agropyro-Rumicion crispi* Nordhagen 1940 em. R. Tüxen 1950 pro parte. Non *Agropyro-Rumicion crispi* Nordhagen 1940 (see Sýkora 1980)

Syntaxonomy (*table 1*): The *Lolio-Potentillion* as studied in The Netherlands is characterized by the presence of the character-species *Agrostis stolonifera, Alopecurus geniculatus* and *Rumex crispus,* and the constant companion *Poa trivialis.* Constant companions are species which have a presence of more than 60% but cannot be designated as character-species or differential species (BRAUN-BLANQUET 1925, 1928, 1959, 1964).

Carex otrubae and *Juncus inflexus* are placed under the heading *Lolio-Potentillion* in the table because they have a clear preference for some of the lower units in the Belgian, French and Irish material. In the Dutch material these species do not show any obvious preference. *Lymnaea truncatula* Müll., the liver fluke snail, occurs with preference in the *Lolio-Potentillion* (OVER 1967) as its occurrence is promoted by grazing, ground-water fluctuation and poaching (see Synecology).

In 1970 TÜXEN separated the *Lolio-Plantaginion majoris* Sissingh 1969 and the *Lolio-Potentillion* (called Agropyro-Rumicion in his paper) and put them into separate orders which he placed into the class *Molinio-Arrhenatheretea* Tüxen 1937. Whereas the first alliance remained in the *Plantaginetalia majoris* R. Tüxen (1947) 1950, the *Lolio-Potentillion* was placed into the *Trifolio fragiferi-Agrostietalia* (Oberdorfer 1967 em. Tüxen 1970). In 1971 OBERDORFER abandoned the unit *Lolio-Plantaginetum* (Linkola 1921) Beger 1930 em. Sissingh 1969 (*Lolio-Plantaginion* Sissingh 1969), and after dividing this community into three subassociations, one of which he assigned to the *Cynosurion* (Tüxen 1937), her renamed it the *Matricario-Polygonetum* Müller mscr. In the same paper he stated that *Lolium perenne* is not a character-taxon of the *Plantaginetea majoris* Tüxen et Preising 1950, but of the *Cynosurion.*

In 1972 KRIPPELOVÁ divided the *Lolio-Plantaginetum* into the subassociations *typicum* Krippelová 1972, *poetosum annuae* Krippelová 1972 and *potentilletosum anserinae* Krippelová 1972. Besides she recognized within this association the stadium of *Polygonum aviculare* (comparable to the *Matricario-Polygonetum typicum* described by Oberdorfer 1971) and the stadium of *Plantago major*. As *Lolium perenne* occurs with high coverage and high frequency (100%) in the subassociation *typicum* and as species of the *Cynosurion* are almost absent in this community, the unit *Lolio-Plantaginetum* should be maintained. Although *Lolium perenne* occurs with a high presence in communities belonging to the *Cynosurion*, it is obviously a character-species of the *Lolio-Plantaginetum typicum* (KRIPPELOVÁ 1972, KOPECKY 1978).

The assignment of the *Plantaginetalia majoris* to the *Molinio-Arrhenatheretea* can by no means be justified. The same applies for the *Lolio-Potentillion*. This alliance differs considerably in floristic composition from the *Molinio-Arrhenatheretea*. In this class the species *Cynosurus cristatus, Phleum pratense, Plantago lanceolata, Poa pratensis, Festuca rubra, Festuca pratensis, Cerastium fontanum, Ranunculus acris, Trifolium pratense, Rumex acetosa, Holcus lanatus, Vicia cracca, Lathyrus pratensis, Trifolium dubium, Alopecurus pratensis, Arrhenatherum elatius, Bellis perennis, Prunella vulgaris, Leucanthemum vulgare, Veronica chamaedrys* and *Trisetum flavescens* are frequent. On the contrary they are almost absent in the *Lolio-Potentillion*, whereas the opposite applies for a lot of species which are characteristic for this alliance.

As the character-species of the *Plantaginetea, Potentilla anserina, Plantago major, Lolium perenne* and *Poa annua* occur in the *Lolio-Potentillion*, often with high presence degrees in most (*Potentilla anserina, Plantago major*) or in some of the communities (*Lolium perenne* and *Poa annua*), I consider this alliance to belong to this class. Besides the *Lolio-Plantaginetum* and the communities of the *Lolio-Potentillion* are ecologically related by their occurrence on soils which are frequently treaded and are deficient in oxygen. In the *Lolio-Plantaginion* the oxygen deficiency is caused by the compaction of the soil whereas in the *Lolio-Potentillion* it is mainly caused by inundation and waterlogging. Since, on the other hand, the difference in floristic composition and in habitat is obvious, I adopt the opinion of OBERDORFER et al. (1967) to assign the *Lolio-Potentillion* (called *Agropyro-Rumicion* by them) to a separate order, the *Agrostietalia stoloniferae* Oberdorfer, Müller & Görs 1967 (see also GÖRS 1968, MÜLLER & GÖRS 1969). In my opinion the suggested division of the *Lolio-Potentillion* into three suballiances, *Juncion effusi, Loto-Trifolion* and *Eu-Agropyro-Rumicion* (WESTHOFF et al. 1961, WESTHOFF & VAN LEEUWEN 1962, 1966, WESTHOFF & DEN HELD 1969) does not apply for the atlantic domain of Europe.

The *Lolio-Potentillion* occurs in almost all countries of Europe. It is found in the southern part of Sweden, but its northern limitation is still unclear. In the Mediterranean region it is replaced by the vicariant alliance *Trifolio-Cynodontion* Braun-Blanquet & Bolos 1957, which is found under similar ecological conditions, e.g. moist soils poor in oxygen, inundated in winter, grazed by cat-

Fig. 2. The Lolio-Potentillion is restricted to the low-lying inundated zone (January 1980) in a pasture on the bank of a former creek. During summer the water table will be below the soil surface. Just outside the fence where grazing pressure is absent the vegetation is dominated by Phragmites australis.

Fig. 3. The Agrostio-Trifolietum fragiferi inundated by slightly brackish water on an upper salt marsh in The Netherlands (February 1980). The little hummocks are caused by poaching. The little bushes on the small dunes consist of Ononis spinosa and Salix repens.

tle and often poached. In arid or semi-arid climates it is restricted to places where the ground-water level is constantly very high e.g. along rivers with low banks and on frequently inundated islands. It is therefore rather rare and occupies only small areas. The *Caricetum divisae*, subassociation of *Leucojum aestivum* and *Galium constrictum* as described by DONKER & STEVELINK 1961, should be assigned to the *Trifolio-Cynodontion* (BRAUN-BLANQUET & BOLOS 1957, TÜXEN & OBERDORFER 1958, BOLOS 1967, RIVAS-MARTINEZ 1968, BOLOS et al. 1970). J. TÜXEN (1966) is of the opinion that the floristic differences between these two alliances is insufficient and he therefore proposes to abandon the alliance *Trifolio-Cynodontion*. As this alliance has been studied insufficiently no definite enunciation can be made.

Synecology: The communities belonging to the *Lolio-Potentillion* are mainly composed of reptant hemicryptophytes and rhizome-geophytes. These plants have a capacity for rapid vegetative spread and are efficient colonizers of temporary gaps. They occur in water meadows, river forelands, along former river beds, beside pools resulting from dike bursts, in or along depressions containing stagnant water, at the edge of drinking pools for cattle, along ditches, on higher salt marshes and along former creeks, now surrounded by polders. They are found on all kinds of relatively nutrient-rich, hydromorphic soils, varying from sand to heavy clay soils and soils with a peaty top soil layer of about 10 cm consisting for almost 100% of organic material. Most of the species characterizing this alliance have their optimal occurrence on soils moderately rich to rich in nitrogen (ELLENBERG 1978). A mean C/N ratio of 13 ($n = 16$, $\sigma = 2$) measured in the *Ranunculo- Alopecuretum*, the *Nasturtio-Alopecuretum* and the *Agrostio-Trifolietum fragiferi* indicates a rather rapid mineralization. The main factors associated with their occurrence are winter and spring inundation (often with silt or sand deposition) and grazing. The composing species belong to the trichohygrophyta (HEJNY 1960); germination, flowering and maturation of the seed take place in the terrestrial phase when the soil is still moist. A long limose phase offers favourable conditions and a secondary flooding is tolerated.

