

# Heathland vegetation in the Netherlands

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with 10 figures and 15 tables

**Abstract.** A syntaxonomic survey is given from the heathland communities in the Netherlands. The almost natural heathlands on coastal dunes belong to the *Carici arenariae - Empetretum* (*Empetrium nigri*) from dry or humid habitat and to the *Empetro - Ericetum* (*Ericion tetralicis*) from wet dune valleys.

The antropogenous inland heaths belong to the *Ericetum tetralicis* (*Ericion tetralicis*) on wet peaty soils and to the *Genisto - Callunetum* and *Vaccinio - Callunetum* (*Calluno - Genistion pilosae*) on humid to dry sandy soils. The latter association is confined to hilly districts with high precipitation.

Ten new subassociations are described.

## Introduction

The natural habitat of the lowland heath is restricted to exposed coastal rocks and cliffs, coastal dunes and bog margins (DE SMIDT 1975). Most heath is of anthropogenous origin. In the Netherlands two types are present. In the coastal dunes the heath is natural to semi-natural. The inland heath is anthropogenous. Its origin can be traced back to the Neolithic (WATERBOLK 1954). Until the end of the 19th century, the heath was an essential part of the farming system on pleistocene sandy soils in the central and eastern part of the country. The manure from sheep, grazing on the heaths and kept in stables at night, was collected from the stables after being mixed with sods, cut on the heath and this mixture served to fertilize the land. This type of heath farming was found from Antwerp to Hamburg, as evidenced by the characteristic plaggensoils (PAPE 1970). After about ten centuries of mixing sheep dung and sods (plaggen), a black soil was formed, in places more than a meter thick. The use of artificial fertilizer made the heath lose its agricultural function. As a consequence, the total heath area in the Netherlands decreased from 600.000 ha in 1833 (BEYERINCK 1940) to 61.000 ha in 1970. Most of the remaining heath is preserved in nature reserves.

In spite of today's appreciation of the value of semi-natural heathlandscapes, such areas are still being threatened. The Bergerheide near Venlo, 500 ha of outstanding scientific value, is destroyed by sand-winning activities.

The last extensive heathland in the Belgian Kempen near Opgrimbie is similarly doomed.

Most of the phytosociological data for this study were collected in 1954 and in the period 1959–1970. Since 1962, surveys have been carried out with the assistance of 36 students. A total of 1800 relevés were compiled into vegetation tables. The typology established from these tables is documented in this paper with a final selection of 466 relevés. From each syntaxon, 10 to 20 representative relevés have been selected. The remaining unpublished relevés, representing transitional vegetations, and showing complete ranges of diversity within the communities, will be of interest for ecological research and for nature management purposes. From the tables comprising all 1800 relevés, one hundred copies have been printed and distributed among centres of vegetational research.

### Heath on coastal dunes

Heathlands on coastal dunes in the Netherlands are almost natural vegetations (WESTHOFF et al. 1971). For the greater part these heathlands are rather young. Until the end of last century the dunes were heavily grazed, and *Ammophila* and heather were gathered for fuel (VAN DIEREN 1939). VAN EEDEN (1868) and HOLKEMA (1870) described the dunes as a sandy desert, which was unable to reach stabilization because of continuous stripping of edible and combustible vegetation. In some places, however, isolated heathlands of various dimensions must have been present already at that time. On the estate Ockenburg near Loosduinen duneheath was mentioned by WESTERBAEN in 1653. In particular on the inland side of the dunes the heath was preserved to protect adjacent arable land against the blowing dunesands.

Heathland is almost restricted to the North Sea isles in front of the Dutch coast and to the coastal area north of Bergen. South of Bergen the dunesand is too calcareous and only some heath is found on the inland side of the dunes. The oldest dunes of late atlantic age (3000 B. C.), located in this area (JELGERSMA 1966), have lost much of the lime content by leaching in the prevailing humid climate. As a result of sand winning and forestation, only small remnants survived near Noordwijkerhout and Loosduinen (TJALLINGH 1970).

From the southwestern coastal region, TJALLINGH reported some very small heathland areas on the isles of Voorne and Schouwen. All these duneheath communities belong to the alliance *Empetrium nigri* Böcher 1943 em. Schubert 1960; an exception is the cranberry-community, found in periodically inundated dune valleys. SCHUBERT (1960) divided the alliance into the suballiances *Vaccinio - Empetrium* from the european mountains, and the *Carici - Empetrium* from the european coastal regions; the latter includes the heathland in the coastal areas of the Netherlands. SCHUBERT mentioned the *Carici - Empetrium* to be differentiated by *Carex arenaria*, *C. pilulifera*, *C. nigra*, *C. panicea* and a great diversity of *Cladonia*

and *Cetraria* species. From these species, only *Carex arenaria* can be used as differential species in the Dutch coastal heaths. Species of *Cladonia* are present, but these are not more abundant than in the inland heaths. Species of *Cetraria* are very rare on the coast and in the interior.