The flooding (*figs. 2* and *3*) leads to oxygen depletion of the soil which again causes the formation of Mn^{++}-ions, Fe^{++}-ions and reduction of sulphate into sulphides. CO_2, organic acids and for instance methane are produced by decomposition of organic material (BRÜMMER 1974). While lack of oxygen can seriously trouble the respiration in the cell, the substances mentioned above are toxic to many species. Under anaerobic conditions phosphorus is easily available (SCHEFFER et al. 1976). This is in concordance with the fact that most of the species characteristic for the *Lolio-Potentillion* have their highest relative average frequencies on soils with a rather high (P-citric acid 51–80) to high (P-citric acid > 80) phospor status (KRUYNE et al. 1967). Flood sensitive species appear to be excluded from frequently flooded habitats due to the production of increased amounts of ethanol resulting from an increased rate of glycolysis induced by the anaerobic conditions. This accumulation of toxic quantities of ethanol does not occur in flood-tolerant species. According to some evidence a metabolic switch in the latter species may lead to the accumulation of mainly the non-toxic malic acid (HENSHAW et al. 1962, CRAWFORD & MC MANNON 1968, CRAWFORD & TYLER 1969, CRAWFORD 1966, CRAWFORD 1969, MC MANNON & CRAWFORD 1971).

Various plant species avoid oxygen stress by means of oxygen diffusion through stems, rhizomes and roots. *Lolio-Potentillion* species possessing aerenchymous tissues in stem and roots are for instance *Alopecurus geniculatus, Inula britannica, Agrostis stolonifera* and *Potentilla anserina* (WALTHER 1977). Radial oxygen loss from the roots of these plants is of considerable benefit to wetland species as it oxydises the reduced soil toxins (CONWAY 1940, ARMSTRONG 1964, 1967, 1971; BRÄNDLE 1980a, b). Of course this oxygen transport is only possible if the plants are partly emerged. As plant activity is stimulated by higher temperatures, inundation during the summer season is of more influence than winter inundation. According to KLAPP (1971) in a temperate climate growth of grassland species starts at 5°C and abundant growth only above 10°C. By growing on frequently inundated sites, the *Lolio-Potentillion* species avoid competition from flood-sensitive grassland species (DIERSCHKE & JECKEL 1980). Species selection is probably already taking place in the seed bank. Most seeds will not normally germinate if the oxygen tension is decreased below that in the atmosphere and after some time their viability becomes impaired (MAYER & POLJAKOFF-MAYBER 1963). Other species can only germinate if the seeds are shed in a very moist habitat. In years of excessive rainfall and flooding a marked general reduction of the abundance and cover of species which cannot survive prolonged inundation periods (e.g. numerous species of the *Molinio-Arrhenatheretea*) can be observed (STOFFERS & KNAPP 1962, KLAPP 1965, BALATOVA-TULAČKOVA 1972, WALTHER 1977). The fluctuations resulting from climatological differences from year to year (ecotypic oscillations) were called "Harmonika-Sukzession" by TÜXEN (1950). For the species in question the flooding (in some communities even with sea water) is a perturbation i.e. a significant deviation from the nominal state (the normal operating range). For the grassland species sensitive to flooding, the oxygen depletion induced by the inundation is a severe unfavourable deflection or stress (sensu ODUM et al. 1979). In the *Lolio-Potentillion* the fluctuation in the hydrology does not act as a stress but as a subsidy i.e. it improves the performance of the ecosystem. The elimination of these natural pulses will severely perturb the "perturbation-dependent" ecosystem (VAN LEEUWEN 1958, VAN LEEUWEN & WESTHOFF 1961, WESTHOFF et al. 1961, WESTHOFF & VAN LEEUWEN 1966, BAKKER 1965).

The species composing the *Lolio-Potentillion* belong to the category of ruderal-perennial herbs (GRIME 1979). Ruderals sensu Grime are species that thrive under conditions of low stress (sensu Grime) and high disturbance. Grime has unfortunately broadened the concept ruderal. It is used in botanical literature for species growing on rubble (latin: rudus) and disturbed road sides, e.g. *Sisymbrion* and *Onopordietalia* (ELLENBERG 1978, WILMANNS 1978). The communities to which they belong are strongly influenced by man. The term ruderal sensu Grime also comprises communities where disturbances have a natural cause as for instance flooding in the case of the *Lolio-Potentillion.* The anthropogenic influence here is grazing but as will be stated further down, this alliance can also occur under conditions of natural grazing. By preventing the establishment of tall growing species, grazing is advantageous to the low creeping hemicryptophytes and rhizome-geophytes (KLAPP 1971).

Although deep and often numerous hoofprints are seldom absent, poaching is not a necessary condition for the development of the *Lolio-Potentillion.* Totally untrampled but short-grazed sites often occur immediately outside the pasture fence bearing excellently developed *Lolio-Potentillion.* In ELLENBERG 1978 an outline is given of the influence of trampling on the vegetation (see also KLAPP 1971). Soil compaction resulting from this phenomenon again reduces the aeration of the soil.

As grazing by wild herbivores and frequent inundation along uncontrolled rivers were common in the European lowland, this alliance must have existed in prehistoric times (LOHMEYER 1954, WESTHOFF & VAN LEEUWEN 1966, GROENMAN-VAN WAATERINGE 1968, KLAPP 1971, Anonymous 1979). Nowadays human pressure has increased so severely that this alliance although very characteristic for the North European lowland, is declining in a considerable way (FRILEUX 1976, DIERSCHKE 1978, DIERSCHKE & JECKEL 1980). The main factor involved in this process is the drastic land drainage and the consequent lowering of the water tables. Wetlands present the most obvious of challenges to the farmer intent on agricultural intensification (SMEETS et al. 1980). Anything that is wet can be drained – at a price (SHOARD 1980).

In Europe in general the last two decades have witnessed a very impressive increase in field drainage to such an extent that it now is one of the leading factors in rural environmental change (GREEN 1980). Besides drainage the intensive use of herbicides, the large scale use of inorganic fertilizers. overgrazing and an increase in salt influence (MEULEMAN & JOANKNECHT 1980) are detrimental to the *Lolio-Potentillion.*

3.1.1. The lower units

I *Ranunculo-Alopecuretum geniculati* Tüxen 1937.

Synonym: *Rumici-Alopecuretum geniculati* Tüxen 1950.

Syntaxonomy (*table 1* and *2*, clusters nr. 1–11):

Character-species: *Potentilla reptans, Carex hirta, Rorippa sylvestris, Juncus compressus, Inula britannica* and *Mentha pulegium.*

Differential species: *Phalaris arundinacea, Polygonum amphibium, Taraxacum officinale* group, *Elymus repens, Lysimachia nummularia, Myosotis scorpioides, Rorippa amphibia, Alopecurus pratensis, Equisetum palustre, Glechoma hederacea* and *Glyceria maxima.*

Constant companion: *Ranunculus repens.*

Inula britannica and *Mentha pulegium* respectively, are rather rare and very rare in The Netherlands (VAN DER MAAREL 1971a, ARNOLDS et al. 1976). *Mentha pulegium* reaches its north-western boundary in Ireland, South England

Cluster number	1	2	3	4	5	6	7	8	9	10	11
Plantaginetea and Lolio-Potentillion											
Agrostis stolonifera	V	IV	IV	V	V	V	V	V	V	V	V
Rumex crispus	V	V	V	V	III	V	V	IV	IV	III	III
Plantago major	II	V	IV	III	IV	V	III	V	IV	II	III
Poa annua	II	III	IV	II	I	I	III	III	I	I	II
c.c.Poa trivialis	I	V	IV	III	V	V	V	V	V	V	V
c.c.Ranunculus repens	I	V	IV	IV	IV	V	V	V	V	V	V
Alopecurus geniculatus		II	V	V	IV	V	III	II	V	IV	V
Rorippetosum sylvestris											
Rorippa sylvestris	IV	IV	V	II	V	IV	I		II		I
Elymus repens	V	V	V	V	V	IV	III	II	II	I	III
Potentilla reptans	III	IV	V	IV	V	II	II	III	I		I
Equisetosum palustris											
Equisetum palustre						II	IV	III	I	IV	II
Trifolium repens	II	III	II	II	I	III	IV	V	IV	IV	IV
Cardamine pratensis						I	II		III	III	II
Equisetum fluviatile						I	I	II	I	III	
Variants + subvariants											
Potentilla anserina	IV	II	IV	IV	II	IV	III	III	III	I	II
Cirsium arvense	III	V	I	II	IV	II	III	III	II	I	I
Phalaris arundinacea	IV	V	IV	II	II	V	IV	III	III	I	I
Polygonum amphibium	II	III	III	I		IV	IV	IV	IV		
Glechoma hederacea		II				II	II	III	I		
Mentha aquatica		I		I		I	II	IV	III	I	I
Carex hirta	I	I	II	IV	V	II	IV	III	III	II	III
Myosotis scorpioides		I	I	II	V	II	III	IV	V	III	I
Holcus lanatus							I		I	V	V
Artemisia vulgaris	II										
Taraxacum officinale gr.	II	V	III	II	I	III	II	III	II	I	III
Alopecurus pratensis	I	IV	I	II		II	II		I		I
Juncus compressus			I	II	IV	I	II	II	I		I
Mentha pulegium					IV						
Calliergonella cuspidata		I	I		IV	I	I		I	I	
Lolium perenne	I	I	I	III	II	II	I	V	II	I	III
Lysimachia nummularia		II	I	I			III	V	III	I	
Bellis perennis		I	I	I				V	I	II	I
Festuca pratensis		II		II		II	II	V	I	III	II
Prunella vulgaris							I	III			
Cerastium fontanum					I		I	III	I	I	I
Glyceria maxima						I	I	III	IV	IV	I
Juncus articulatus			I	I	III	I	I	IV	IV	IV	II
Glyceria fluitans			I			I	I		IV	V	IV
Galium palustre			I	I	I	I	II	II	IV	II	
Remaining species											
Eleocharis palustris		I	II	I	III	II	III	II	III	II	II
Veronica catenata		I	I	II	III	II	I	II	II	I	I
Poa pratensis	II	I	I	II	III	I	I	III	I		
Rorippa amphibia		I	II	I	II	III	II	II	I		
Leontodon autumnalis	III	I	II	I		I	I	III	II		I
Equisetum arvense	III	I	I	III	I		I		I		
Polygonum aviculare	I	I	II	II	I	II	I		I	I	
Stellaria media		I			III	II	I		I		
Juncus bufonius gr.				I	II	I	I	II	II	II	I
Plantago lanceolata		I	I	I	I	I		II	I	I	
Polygonum hydropiper		I	I	I		I	I	II	I	I	I
Ranunculus sceleratus			I	I	II	I	I		I	I	
Myosotis laxa ssp.caespitosa			I			I	I	II	I	I	I
Oenanthe aquatica		I		I		I	I	II	I		I
Rumex obtusifolius	II	II	I			II			I		I
Trifolium fragiferum					I	I	I		II		I
Urtica dioica		II	I			I	I		I		
Trifolium pratense			I					II	I		I
Mentha arvensis				II		I	I		I		
Phleum pratense				I		I		II	II		
Iris pseudacorus		II				I	I		I		
Veronica serpyllifolia							I	II	I		I
Butomus umbellatus			II			I	I			I	
Oenanthe fistulosa								II	II	I	
Ranunculus acris							I	II			I
Rumex conglomeratus			I	I			I	II	II		
Carex otrubae						I	I	II	I		
Juncus inflexus						I	I	II	I		
Lychnis flos-cuculi						I		II			

and The Netherlands. In The Netherlands it has been recorded only in nine hoursquares since 1950. A new locality has been found in 1981 (ADEMA 1981). Its decline from 47 hoursquares before 1950 is probably due to a change in water control (ADEMA 1980). In the literature (WESTHOFF & DEN HELD 1969, OBERDORFER 1970, VICHEREK 1973, KNEEPKENS & VERHOEVEN 1975, ELLENBERG 1978) these species are considered to be character-species of the *Lolio-Potentillion* (*Agropyro-Rumicion crispi* sensu Tüxen 1950); in *table 1* they are represented in the *Ranunculo-Alopecuretum* only, so that they are considered to be characteristic for this association.

Elymus repens and *Ranunculus repens* are neither character-species of the alliance nor of the *Ranunculo-Alopercuretum*. *Elymus repens* has a wide ecological amplitude and occurs with presence class IV or V in several communities (see *table 3*). These communities occur on arable lands, recently disturbed soils, ruderal and otherwise anthropogenically influenced sites.

According to PALMER & SAGAR (1963) *Elymus repens* is usually found in waste places and on arable land where tree or shrub cover is not continuous. It is a common component of lightly grazed grassland communities of basic soils in Britain, a pioneer plant in the colonization of waste places, a pest of agriculture, especially associated with arable land. In case of disturbance of the vegetation cover this species is quickly colonizing the gaps by means of its prolific vegetative reproduction through rhizomes (PALMER & SAGAR 1963). *Elymus repens* is both very resistant against drought and against flooding (KRUYNE & DE VRIES 1968). It has been observed to spread impressively as a reaction to overfertilization with nitrogen (LAMBERT 1979). MÜLLER & GÖRS (1969) consider it to be a character-species of the *Convolvulo-Agropyrion repentis* Görs 1966, *Agropyretea intermedii-repentis* Oberdorfer, Müller & Görs 1967, semi ruderal grasslands from dry and medium dry sites. Originally, before the creation of these antrhopogenic habitats, the optimal occurrence of *Elymus repens* must have been in natural *Lolio-Potentillion* communities where open places were created by the influence of inundation (e.g. sedimentation, erosion) or poaching.

Ranunculus repens occurs with high presence class in some *Magnocaricion*-communities, especially in the *Phalaridetum arundinaceae* Libb. 1931 and the *Caricetum gracilis* (Graebn. & Hueck 1931) Tüxen 1937 as well as in several communities of the *Calthion palustris* Tüxen 1937 em. 1951, especially in the *Cirsietum oleracei* Tüxen (1937) 1951 and the *Juncetum subnodulosi* Koch 1936 (PASSARGE 1964). It is a weed of grassland and arable land and of recently disturbed ground. *Ranunculus repens* is especially abundant where drainage is impeded and is found mainly on heavy wet soils. Colonization of open ground is quickly effected by the production of long stolons (HARPER 1957). These conditions explain its high presence in the *Lolio-Potentillion.*

a) Subassociation *typicum* (cluster nr. 6). This subassociation takes a central position between the other subassociations.
b) Subassociation *rorippetosum sylvestris* (clusters nr. 1–5). Differential spe-

Table 3. Communities in which Elymus repens is found with presence class IV or V (PASSARGE 1964, WESTHOFF & DEN HELD 1969, KOPECKÝ 1978, RUNGE 1980).

I Polygono-Chenopodion W. Koch 1926 em. Sissingh 1946 denuo em. Oberd. 1957.
  1. Chrysanthemo-Sperguletum (Br.-Bl. & De Leeuw 1936) Tx. 1937
  2. Chenopodietum albi Pass. 1955
  3. Digitarietum ischaemi Tx. & Prsg. (1942) 1950
  4. Lycopsetum arvensis Raabe 1944
  5. Mercuriali-Fumarietum (Kruseman & Vl. 1939) em. Tx. 1950
  6. Veronico-Lamietum hybridi Kruseman & Vl. 1939
II Sisymbrion Tx., Lohm. & Prsg. 1940
  1. Agropyro-Convolvuletum arvensis Feldföldy 1943
III Arction (Tx. 1937) em. Sissingh 1946
  1. Lamio-Conietum Oberdorfer 1957
  2. Artemisietum vulgaris (Br.-Bl. '31) Tx. 1942
IV Aegopodion podagrariae Tx. 1967
  1. Aegopodietum Tx. 1967
V Trifolion medii Th. Müller 1961
  1. Urtico-Cruciatetum laevipes Dierschke 1973
VI Derivate community of [Agropyron repens-Arrhenatheretalia] Kopecký 1978.

cies: *Rorippa sylvestris, Elymus repens* and *Potentilla reptans.*
Variant with *Phalaris arundinacea* and *Polygonum amphibium* (clusters nr. 1–3).
Variant with *Carex hirta* and *Myosotis scorpioides* (clusters nr. 4 & 5).

c) Subassociation *equisetetosum palustris* (clusters nr. 7–11). Differential species: *Equisetum palustre, Trifolium repens, Cardamine pratensis* and *Equisetum fluviatile.*

Variant with *Polygonum amphibium* and *Phalaris arundinacea,* (clusters nr. 7–9).
Variant with *Holcus lanatus* (clusters nr. 10 & 11).