In our opinion, all Dutch Carici - Empetretion heaths belong to one association: Carici arenariae - Empetretum R. Tüxen 1975 in R. Tüxen et Y. Kawamura 1975. The cranberry community, Empetro - Ericetum Westhoff (1943) 1947 is the only other dune heath association and falls within the Oxycocco - Sphagnetum. WESTHOFF & DEN HELD (1969), however, mentioned four associations. Two of them (Polypodio - Empetretum and Pyrolo - Salicetum) were placed by these authors in the Empetretion, a third (Empetro - Genistetum tinctoriae) in the Calluno - Genistion and the fourth (Empetro - Ericetum) in the Oxycocco - Sphagnetum - class. In the original publication of this typology by WESTHOFF (1947) unfortunately no relevés were presented. For this reason it is not possible to decide if the differences are due to changes in the vegetation in thirty or forty years or to different interpretations. WESTHOFF collected his field data in 1937-1939, and there is some evidence of changing conditions: *Sphagnum compactum* apparently has disappeared. This applies also to some species listed by HOLKEMA (1870), as *Rhynchospora alba*, *Rhynchospora fusca*, *Narthecium ossifragum* and *Scirpus caespitosus*. Particularly on the isle of Texel forestation is one of the main causes of acid peaty heaths and of these species being extinct. PREISING (1949) mentioned *Empetrum nigrum* as the only character species of the Empetretion, and as differential species *Carex areraria*, *Salix repens* ssp. *argentea*, *Hieracium umbellatum* ssp. *linariifolium* and *Ammophila arenaria*. WESTHOFF & DEN HELD (1969) considered *Empetrum nigrum* and *Salix repens* ssp. *argentea* as character-combination. The vegetation tables in this paper are in support of PREISING's list, to which *Polypodium vulgare* should be added.

The Empetretion was recorded along the coast of the North Sea in Scotland (GIMINGHAM 1964), the Netherlands (WESTHOFF 1947), Germany (TÜXEN & KAWAMURA 1975), Denmark (BÖCHER 1943), along the Danish and Swedish coasts of Skagerak and Kattegat (BÖCHER 1943) and along the German and Polish coasts of the Baltic Sea (LIBBERT 1940).

### 1 Ass. Carici arenariae - Empetretum R. Tüxen in R. Tüxen et Y. Kawamura 1975 (Fig. 1)

Syn.: Empetro - Genistetum tinctoriae Westhoff (1947) 1968  
 Calluneto - Genistetum litoralis Westhoff (1943) 1947  
 Polypodio - Empetretum (Meltzer 1941) Westhoff 1947

Character and differential species: *Empetrum nigrum*, *Carex arenaria*, *Salix repens* ssp. *argentea*, *Genista tinctoria*.

Other species with high constancy are the class character species of the Nardo - Callunetea *Calluna vulgaris*, the character species of the

**Vaccinio - Genistetalia** *Hypnum cupressiforme* var. *ericetorum* and the companions *Dicranum scoparium*, *Festuca tenuifolia*, *Calamagrostis epigejos*, *Cladonia pyxidata* var. *chlorophaea* and *Cladonia impexa*.

On account of its great homogeneity this type of vegetation must be considered as one association. It includes the heaths of dry and humid, but not wet, locations in the dunes. About 250 relevés were available. A representative selection is shown in table 1. The community is divided into three subassociations. The critical ecological factors are humidity of the soil and exposure.

### 1.1 Subass. ericetosum subass. nov. (Table 1)

Syn.: **Empetro-Genistetum tinctoriae molinietosum**  
Westhoff 1947

Differential species: *Erica tetralix*, *Potentilla erecta*, *Carex trinervis*.

In this heath of humid valleys and level areas in the dunes, *Genista tinctoria* has its optimum but is still a rare species. This subassociation on damp habitat is frequently recorded from the isles of Texel, Vlieland, Terschelling and Ameland.

#### 1.1.1 Variant of *Genista tinctoria* (Table 2)

Differential species: *Genista tinctoria*.

In order to find out if the **Empetro-Genistetum tinctoriae** from WESTHOFF might have been overlooked, part of the relevés comprising *Genista tinctoria* have been put together in table 2.

The differentiating character hardly supports the status of a separate variant and certainly not the status of a syntaxon of a higher rank.

In comparison with the other dune heath communities, some grasses as *Anthoxanthum odoratum* and *Holcus lanatus* show a slight preference for this variant and for the **Carex panicea** variant. Lichens on the contrary are less conspicuous; this may be attributed to the dense canopy of the dwarf shrubs. This variant has been recorded from Texel and Terschelling.

#### 1.1.2 Variant of *Carex panicea* (Table 3)

Differential species: *Carex panicea*, *Nardus stricta*.

In humid dune valleys, particularly near footpaths, a variant appears with some affinity to the **Empetro-Ericetum**. This affinity is demonstrated by the presence of *Carex panicea*, *Carex nigra*, *Eriophorum angustifolium* and *Juncus alpino-articulatus*. The damp humid but not really wet peaty soil is responsible for this somewhat intermediate position. *Erica tetralix* is the dominant dwarf shrub. The variant nevertheless belongs to the subassociation **ericetosum** of the **Carici-Empetretum**.

All character and differential species of the association and subassociation are present and in addition five character species of higher ranked syntaxa

within the *Nardo-Caellunetea*. The *Carex panicea* variant is recorded from Texel, Ameland and Schiermonnikoog. All relevés available from Schiermonnikoog fall within this variant.

### 1.1.3 Variant of *Schoenus nigricans* (Table 4)

Differential species: *Schoenus nigricans*, *Lonicera periclymenum*, *Rubus caesius*, *Eurhynchium praelongum*, *Lotus uliginosus*, *Galium palustre*, *Hippophae rhamnoides*.