Within the *Ranunculo-Alopecuretum* each cluster represents a unit below the variant. These units will not be discussed here. The differential species are apparent from *table 2.*

Synecology: The subassociation *rorippetosum sylvestris* is confined to sites with a low ground water table and a dry top soil after the retreat of the water. The water table is often situated more than one meter below the ground level. This subassociation is found on sandy ridges and sandy river shores (cluster 1), in pastures in the river forelands mainly on heavy clay and sometimes on sandy clay. In summer the clay becomes very hard and fissured by desiccation. It also occurs on steep banks along pools resulting from former dike bursts and on the foot of dikes with only five to ten centimeter of soil (clay, sometimes sand) on a stoney or asphalt underground.

The two variants mainly result from a difference in grazing intensity. The variant with *Phalaris arundinacea* is mainly found in alternate pastures and in hay pastures. This is in concordance with the results of KRUYNE et al. (1967), which demonstrate that *Phalaris arundinacea* and *Polygonum amphibium* have their highest relative average frequencies in pure hayfields and hay pastures and the lowest in alternate pastures and pure pastures.

The variant with *Carex hirta* and *Myosotis scorpioides* on the contrary is found in pure pastures. Concerning *Carex hirta* this is again in concordance with the data from KRUYNE et al. 1967. *Myosotis scorpioides* on the other hand has a highest relative average frequency in hay pastures. In this case it is confined to the variant with *Carex hirta* and *Myosotis scorpioides,* a community from pastures with a slightly higher water table and a somewhat moister top soil.

In the subassociation *equisetetosum palustris* the water table is a long time above the surface and close to the soil surface even in the driest period. In almost all cases it has been found adjacent to open water, along former river beds, pools resulting from dike bursts, marshy, severely poached ditch banks, on the bottom of ditches and drainage furrows. Measurements revealed that the ground-water level was always within 30 cm from the soil surface, in many cases at the same level as, or even sometimes ± 5 cm above the soil surface. The *Ranunculo-Alopecuretum geniculati equisetetosum palustris* occurs on heavy clay, sandy clay and peaty soils. Because of the high water content these soils are very soft resulting in the presence of many, often deep hoofprints.

The variant with *Phalaris arundinacea* and *Polygonum amphibium,* is almost restricted to the river forelands where the hydrological dynamics are more pronounced than in the sites where the variant of *Holcus lanatus* is found. While the former variant is yearly inundated by a deep water layer, the depth of the water in the latter is always restricted to about 20 cm, permitting species like *Holcus lanatus* to be emerged during the greater part of the growing season. The variant with *Holcus lanatus* was not found in river forelands but in moist pastures mostly in the polder areas, mainly on peaty soils, on soils consisting of 5–10 cm of organic material on clay or sand, on sandy clay and on clay.

The subassociation *typicum* is intermediate in its hydrological characteristics. It occurs in river forelands, mainly on heavy clay, sandy clay and sometimes on sand.

II Association group with *Eleocharis uniglumis.*
Syntaxonomy:
Character-species: *Eleocharis uniglumis.*
Differential species: *Phragmites australis, Festuca arundinacea.*
These three taxa combine the three associations:
Nasturtio-Alopecuretum geniculati
Triglochino-Agrostietum stoloniferae
Agrostio-Trifolietum fragiferi.
Synecology: The associations belonging to this group are restricted to habitats where the top soil never desiccates. The hydrology is considerably less dynamical than in the river forelands.

A. *Nasturtio-Alopecuretum geniculati* ass.nov.
Syntaxonomy (*table 1*):

Local character-species: *Ranunculus sardous.*
Differential species: *Nasturtium microphyllum, Ranunculus sceleratus, Veronica catenata, Epilobium parviflorum.*
Constant companions: *Ranunculus repens* and *Glyceria fluitans.*
Nomenclatural type:
Locality: Zeeuws Vlaanderen, "Cambronkreek", a former creek;
Date: 15th of June 1978;
Size: 5 m^2; Total cover 95%; height 20–50 cm; soil type: sandy clay.
Ranunculus sardous +, *Nasturtium microphyllum* 1, *Ranunculus sceleratus* +, *Veronica catenata* +, *Epilobium parviflorum* +, *Ranunculus repens* +, *Glyceria declinata* 1, *Alopecurus geniculatus* 2a, *Rumex crispus* 3, *Agrostis stolonifera* 5, *Juncus articulatus* +, *Eleocharis uniglumis* 1, *Poa trivialis* 2a, *Festuca arundinacea* +, *Trifolium fragiferum* +, *Phragmites australis* +, *Scirpus lacustris* ssp. *tabernaemontani* 1, *Phalaris arundinacea* +, *Oenanthe aquatica* +, *Mentha aquatica* 2, *Brachythecium rutabulum* +.

Relevés of this community have also been made by me in Belgium, N.W. France, Britain and Ireland. The *Nasturtio-Alopecuretum* is transitional to the *Helosciadetum nodiflori* Braun-Blanquet 1931 and the *Nasturtietum officinalis* Seib. 1962 (*Glycerio-Sparganion* Braun-Blanquet et Sissingh 1942). It is often adjoined by these communities and by the *Bidention* Nordhagen 1940. Although *Apium nodiflorum* rarely occurs in the Dutch material, it is regularly found in the relevés made abroad. This species reaches its northern limit in The Netherlands and is rather rare (TUTIN et al. 1968, ARNOLDS et al. 1975).
Synecology: The association occurs along ditches and along former creeks now lying inland. The very soft, severely poached sandy clay soils are water saturated throughout the year. The top soil consists of slime mixed with organic material. The water level is situated at 10–20 cm above the soil surface during the greater part of the year. The presence of shells in the soil indicates a high calcium content.

B. *Triglochino-Agrostietum stoloniferae* Konczak 1968.
Syntaxonomy (*tables 1* and *4*):
Character-species: *Triglochin palustris.*
Differential species: *Juncus articulatus, Galium palustre, Ranunculus flammula, Hydrocotyle vulgaris, Carex nigra, Myosotis laxa* spp. *caespitosa.* Lectotype: relevé nr. 5, table 18 from KONCKZAK 1968. The table given by Konczak (1968) is somewhat complex and the floristic composition of this table is not sufficiently characteristic for this association. This is probably caused by the fact that his relevés are made on relatively dry sites (water table at a depth of 60 cm on 20-8-1964) and originate from a restricted locality, viz. the Havelseen near Potsdam. *Triglochin palustris* has been considered a character-species of the *Scheuchzerio-Caricetea fuscae* Nordhagen 1939 (KRAUSCH 1968, OBERDORFER 1970 and 1977, ELLENBERG 1978). Close examination of published synoptic tables shows that this does not apply. It is absent in most of the communities belonging to that class, while in the other communities its presence class does

	cluster number				
	18	19	20	21	22
Agrostis stolonifera	V	V	V	V	IV
Potentilla anserina	V	III	V	V	V
Eleocharis uniglumis	II	II	IV	III	III
Juncus articulatus	IV	V	V	V	V
Galium palustre	IV	V	V	IV	II
Alopecurus geniculatus	III	V	IV	I	II
Ranunculus flammula	IV	III	V	III	V
Hydrocotyle vulgaris	IV	III	V	V	II
Carex nigra	V		V	V	V
Ranunculetosum repentis and Juncetosum gerardii					
c.c.Poa trivialis	I	V	III	I	IV
Phragmites australis	I	III	V	IV	III
Triglochin palustris		V	III	II	IV
Ranunculetosum repentis					
Ranunculus repens	II	V	V	II	
Lolium perenne		III	II		
Juncetosum gerardii					
Juncus gerardi	I	II	I	V	V
Glaux maritima	I			IV	V
Inops					
Stellaria palustris	II				
Carex panicea	II				
Variants					
Cardamine pratensis	II	V	IV	III	
Juncus bufonius group	II	I	II	III	
Mentha aquatica	I	IV	III	II	
Leontodon autumnalis	II	III	IV	III	I
Myosotis laxa ssp.caespitosa	I	IV	V	III	
Plantago major	I	IV	I	II	
Holcus lanatus	II	IV		I	I
Scirpus lacustris ssp tabernaemontani		IV			
Festuca arundinacea		III			
Senecio aquaticus		III			
Berula erecta		III			
Lysimachia nummularia		II			
Epilobium palustre		II			
Eleocharis palustris			V		
Rumex crispus	I	I	III		
Carex disticha			III		
Plantago lanceolata			II		
Vicia cracca			II		
Calliergonella cuspidata				IV	
Carex serotina				II	
Anagallis minima				II	
Centaurium pulchellum				II	
Trifolium fragiferum					V
Eleocharis quinqueflora					IV
Brachythecium rutabulum					IV
Remaining species					
Trifolium repens	II	IV	II	II	IV
Glyceria fluitans	I	III	II		
Polygonum amphibium	I	I	II		
Ranunculus sceleratus		II		I	
Triglochin maritima		I		I	II
Lotus corniculatus	II	II		I	
Poa pratensis	I		II	I	I
Cerastium fontanum		II	I		
Mentha arvensis	II		I		III
Equisetum arvensis			II	I	
Sagina procumbens	I	III		III	
Lycopus europaeus	II	I	II	I	
Veronica scutellata	II		I	I	
Juncus effusus	II	II			
Drepanocladus aduncus	I	II	II	I	II

not exceed II (PASSARGE 1964, KRAUSCH 1968, OBERDORFER 1977, ZIJLSTRA 1981). In TÜXEN (1937) *Triglochin palustris* is absent from the *Scheuchzerietalia,* but occurs in the *Ranunculus repens-Alopecurus geniculatus* association, subassociation of *Eleocharis uniglumis* Tüxen et Hintz 1937, with presence class IV.

In agreement with VAN OOSTSTROOM (1954) I consider the species to have its optimal occurrence in the *Lolio-Potentillion* (*Agropyro-Rumicion crispi* Tüxen 1950 p.p.) and more in particular as a character-species of the *Triglochino-Agrostietum stoloniferae* (compare *table 1*).

a) Subassociation *ranunculetosum repentis* (19–20)
   Differential species: *Ranunculus repens, Lolium perenne.*
b) Subassociation *Juncetosum gerardii*
   Differential species: *Juncus gerardi, Glaux maritima.*
c) Subassociation *inops*: This species-poor community is characterized by the absence of differential species.

Synecology: The *Triglochino-Agrostietum stoloniferae* is restricted to pastures without any artificial manuring. Consequently the nutrient status is low and the soil is moderately acid. The character- and differential species have their highest presence on wet, moderately to strongly acid, peaty to pure peat soils, with a rather low to low (P-citric acid 0–20 and 21–32 respectively) phosphorus status (KRUYNE et al. 1967, KRUYNE & DE VRIES 1968); their optimal occurrence is on soils which are poor to very poor in nitrogen (ELLENBERG 1978). Throughout the year the water table stands just above or just beneath the soil surface.

The association has an affinity to the *Caricion curto-nigrae* W. Koch 1926 em. Nordhagen 1936, the small sedge communities, peat building, mesotraphent communities from calcium-poor soils (WESTHOFF et al. 1969, OBERDORFER 1977). In The Netherlands these communities as well as the *Triglochino-Agrostietum* are very rare at present, because of the extensive use of artificial fertilizers, often in combination with drainage.

The subassociation *ranunculetosum repentis* is confined to marshy fresh soils. It has been found in and along ditches, along former creeks in a pasture grazed by pigs, along dune slacks and in a ditch shaded by *Pinus sylvestris.* The soil consists of brown peaty clay, peat, clay, sandy clay or sand rich in organic material.

The subassociation *juncetosum gerardii* occurs under slightly brackish conditions. Two samples taken from water inundating this community on the 27th of February, each contained $0.46^0/_{00}$ Cl^-. It occurs on the higher saltmarshes where it is inundated with seawater during high water spring tides, but only when there is a considerable influence of fresh water from lateral seepage out of surrounding dunes or from stagnant rain water. It is also found on saltmarshes nowadays inaccessible for the sea where the salt has partly been washed out of the soil. The top soil (5–10 cm) consists of peat, sometimes mixed with sand, on grey, reduced sand. Compared to the situation in the other subassociations, the top soil of the subassociation *inops* is drier in summer. In some

	cluster number			
	23	24	25	26
Agrostis stolonifera	V	V	V	V
Potentilla anserina	V	II	V	V
Juncus gerardi	V	V	V	V
Glaux maritima	IV	V	II	V
Eleocharis uniglumis	IV	V	I	III
C.c. Trifolium repens	II	IV	V	V
Typicum, festucetosum rubrae and Ononido-Caricetum.				
Carex distans		IV	IV	IV
Leontodon autumnalis		III	III	III
Triglochin maritima		II	II	I
Typicum and festucetosum rubrae				
Trifolium fragiferum	I	V	III	II
Centaurium pulchellum	I	V	III	
Typicum				
Plantago major	II	IV	II	
Phragmites australis	II	IV	II	II
Drepanocladus aduncus		IV		
Poa trivialis	I	III	I	
Carex otrubae	I	III		
Samolus valerandi		III		
Lotus tenuis		III	I	
Bellis perennis		III		
Festucetosum rubrae and Ononido-Caricetum				
Festuca rubra	I		V	V
Holcus lanatus	I	I	V	V
Poa pratensis	I	I	IV	V
Plantago coronopus	I	I	III	III
Odontites verna ssp serotina	II		III	III
Plantago maritima	I	I	III	III
Centaurium littorale			II	II
Ononido-Caricetum				
Cerastium fontanum			III	V
Ononis spinosa		I	I	V
Armeria maritima			II	IV
Lotus corniculatus			I	IV
Trifolium pratense		I	I	III
Cochlearica danica				II
Elymus pungens				II
Remaining species				
Lolium perenne	I	II	I	
Festuca arundinacea	II	III	II	I
Scirpus maritimus	II	III		
Juncus articulatus	I	III	II	I
Galium palustre	II	I		
Triglochin palustris	I	II	II	
Carex nigra	I		II	I
Cirsium arvense	I		II	I
Juncus bufonius group	I	III	II	I
Sagina procumbens		I	II	II
Alopecurus geniculatus	II			
Scirpus lacustris ssp tabernaemontani	I	II		
Leontodon taraxacoides		I	II	II
Salix repens	I		I	II
Brachythecium rutabulum	II	III	III	III

cases it even runs fully dry, i.e. a layer of dry papery organic material is formed on a moist sandy subsoil.