The variant of *Schoenus nigricans* has an even more marginal position within the *Carici - Empetretum* than the *Carex panicea* variant. None of the seven differential species are typical heathland species. Some of them belong to the *Caricion davallianae* of wet dune valleys, the other to the *Sambuco - Berberidion* dune scrub.

All relevés are from one locality, the Slufter on Texel (DUYVERMAN 1968). Alongside this creek, which is in open connexion with the North Sea, a complex gradient is found with transitions between salt and fresh, wet and dry, young and old sediments, basic and acid, mineral and organic soil.

### 1.2 Subass. *polypodietosum* subass. nov. (Table 1)

Syn.: *Polypodio - Empetretum* (Meltzer 1941) Westhoff 1947  
*Empetro - Genistetum tinctoriae caricetosum arenariae* Westhoff 1947

Differential species: *Polypodium vulgare*, *Hieracium umbellatum*, *Ammophila arenaria*.

*Genista anglica* and *Hypochoeris radicata* have their optimum in this subassociation, which has a preference for north exposure and for dry level parts in dune areas. In places with small patches of bare dunesand, *Corynephorus canescens*, *Cornicularia aculeata* and *Cladonia foliacea* var. *alcicornis* are present also.

WESTHOFF (1947) mentioned *Rhytidiadelphus loreus* and *Cetraria glauca* as character species. The first one, however, has not been found and *Cetraria* only once or twice. WESTHOFF also reported a variant with *Rosa spinosissima*<sup>1</sup> and *Calluna* from Texel. *Rosa* is indeed rather frequent, but it has its optimum in the subassociation *typicum*. The subassociation *polypodietosum* is recorded from Texel, Vlieland, Terschelling, Ameland and from the mainland near Callantsoog.

### 1.3 Subass. *typicum* subass. nov. (Table 1)

This type of dune heath does not contain the differential species of the other two subassociations. It contains perhaps one weak differential species of its

<sup>1</sup> *Rosa spinosissima* = *R. pimpinellifolia* all through this paper.

own: *Rosa spinosissima*, *Viola canina* and *Galium verum* have a weak optimum. This type covers only a minor part of the dune heath; it was observed in not more than ten relevés out of the total of 250. The subassociation *typicum* appears on dry dunes and avoids north exposure. It is recorded from Texel, Terschelling, Ameland and on the main land as far south as Bergen and even Bakkum. The dune heath near Bakkum is situated south of the limit of the calcareous dunes. For this reason the heath in this locality is found only on the landside fringe of the dunes, containing the oldest and decalcified dunes.

## 2 Ass. Empetro - Ericetum Westhoff (1943) 1947 (Table 5, Fig. 2)

Character species: *Oxycoccus macrocarpos*.

Differential taxa: *Salix repens* ssp. *argentea*, *Calamagrostis epigejos*, *Carex trinervis*, *Juncus arcticus* ssp. *balticus*, *Juncus alpino-articulatus* ssp. *atricapillus*, *Empetrum nigrum*.

Tabel 5 contains fifteen relevés considered to belong to the *Oxycocco - Sphagnetea*. It must be admitted that the relationship with this class of raised bogs and wet heaths is only based on the presence of *Erica tetralix* and *Aulacomnium palustre* (just once). On the other hand, the affinity to the *Nardo - Callunetea* is not strong either. WESTHOFF reported *Sphagnum compactum* from the wet dune heath in 1937–1939. This character species of the *Ericion* has not been found again. Nevertheless, because of the presence of a set of species from acid peaty soils as *Eriophorum angustifolium*, *Carex panicea*, *Carex nigra*, *Molinia coerulea*, this vegetation can be best placed in the *Empetro - Ericetum*.

*Oxycoccus macrocarpos* is always present and mostly dominant, which is considered as diagnostic; this may be strengthened by the presence of the two *Juncus* species.

During the winter, the dune valleys are inundated to a depth of about two decimeters of water. This causes the absence of the mosses and lichens of the *Carici - Empetretum*. The mosses of the wet habitat on the other hand are only weakly represented because the valleys dry up in summer.

The cranberry heath of wet dune valleys is only recorded from Vlieland and Terschelling.

## The inland heath

Inland heaths correspond to the dune heaths falling in the same two classes *Nardo - Callunetea* and *Oxycocco - Sphagnetea*. On the other hand phytogeographic features distinguish the inland heaths from those in the coastal dunes (Table A).

The floristic differences may be related to a complex of environmental factors. The nearly eu-oceanic climate of the Wadden region is expressed by the small fluctuations of the temperature, high air-humidity and high winds