C. *Agrostio-Trifolietum fragiferi* ass.nov. (cluster nr. 23–25). Synonym: community of *Agrostis stolonifera* subvar. *salina and Trifolium fragiferum* Westhoff 1947.
Syntaxonomy (*tables 1* and *5*):
Character-species: *Trifolium fragiferum.*
Differential species: *Juncus gerardi, Glaux maritima, Carex distans, Centaurium pulchellum.*
Constant companion: *Trifolium repens.*
Nomenclatural type:
Locality: Noord-Beveland.
Date: 27th of July 1978.
Size: 9 m^2; total cover 98%; height 10–25 cm; soil type: 5 cm organic material on grey reduced sand.
Agrostis stolonifera 4, *Trifolium repens* 2b, *Trifolium fragiferum* 3, *Festuca arundinacea* 2b, *Carex distans* 2a, *Carex otrubae* +, *Centaurium pulchellum* 1, *Lotus tenuis* +, *Triglochin maritima* +, *Scirpus maritimus* +, *Plantago major* +, *Ononis spinosa* +, *Juncus gerardi* 3, *Phragmites australis* 1, *Bellis perennis* +, *Samolus valerandi* 1, *Juncus articulatus* +, *Poa trivialis* 1, *Lolium perenne* +, *Glaux maritima* 1, *Poa annua* 1, *Leontodon autumnalis* +, *Drepanocladus aduncus* 4, *Brachythecium rutabulum* 1.

a) Subassociation *typicum* (cluster nr. 24).
Differential species: *Plantago major, Phragmites australis, Drepanocladus aduncus, Poa trivialis, Carex otrubae, Samolus valerandi, Lotus tenuis, Bellis perennis.*

Carex otrubae is probably a character-species of the *Agrostio-Trifolietum fragiferi*; in this association it has a high presence in Belgium and France too. Its status will be decided after the interpretation of the relevés made in these countries.

b) Subassociation *festucetosum rubrae* (cluster nr. 25).
Differential species: *Festuca rubra, Holcus lanatus, Poa pratensis, Plantago coronopus, Odontites verna* spp. *serotina, Plantago maritima, Cerastium fontanum, Centaurium litorale.*

The *festucetosum rubrae* is a transition community between the subassociation *typicum* and the *Ononido-Caricetum distantis* Tüxen 1955.

c) Subassociation *inops* (cluster nr. 23). Synonym: *Agrostis stolonifera-Potentilla anserina* community Runge 1966.

This subassociation is negatively characterized by the absence or very low presence of the differential species of the other subassociations and of *Carex distans, Leontodon autumnalis, Triglochin maritima, Trifolium fragiferum* and *Centaurium pulchellum.*

Synecology: The habitats of the subassociations *typicum* and *festucetosum rubrae* differ mainly in salt influence. The subassociation *typicum* has only been found on slightly brackish soils out of reach of the sea. The *festucetosum rubrae* is inundated irregularly in winter during high water spring tides by sea water. The former occurs on sites adjacent to the inland slopes of sea dikes through which sea water is percolating and on primary dune slacks. The latter is restricted to higher salt marshes (*fig. 3*) and to so called "sluftervlakten" i.e. salt marshes of restricted surface behind the dunes in connection with the sea through a narrow inlet. Three samples taken from water inundating the subassociation *festucetosum rubrae* on the 27th of February 1980 contained 1.23, 1.93 and 2.13 $^{0}/_{00}$ Cl^- respectively. Both habitats have the same soil composition viz. 5–10 cm of silt rich in organic material, on grey, reduced sand.

The subassociation *inops* experiences very low grazing pressure. On some sites the vegetation was grazed very extensively by sheep, on other sites by cattle and sometimes even by rabbits only. It often occurs as low lying patches surrounded by a stand dominated by *Juncus maritimus, Calamagrostis epigejos, Schoenus nigricans* or *Festuca rubra* (*fig. 4*).

III Other units.

A. *Ononido-Caricetum distantis* Runge 1966. Synonym: *Ononis spinosa-Carex distans* association Tüxen 1955 nomen nudum.

Syntaxonomy (*tables 1* and *5*, cluster nr. 26).

Local character-species: *Ononis spinosa.*

WESTHOFF & DEN HELD (1969) assigned this association to the *Agropyro-Rumicion* (*Lolio-Potentillion*). Although it has a strong affinity to the *Agrostio-Trifolietum fragiferi* (*table 5*), the preponderance of *Glauco-Puccinellietalia* and *Armerion* species, like *Plantago maritima, Armeria maritima, Festuca rubra* ssp. *litoralis, Centaurium litorale, Juncus gerardi, Carex distans* and *Glaux maritima,* justifies its classification into the *Armerion,* as has been done by TÜXEN (1955) and RUNGE (1980). The *Ononido-Caricetum* has only been recorded on the Wadden islands and along the coast of the Baltic Sea.

Synecology: The *Ononido-Caricetum distantis* occurs as a zone above the *Agrostio-Trifolietum fragiferi festucetosum rubrae* on small dunes in extensively grazed upper salt marshes. The soil is composed of a top layer of about 5 cm which is very rich in organic material, lying on sand. The colour of the sandy subsoil is yellow indicating that reduction of the soil is considerably less severe than in the grey subsoil of the *Agrostio-Trifolietum.* The association occurs 40–60 cm above mean high tide level (RUNGE 1980). the vegetation is hardly grazed due to the protection given by the spines of the *Ononis spinosa* bushes.

B. Derivate community (Derivatgesellschaft sensu Kopecký & Hejný 1978) of *Festuca arundinacea-[Lolio-Potentillion].*

Syntaxonomy (*tables 1* and *6*, clusters nr. 12 and 13): This community is characterized by the high presence and high coverage of *Festuca arundinacea.* As character-taxa of lower units are hardly present and as this community has no character-taxon of its own, it can be considered a derivate community of the alliance (KOPECKÝ & HEJNÝ 1974, 1978). Within this community two types

	cluster number	
	12	13
Festuca arundinacea	V	V
Agrostis stolonifera	V	V
Poa trivialis	IV	V
Rumex crispus	III	IV
Potentilla anserina	III	II
Carex otrubae	II	III
Ranunculus sardous	II	III
Phragmites australis	II	I
Lolium perenne type:		
Lolium perenne	IV	II
Elymus repens	IV	
Ranunculus acris	II	
Urtica dioica	II	
Alopecurus geniculatus type:		
Trifolium repens	III	V
Ranunculus repens	III	V
Plantago major	II	IV
Alopecurus geniculatus	II	IV
Taraxacum officinale group	I	III
Carex hirta		III
Eleocharis uniglumis	I	III
Equisetum palustre		II
Nasturtium microphyllum		II
Eleocharis palustris		II
Glyceria fluitans		II
Remaining species		
Holcus lanatus	III	IV
Bellis perennis	II	III
Cirsium arvense	III	II
Cerastium fontanum	III	II
Rumex conglomeratus	I	II
Scirpus maritimus	I	II
Juncus articulatus	I	II
Trifolium fragiferum	I	II
Mentha aquatica	I	II
Cardamine pratensis	I	II
Brachythecium rutabulum	I	II

can be distinguished:
a) the *Lolium perenne* type is characterized by the presence of *Lolium perenne, Elymus repens,* and, with a lower presence, *Ranunculus acris* and *Urtica dioica.*
b) the *Alopecurus geniculatus* type is characterized by the higher presence of *Trifolium repens, Ranunculus repens, Plantago major, Alopecurus geniculatus, Taraxacum officinale* group, *Carex hirta, Eleocharis uniglumis, Nasturtium microphyllum, Eleocharis palustris* and *Glyceria fluitans.*

As *Festuca arundinacea* can be found with high coverage in all kinds of grasslands under special management conditions, it is neither a character-species of this community nor of the *Potentillo-Festucetum arundinaceae* Tüxen 1950, or of any other community within the *Lolio-Potentillion. Festuca arundinacea* dominated vegetation types are of common occurrence on most of the dikes in The Netherlands. These sites are never inundated, ungrazed, irregularly burned and they contain a heavy clay soil. Under these conditions *Festuca arundinacea* tussocks are accompanied by *Molinio-Arrhenatheretea* species while *Lolio-Potentillion* species are hardly present or altogether absent. This situation can be found both in ruderal forms of *Arrhenatheretum* as well as in irregularly grazed *Lolio-Cynosuretum* communities (SÝKORA & SÝKORA-HENDRIKS 1977, SÝKORA-HENDRIKS & SÝKORA 1973 and many unpublished relevés).

That management (selective irregular grazing) rather than hydrology determines the spreading of *Festuca arundinacea*, can be seen in pastures consisting of both a dike and a piece of river foreland. In the same pasture the facies of this species occurs both in the inundated *Lolio-Potentillion* as well as in the adjoining *Lolio-Cynosuretum*.