Table A

	inland		dunes	
	Oxy.-Sph.	N.-Call.	Oxy.-Sph.	N.-Call.
<i>Cladonia crispata</i>	+	+		
<i>Telaranea setacea</i>	+	+		
<i>Odontoschisma sphagni</i>	+	+		
<i>Ptilidium ciliare</i>	+	+		
<i>Leucobryum glaucum</i>	+	+		
<i>Dicranum spurium</i>	+	+		
<i>Campylopus fragilis</i>	+	+		
<i>Campylopus brevipilus</i>	+	+		
<i>Polytrichum comm. v. perigoniale</i>	+	+		
<i>Vaccinium myrtillus</i>	+	+		
<i>Melampyrum pratense</i>	+	+		
<i>Pinus sylvestris</i>	+	+		
<i>Cladonia strepsilis</i>	+			
<i>Sphagnum compactum</i>	+			
<i>Sphagnum papillosum</i>	+			
<i>Sphagnum cuspidatum</i>	+			
<i>Narthecium ossifragum</i>	+			
<i>Rhynchospora alba</i>	+			
<i>Rhynchospora fusca</i>	+			
<i>Scirpus caespitosus</i>	+			
<i>Salix repens</i>	+			
<i>Genista pilosa</i>		+		
<i>Cuscuta epithymum</i>		+		
<i>Galium hercynicum</i>		+		
<i>Arnica montana</i>		+		
<i>Salix repens ssp. argentea</i>			+	+
<i>Calamagrostis epigeios</i>			+	+
<i>Lotus corniculatus</i>			+	+
<i>Carex trinervis*</i>			+	+
<i>Oxycoccus macrocarpos*</i>			+	
<i>Juncus arcticus ssp. balticus</i>			+	
<i>Juncus alpino-art. ssp. atricapillus</i>			+	
<i>Genista tinctoria</i>				+
<i>Arctostaphylos uva-ursi</i>				+
<i>Rhytidiadelphus triquetrus</i>				+
<i>Hylocomium splendens</i>				+
<i>Peltigera polydactyla</i>				+
<i>Polypodium vulgare</i>				+
<i>Rosa pimpinellifolia</i>				+
<i>Ammophila arenaria</i>				+

\* These species are also found in some isolated localities in Drente.

(WESTHOFF 1947). Climatic conditions on the heath in the inland, however, are characterised by great amplitudes in temperature and air-humidity and considerably less wind (STOUTJESDIJK 1959; LÖTSCHERT 1962; HORST 1964). Transport of minerals by the seawind might affect dune heath, but this has so far never been studied (TJALLINGH 1970).

In addition to the climate, there are great differences in soil condition. The dune sands are too young to have more than an initial soil profile. The inland heath, on the contrary, has normally a well-developed podzol or gley profile. These old soils are rich in organic material but very poor in nutrients.

The mor with its water absorbing capacity has a strong regulating influence on the air-humidity. The humic B-horizon regulates the soil humidity (DE VRIES 1942; SCHEFFER & SCHACHTSCHABEL 1952; STOUTJESDIJK 1959; HORST 1964).

### 3 *Ericetum tetralicis* Schwick, 1933 (Table 6, Fig. 3)

Character species: *Scirpus caespitosus* ssp. *germanicus*, *Sphagnum compactum*, *Sphagnum tenellum*, *Sphagnum molle*, *Hypnum imponens*.

*Sphagnum molle* and *Hypnum imponens* have not been recognized during the fieldsurveys. DIERSSEN (1972) drew the attention of phytosociologists to the character species, which is superficially very similar to *Sphagnum compactum*. *Hypnum imponens* is much alike *Hypnum cupressiforme* var. *ericetorum*, and both species are rare.

WESTHOFF & DEN HELD (1969) mentioned as other character species: *Rhacomitrium lanuginosum*, *Polytrichum commune* var. *perigoniale*, *Odontoschisma denudatum*, *Cladonia crispata*, *Cl. strepsilis*, *Cl. squamosa*. This applies only to *Rhacomitrium*. It is a rare species in the Netherlands, but all finds are from the *Ericetum* (BARKMAN in LANDWEHR 1966). In Jutland this moss is also rare and restricted to the *Ericetum* (GALLØE & JENSEN 1906; MÖLHOLM HANSEN 1932).

*Polytrichum perigoniale*, *Cladonia crispata* and *Cl. squamosa* are frequent outside this community in the *Genisto-Callunetum*, and *Cladonia strepsilis* has also been recorded from stabilized inland dunes.

The special ecological demands of *Cladonia*'s render them hardly suitable as character species. On the basis of field observations, the essential ecological conditions seem to be high light intensity, considerable air-humidity, and an oligotrophic substrate. This combination is found in raised bogs, in wet heath, in dry heath and in inland dunes.

Apparently, the humidity and the nature (mineral sand or humus) of the substrate are not of prime importance. For lichens, the heath must have an open structure. This may be low and thin heath, as in the *Ericetum*, or dry heath where sods have been cut. In high-growing heath, lichens may be found in gaps caused e. g. by the heather beetle (*Lochmaea suturalis*).

The lichens differ from most other plants in being not or only indirectly dependent on soil factors like humus content, water content, pore volume and grain size. Ecological differences between the habitats of the *Oxyocco-Sphagnetea* and the *Nardo-Callunetea* are essentially based on these soil factors, consequently lichens cannot be expected as character species on the higher ranked levels nor on the association level; they are found as differential species on the level of subassociation.

*Odontoschisma denudatum* is characteristic of mixed stands of *Erica* and *Calluna* on humid soil, and is sometimes found on decaying wood (GRADSTEIN



1972). This rare hepatic, recorded from North Limburg by CLEEF & KERS (1968) and in permanent quadrats on the »Strabrechtse heide« and on the »Kralose heide«, has not been included in the tables.

WESTHOFF & DEN HELD (1969) mentioned as differentiating species with respect to the *Empetro-Ericetum*: *Campylopus brevipilus*, *Dicranum scoparium*, *Leucobryum glaucum*, *Cetraria islandica* and *Cladonia papillaria*. The first 21 species in table A are completing this list. In nearly 50% of the relevés the association character species *Sphagnum compactum* and *Sphagnum tenellum* are absent, and *Scirpus caespitosus* is infrequently present. These species represent transitions to the *Genisto-Callunetum*. For this reason these relevés have not been used for the typology in this paper. A limited number of copies of the table of all relevés (DE SMIDT 1975) is made available to libraries in several centres of vegetational research.

Different opinions have been expressed on the synsystematic position of *Juncus squarrosus*. Some authors considered this *Juncus* a character species of the *Ericetum tetralicis* (TÜXEN 1937; BARKMAN & WESTHOFF 1969). SCHWICKERATH (1944) divided the *Ericetum* into the *Juncetum squarrosi* and some other associations. DUVIGNEAUD & VAN DEN BERGHEN (1945) and MOORE (1968) on the contrary mentioned it as a character species on the level of the alliance *Ericion tetralicis*. SCHWICKERATH was not followed by other authors, but his description is the key to the confusion about the status of this species. He reported that regular mowing and carriage traffic are essential factors for *Juncetum squarrosi*. In Scotland the same effect was reported for intensive grazing on peaty soil (KING & NICHOLSON 1964). There is some evidence of a decrease of *Juncus squarrosus* in the *Ericetum* in the last decades. This might be attributed to the fact that the heath was abandoned as part of the farming system. Observations since 1959 in a permanent quadrat on the »Dwingelose heide« confirm this assumption. As of that year, a herd of sheep grazed the heath making trails. *Juncus squarrosus* has a preference for the sheep trails. The *Ericetum* is apparently better suited to *Juncus* under the old agricultural system. A parallel can be made with *Gentiana pneumonanthe*. RUNGE (1961) considered it first as a character species, but in 1969 as a companion of the *Ericetum*. PREISING in 1949 and 1950 separated the poor grasslands and the heaths; the association on the humid and poor grasslands was named *Nardo-Gentianetum pneumonanthis*. Most authors, e. g. WESTHOFF & DEN HELD (1969), followed this division.

The poor grassland may originate from heath by grazing, treading and mowing, particularly when there is some supply of nutrients. Under such conditions, *Gentiana pneumonanthe* and *Juncus squarrosus* reach their optimum. BARKMAN (1973) published a vegetation table for Drente, on which this is clearly visible.

Finally, some remarks will be made on *Campylopus brevipilus*. This rare atlantic moss has been recorded only a few times, but always from well-

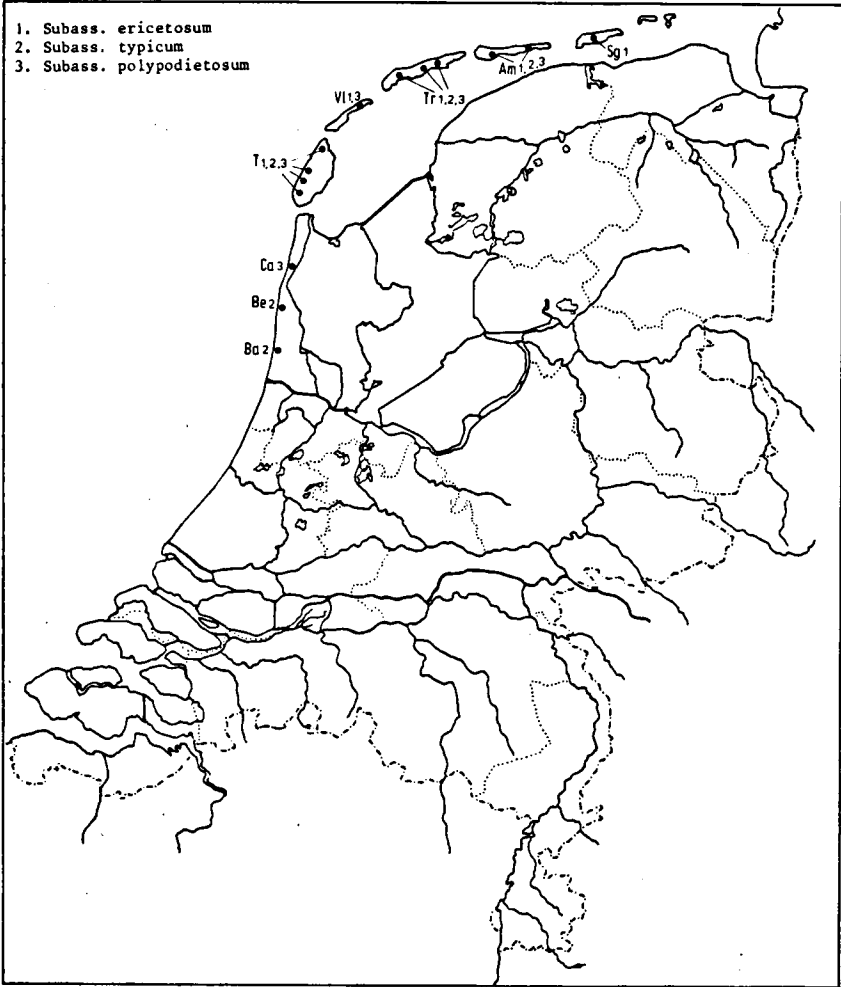


Fig. 1. Localities of Carici - Empetretum.