Synecology: The D.c. *Festuca arundinacea-[Lolio-Potentillion]* was found in irregularly grazed pastures inundated or waterlogged in winter. *Festuca arundinacea* seems especially favoured by irregular horse grazing, but the community also occurs in pastures irregularly grazed by cattle and sheep (KLAPP 1965, 1971). The community occurs on various soils, e.g. peaty soils, on heavy clay, sandy clay and sand. The habitats of the two types differ in hydrology. The *Lolium perenne* type is restricted to sites which are considerably drier during the growth season than those occupied by the *Alopecurus geniculatus* type.

C. Community of *Scirpus maritimus* and *Alopecurus geniculatus*.

Syntaxonomy (*table 1*, cluster nr. 15): This community is a transition between the *Lolio-Potentillion* and the *Scirpetum maritimi* (W. Christ. 1934) Tüxen 1937. Although *Potentilla anserina, Agrostis stolonifera, Alopecurus geniculatus* and *Eleocharis uniglumis* are still frequent the occurrence of *Scirpus maritimus* with presence class V and *Scirpus lacustris glaucus* (presence class III) indicates its affinity with the *Scirpetum maritimi*.

Synecology: This community was found on low lying parts of pastures where the water remains above soil level for most of the year. It occurs under slightly brackish conditions on peaty soils, sandy clay soils, clay and sand. The *Scirpetum maritimi* is permanently inundated by brackish water with a depth of 5 to maximally 100 cm (WESTHOFF & DEN HELD 1969, OBERDORFER 1977, RUNGE 1980).

D. Basal community (Basalgesellschaft sensu Kopecký & Hejný 1978) of *Agrostis stolonifera-[Lolio-Potentillion]*.

Syntaxonomy (*table 1*, clusters nr, 16, 17): On floristic criteria this community cannot be assigned to one of the associations. Two types can be distinguished. The *Scirpus maritimus-Juncus bufonius* type (nr. 17) is almost exclusively composed of the class and alliance character-species *Potentilla anserina, Agrostis stolonifera* and *Alopecurus geniculatus*. Also *Scirpus maritimus* and *Juncus bufonius* occur in this type (presence class III). The *Trifolium fragiferum-Ranunculus sardous* type (cluster nr. 16) is somewhat less severely disturbed and apart from the class and alliance species mentioned for the *Scirpus maritimus-Juncus bufonius* type, it contains *Plantago major* and *Lolium perenne*. Besides *Poa trivialis, Festuca arundinacea, Ranunculus sardous, Juncus gerardi, Trifolium fragiferum* and *Trifolium repens* also occur (with presence class III or more).

Synecology: The main factor in the development of the basal community is disturbance. In some sites the disturbance was caused by severe treading and overgrazing, the vegetation having a height of only 5 cm and in extreme situations scoring only 30% total coverage. In other localities herbicides were used,

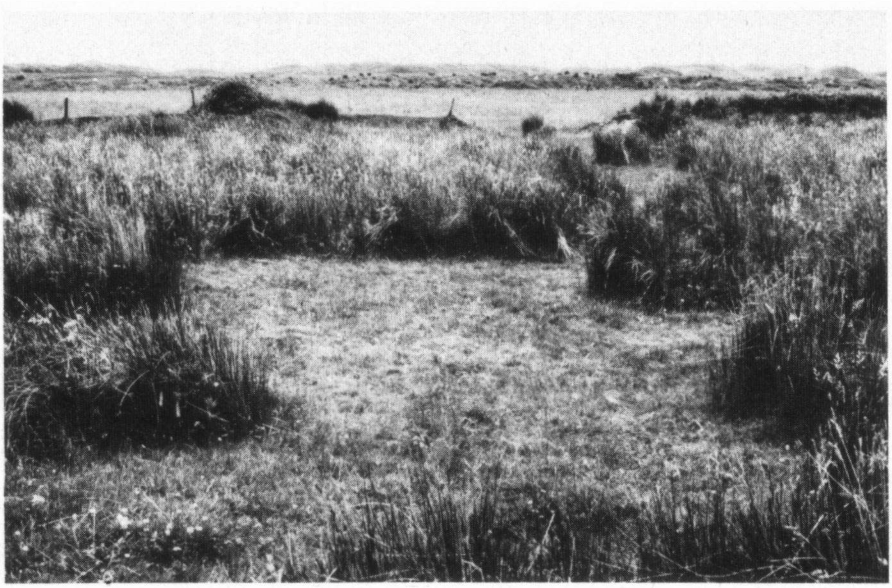

Fig. 4. The Agrostio-Trifolietum fragiferi is often constricted to grazed patches between a hardly grazed vegetation in which Juncus maritimus is the dominant species.

a thick layer of organic material was deposited on the pasture, a grazing regime had just recently been started in a formerly unmanaged grassland, a recently reclaimed soil was in the process of desalination, or a pasture was overfertilized with artificial fertilizers or by the droppings of a colony of seagulls.

E. *Juncus maritimus* dominated communities.

In many cases the *Agrostio-Trifolietum fragiferi* can be found as a mosaic of grazed low lying patches between a vegetation dominated by *Juncus maritimus*. The units 27 and 28 (*table 1*) result from relevés made in this adjoining vegetation in order to study its syntaxonomical position. *Juncus maritimus* has been considered to be a differential species with special affinity to the *Agropyro-Rumicion crispi* Nordhagen 1940 em. Tüxen 1950 (WESTHOFF et al. 1961, WESTHOFF & DEN HELD 1969) and some other authors even considered the species to have its optimum in the alliance (WESTHOFF & VAN LEEUWEN 1966, BEEFTINK 1968). According to BEEFTINK (1968) on the European Atlantic coast *Juncus maritimus* is only a facultative halophyte, with an optimum in the *Agropyro-Rumicion crispi*.

As can be seen in *table 1* the *Juncus* dominated vegetation adjoining the *Agrostio-Trifolietum fragiferi* clearly belongs to the *Juncetum maritimi* Bilik 1956 (*Armerion maritimae* Braun-Blanquet & De Leeuw (1936) and *Juncus maritimus* is by no means characteristic for any of the *Lolio-Potentillion* communities. Moreover one of the essential factors for the development of the *Lolio-Potentillion* is grazing. This is considerably restricted or even prevented between the coarse *Juncus* bushes. Only on the lower-lying patches where the vegetation is kept short by a sufficiently high grazing pressure, the *Agrostio-Trifolietum fragiferi* is optimally developed (*fig. 4*). The boundary between the two vegetation types is very sharp, forming a convergent limit: limes convergens or ecotone (VAN LEEUWEN 1966, BECKING 1968, VAN DER MAAREL 1971b, SHIMWELL 1971).

F. *Alopecurus arundinaceus* community.
The syntaxonomic position of this community still remains unclear. It has been compared to an *Alopecurus geniculatus* community by TYLER (1969). The absence of a sufficiently strong grazing pressure enables the development of tall *Alopecurus arundinaceus* and *Festuca arundinacea* clumps, thus leading to a more or less ruderal tall forb community. The relevés presented in *table 1* were made near the Baltic Sea on an upper salt marsh. The soil respectively consisted of an upper layer of organic material, litter and even a decaying faggot on a sandy soil. The *Alopecurus arundinaceus* community (see also NORDHAGEN 1954) can certainly not be assigned to the *Lolio-Potentillion.*

3.2. Principal components analysis (*fig. 5*)
Fig. 5 is the result of the ordination of the units represented in *table 1*. The first two dimensions (percentage extracted variance respectively 28 and 12%) illustrate the relations of the units to one another and to the two main environmen-