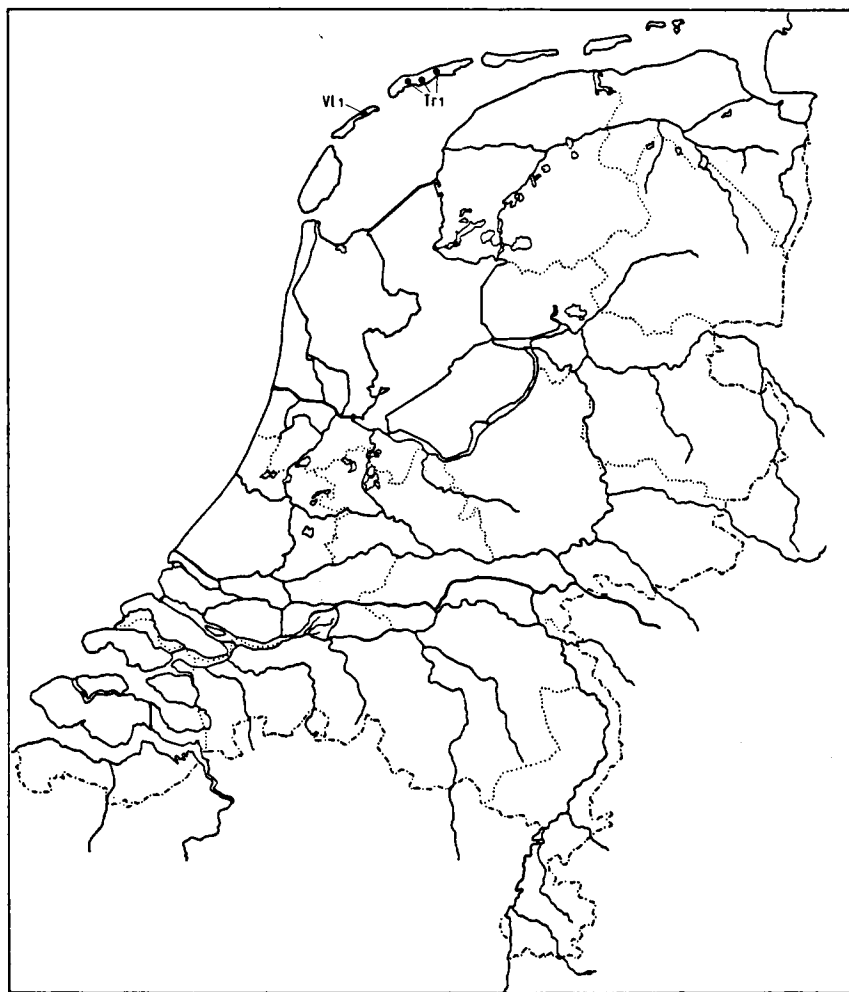


Fig. 2. Localities of *Empetro - Ericetum*.

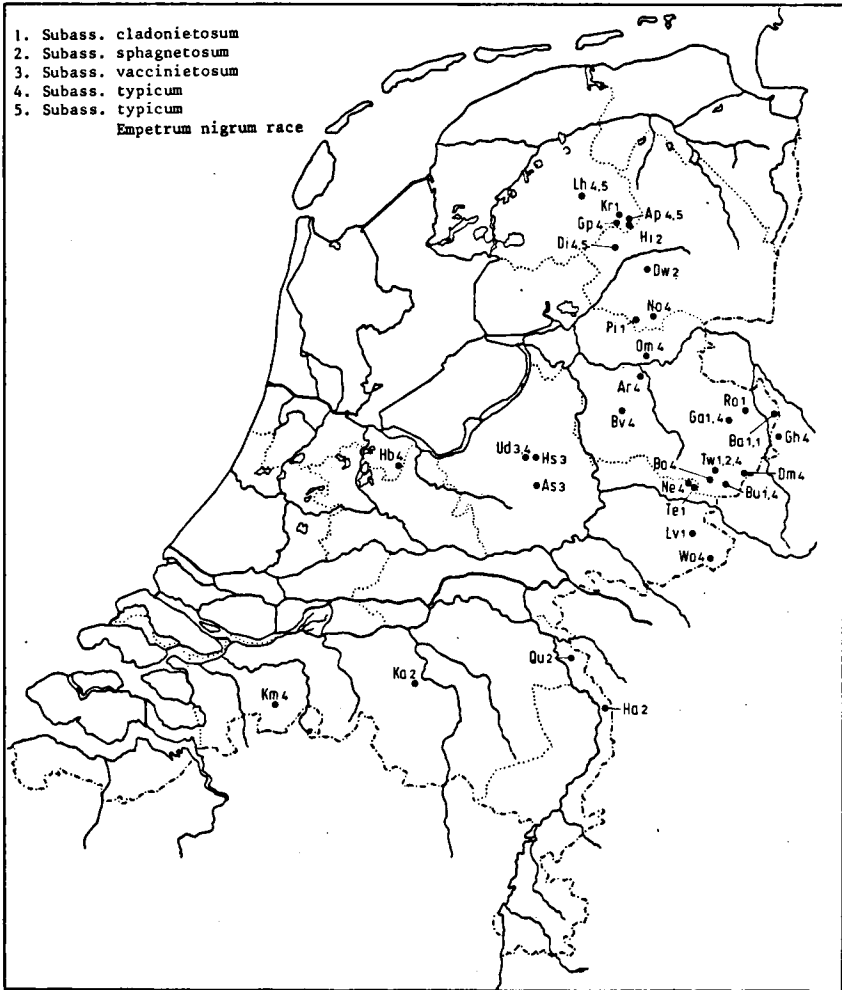


Fig. 3. Localities of *Ericetum tretalicis*.





Table 2 Carici - Empetretum, Var. of *Genista tinctoria*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	AVERAGE
Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Author of relevé	JU	S	S	S	S	1	1	1	HO	HO	HO	HO	HO	HO	HO	HO	
Locality	1x	1x	1x	1x	1x	Tr	Tr	Tr	Tr	Tr	Tr	Tr	Tr	Tr	Tr	Tr	
Exposure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Inclination (°)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Height (cm)	60	80	90	70	50	50	50	40	-	-	-	-	-	-	-	-	
Coverage dwarfshrub layer (X)	100	99	99	90	99	100	100	100	80	90	90	95	100	95	90	80	
Coverage moss layer (X)	5	<5	-	<5	20	20	20	10	35	60	50	60	50	10	10	40	
Species number	16	15	8	13	10	15	16	17	21	21	17	20	16	15	22	13	16,4
Regional char. + diff. species of Ass. Carici-Empetretum																	
Empetrum nigrum	1	3	5	4	4	5	5	5	4	3	4	5	4	2	3	3	
Salix repens ssp. arg.	2	2	1	2	1	2	2	1	2	2	1	4	2	3	3	+	
Carex arenaria	1	1	2	2	1	2	2	2	1	+	+	+	+	+	+	+	
Diff. species subass. ericetosum																	
Carex trinervis	.	+	1	+	1	.	+	1	+	1	1	1	+	+	+	+	
Erica tetralix	2	.	.	3	3	3	2	.	.	1	1	+	3	3	+	+	
Potentilla erecta	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	
Diff. species <i>Genista tinctoria</i> var.																	
<i>Genista tinctoria</i>	1	1	1	1	2	+	+	1	1	+	+	+	+	+	+	1	
All. O. and Cl. char. species																	
Nardo-Callunetea																	
Calluna vulgaris	1	.	.	.	.	.	+	2	3	1	3	2	1	.	.	3	
Hypnum cupr. v. ericetorum	.	.	.	.	.	+	2	2	2	3	4	3	3	3	+	+	
<i>Genista anglica</i>	.	.	.	.	.	2	2	.	1	.	.	+	.	.	.	.	
<i>Sieglingia decumbens</i>	+	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	
<i>Luzula multiflora</i>	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	+	
<i>Veronica officinalis</i>	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	
Companions																	
<i>Calamagrostis epigejos</i>	+	4	2	3	1	.	.	.	+	1	.	+	.	1	1	.	
<i>Lophocoles cuspidata</i>	.	+	1	.	.	.	+	.	+	1	.	.	.	1	+	+	
<i>Festuca tenuifolia</i>	2	1	.	1	2	.	.	.	1	+	.	.	.	.	.	+	
<i>Dicranum scoparium</i>	.	.	.	.	.	.	.	.	1	+	2	1	2	.	+	+	
<i>Pleuroxium schreberi</i>	.	.	.	.	.	.	.	.	+	+	3	.	.	+	2	+	
<i>Holcus lanatus</i>	+	1	.	.	1	1	+	.	.	.	.	.	.	.	.	.	
<i>Anthoxanthum odoratum</i>	+	.	.	.	2	2	2	1	+	.	.	.	.	.	.	.	
<i>Eurhynchium praelongum</i>	+	.	.	+	.	.	.	.	.	+	.	.	.	+	+	.	
<i>Pseudoclasopodium purum</i>	2	.	.	+	1	.	.	.	+	.	.	.	2	.	.	.	
<i>Festuca rubra</i> v. <i>rubra</i> subv. <i>aren.</i>	.	.	.	.	.	1	1	+	.	+	.	.	.	.	.	.	
<i>Lotus corniculatus</i>	.	.	.	.	2	1	1	2	.	.	.	.	.	.	.	.	
<i>Farmelia physodes</i>	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	
<i>Agrostis tenuis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
<i>Poa pratensis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
<i>Cladonia pyx.</i> v. <i>chlorophaea</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
<i>Agrostis stolonifera</i>	+	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	
<i>Epilobium montanum</i>	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
<i>Vicia sativa</i>	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	
<i>Trifolium repens</i>	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	
<i>Drepanocladus fluitans</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
<i>Luzula campestris</i>	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	
<i>Salix aurita</i>	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	
<i>Cladonia furcata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	
<i>Lotus uliginosus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
<i>Hypnum cupr. v. lacunosum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
<i>Oxycoccus macrocarpos</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

## Other species

*Rubus cassius*(2)1; *Rumex acetosella*(2)+; *Hydrocotyle vulgaris*(2)2; *Cirsium palustre*(2)1; *Carex distans*(8)+; *Viola canina*(10)+; *Molinia coerulea*(12)+; *Cladonia arbuscula*(13)+; *Cladonia tenuis*(13)+; *Carex nigra*(16)+; *Hippophae rhamnoides*(16)+; *Lonicera periclymenum*(11)3; *Juncus balticus*(15)+.