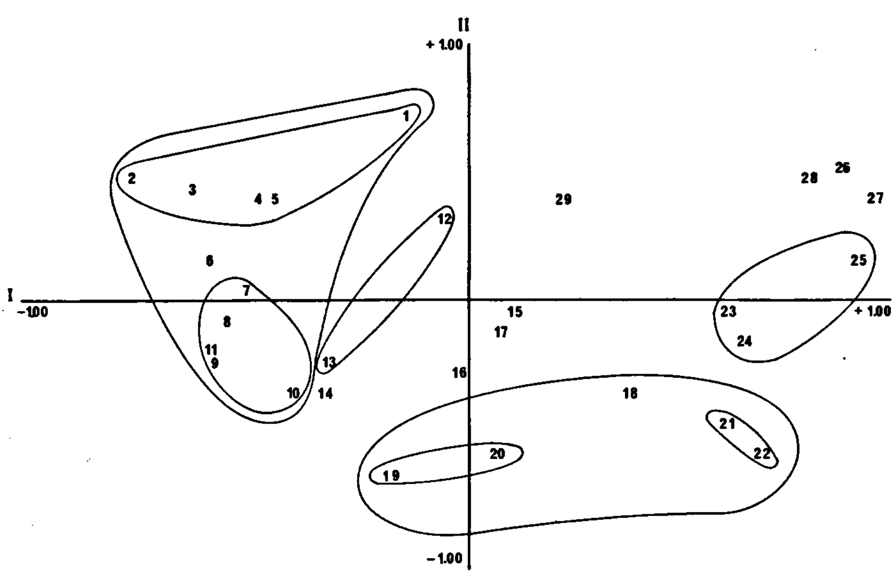

Fig. 5. Ordination of the clusters presented in *table 1*. The numbers used in this figure correspond with the cluster numbers in *table 1*. Dimension 1 corresponds with the salt influence, dimension 2 with the depth of the water table during the growth season. For explanation of the numbers see text and *table 1*.

tal factors. Ecological interpretation of dimension 3 and 4 appeared to give difficulties. Dimension 1 corresponds with an increase in salt influence. The *Ranunculo-Alopecuretum geniculati* (clusters 1–11), the *Nasturtio-Alopecuretum geniculati* (cluster 14) and the derivate community of *Festuca arundinacea-[Lolio-Potentillion]* (cluster 12–13) on the left side of the diagram, are restricted to fresh soils. The *Agrostio-Trifolietum fragiferi* (cluster 23–25), *Juncetum maritimi* (clusters 27–28) and *Ononido-Caricetum distantis* (cluster 26) on the right side are restricted to brackish sites, whereas the community of *Scirpus maritimus* (cluster 15) and the *Alopecurus arundinaceus* community (cluster 29) take an intermediate position.

From the *Triglochino-Agrostietum* the subassociation *ranunculetosum repentis* (clusters 19-20), growing on fresh soils, is found on the left hand side, whereas the subassociation *juncetosum gerardii* (clusters 21–22) from brackish sites occurs in the right hand side of the diagram.

Because the basal community of *Agrostis stolonifera-[Lolio-Potentillion]* (clusters 16–17) and the *Triglochino-Agrostietum inops* (cluster 18) are very poor in species as well as poor in indicative species, their position in the diagram does not clearly show their relation to the salt influence.

The second dimension corresponds with the depth of the water table during the growth season and consequently the extent to which the top soil is desiccating. Within the *Ranunculo-Alopecuretum* the *rorippetosum sylvestris* (clusters 1–5), growing on sites with a low water table in summer, is situated in the upper part of the diagram while the *equisetetosum palustris* (clusters 7–11) is found considerably lower. The subassociation *typicum* (cluster 6) takes an intermediate position. The *Nasturtio-Alopecuretum* (cluster 14) and the *Triglochino-Agrostietum* (clusters 18–22) from sites with a very moist top soil throughout the year, are presented in the lower half of *fig. 5*. The same applies for the brackish communities. While the *Ononido-Caricetum distantis* (cluster 26) and the *Juncetum maritimae* (clusters 27–28) occur in the upper half, the *Agostio-Trifolietum fragiferi* (clusters 23–25) is represented lower down.

The two types of the D.C. of *Festuca arundinacea-[Lolio-Potentillion]* also show this configuration, the drier *Lolium perenne* type (cluster 12) above the wetter *Alopecurus geniculatus* type (cluster 13). The *Triglochino-Agrostietum* subassociation *inops* (cluster 18), having a dry topsoil in summer, is positioned above the two other subassociations. The community of *Scirpus maritimus* and *Alopecurus geniculatus* [cluster 15), a community of low lying parts in pastures inundated for most of the year, is located too high in the diagram.

APPENDIX

Species with presence restricted to class I, with the cluster numbers: Achillea millefolium 2 and 6; Achillea ptarmica 2, 7, 9, 6, 3, 1; Agrostis canina 18; Alisma lanceolatum 7, 9, 6, 3; Alisma plantago-aquatica 9, 6, 15; Allium vineale 2, 12; Alopecurus aequalis 9; Anthoxanthum odoratum 7, 11, 9, 20, 19; Apium graveolens 25; Apium nodiflorum 7, 9; Artemisia maritima 26; Atriplex patula 26; Bidens cernua 19; Bidens frondosa 6; Bidens tripartita 2, 4, 6, 3, 20, 19; Brachythecium velutinum 1; Bryum species 6; Calamagrostis epigejos 23, 24; Capsella bursa-pastoris 6; Carduus crispus

12, 17, 25; Carex acuta 7, 9, 6, 14; Carex arenaria 23, 21; Carex curta 18; Carex ovalis 9; Carex riparia 19; Carex trinervis 26; Centaurea debeauxii ssp. thuillieri 20; Ceratodon purpureus 25; Chamomilla recutita 4; Cicuta virosa 10; Cirsium palustre 23, 26, 28, 19; Cirsium vulgare 12, 25; Convolvulus arvensis 2, 9; Coronopus squamatus 3; Crepis capillaris 4; Dactylis glomerata 12; Danthonia decumbens 16, 18, 23; Deschampsia caespitosa 2, 7, 6; Eleocharis acicularis 4; Epilobium hirsutum 9, 6; Equisetum variegatum 18; Eriophorum angustifolium 7; Eupatorium cannabinum 12; Euphorbia esula 2, 6, 1; Eurhynchium praelongum 19; Filaginella uliginosa 18; Filipendula ulmaria 18,20; Galium aparine 12; Galium mollugo 2; Galium uliginosum 24; Geranium dissectum 9; Herniaria glabra 3; Hippophae rhamnoides 25; Hordeum secalinum 12, 15; Hypochoeris radicata 21; Juncus alpinus 27, 21; Juncus conglomeratus 20; Juncus filiformis 18; Lemna minor 14; Limonium vulgare 23; Linum catharticum 23, 25, 24; Linum usitatissimum 16; Lotus uliginosus 11, 10, 9, 23, 28; Lysimachia vulgaris 9, 6, 1; Lythrum salicaria 2, 7, 11, 9, 4, 6, 18; Matricaria maritima 2, 6, 5, 3; Medicago lupulina 3, 26; Menyanthes trifoliata 23; Myosoton aquaticum 2, 9; Nardus stricta 18; Ophioglossum vulgatum 18, 26, 21, 20; Parapholis strigosa 23, 25, 24; Poa palustris 9; Polygonum mite 10, 9, 6; Polygonum persicaria 11, 13, 18; Potentilla supina 7; Puccinellia distans 16, 12, 17, 15; Radiola linoides 21; Ranunculus circinatus 7, 11, 3; Ranunculus ficaria 2; Rhinanthus angustifolius 5, 21; Rhytidiadelphus squarrosus 18, 25, 21, 19; Rhynchostegiella curviseta 25, 27; Rorippa islandica 2, 7, 17, 9, 6, 3, 14; Rumex x abortivus 6; Rumex acetosa 11, 13, 20; Rumex hydrolapathum 19; Sagina nodosa 26, 24; Salix cinerea 12; Salix triandra 7; Schoenus nigricans 23, 25, 27, 21, 28; Scirpus lacustris ssp. glaucus x triqueter 13; Scirpus setaceus 24; Senecio vulgaris 2; Spergularia marina 16, 14, 23, 21; Spergularia media 12, 17; Symphytum officinale 2, 7, 6, 20, 28; Tanacetum vulgare 3, 1; Thalictrum flavum 2, 7; Trifolium arvense 25, 28; Trifolium dubium 23; Typha latifolia 19; Veronica beccabunga 11, 9, 6; Vicia sativa ssp. nigra 6, 12, 23; Vicia sativa ssp. sativa 12.

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