Table 3 Carici - Empetretum, Var. of Carex panicea

	1	2	3	4	5	6	7	8	9	10	MEAN
Number of relevé	1	2	3	4	5	6	7	8	9	10	
Author of relevé	vS	T	T	1	vS	vS	vS	vS	S	S	
Locality	Sg	Tx	Sg	Am	Sg	Sg	Sg	Sg	Tx	Tx	
Height (cm)	-	35	50	30	60	-	-	-	60	40	
Coverage dwarfshrub layer (%)	30	100	100	70	100	70	80	95	100	100	
Coverage mosslayer (%)	1	<5	10	20	5	<1	<1	<1	70	70	
Species number	29	17	17	12	17	14	14	16	19	23	18
Regional char. + diff. species of Carici - Empetretum											
Salix repens		1	+	3	1	+	1	1	1	1	2
Empetrum nigrum		.	.	.	+	.	.	.	1	1	2
Carex arenaria		+	1	2	.	.	.	.	.	.	.
Diff. species subass. ericetosum											
Erica tetralix		2	3	3	4	5	3	3	3	4	3
Potentilla erecta		1	1	2	.	1	3	3	2	1	1
Carex trinervis		+	.	.	2	1	.	+	2	1	+
Diff. species Carex panicea var.											
Carex panicea		1	1	1	1	1	1	2	1	1	1
Nardus stricta		+	3	2	.	.	+	.	1	.	.
All. O. and Cl. char. species Nardo-Callunetea											
Sieglingia decumbens		+	2	1	1	+	.	+	1	.	.
Hypnum cupr. v. ericetorum		+	1	2	2	.	.	.	+	3	.
Calluna vulgaris		.	+	.	.	.	.	.	.	1	.
Luzula multiflora		.	.	.	+	.	.	.	2	.	.
Companions											
Festuca tenuifolia		2	2	2	1	.	1	+	1	2	.
Bolcus lanatus		+	+	+	+	.	+	1	+	1	.
Agrostis tenuis		+	.	1	1	+	.	.	+	.	.
Calamagrostis epigejos		1	1	.	.	1	.	.	.	2	2
Anthoxanthum odoratum		.	.	.	.	.	+	+	2	1	1
Carex nigra		.	.	.	.	2	2	1	2	.	.
Hydrocotyle vulgaris		.	.	.	.	.	.	1	.	2	1
Lotus corniculatus		+	+	.	.	.	.	.	.	1	2
Juncus subuliflorus		+	1	1	.	+	.	.	.	.	.
Pseudoscleropodium purum		.	1	1	.	.	.	.	.	.	.
Dicranum scoparium		+	+	+	.	.	.	.	.	.	.
Rhynchospora squarrosa		+	.	+	.	.	.	.	.	.	.
Juncus alpino-art. ssp. atr.		+	.	1	+	.	.	.	.	.	.
Cephalozia bicuspidata		.	.	.	.	.	.	+	+	.	.
Schoenus nigricans		.	.	.	.	.	.	.	.	1	+
Eriophorum angustifolium		.	.	.	.	.	.	2	2	+	.
Cirsium dissectum		.	.	.	.	.	.	.	.	.	.
Polytrichum juniperinum		.	.	1	.	1	.	.	.	.	.
Molinia coerulea		.	.	.	.	.	.	+	1	.	.
Betula pubescens		.	.	.	.	.	.	.	+	1	.
Mnium hornum		.	.	.	.	.	.	.	.	2	4
Calyptogeia trichomanis		.	.	.	.	.	.	.	.	1	1
Carex pulicaris		.	.	.	.	.	.	.	.	1	+

Other species  
 Ceratodon purpureus(5)2; Cladonia glauca(1)+; Epipactis palustris(6)1; Fragaria vesca(10)1; Potentilla anserina (10)1; Parnassia palustris(10)+; Carex flacca(10)2; Koeleria albescens(11)+; Luzula campestris(11)1; Eriophorum pilosella(1)r; Cladonia furcata(1)+; Polytrichum commune(1)1; Cladonia gracilis(1)+; Polytrichum piliferum(2)r; Cladonia arbuscula(1)+; Peltigera sp.(1)+; Pyrola rotundifolia(2)+; Euphrasia cf. nemorosa(2)+; Carex serotina ssp. pulchella(2)1; Agrostis stolonifera (3)2.



Table 4 Carici - Empetretum, Var. of Schoenus nigricans

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of relevé	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Author of relevé	ix	ix	ix	ix	ix	ix	ix	ix	ix	ix	ix	ix	ix	ix	ix
Locality	35	30	80	40	50	49	40	40	50	50	50	50	50	50	50
Height (cm)	90	35	60	90	55	95	49	40	50	50	50	50	50	50	50
Coverage dwarfshrub layer (%)	10	35	40	30	30	35	49	40	50	50	50	50	50	50	50
Coverage moss layer (%)	20	16	21	24	20	20	16	13	16	16	16	16	16	16	16
Species number															

Regional char. + diff. species  
 Ass. Carici-Empetretum  
 Ass. Salix repens ssp. atg.  
 Empetrum nigrum  
 Diff. species subass. ericetostem  
 Erica tetralix  
 Potentilla erecta  
 Diff. species Schoenus nigricans var.  
 Lonicera periclymenum  
 Eurhynchium praelongum  
 Rubus caesius  
 Schoenus nigricans  
 Lotus uliginosus  
 Galium palustre  
 Hippophae rhamnoides  
 All., O. and Cl. char. species  
 Nardo-Calluneta  
 Calluna vulgaris  
 Hyssopus cupr. v. ericetorum  
 Veronica officinalis  
 Luzula multiflora  
 Companions  
 Calamagrostis epigejos  
 Festuca tenuifolia  
 Lophocolea bidentata  
 Pseudocleropodium purum  
 Bryum pseudotriquetrum  
 Cirsium palustre  
 Cirsium lanatum  
 Helcus lanatus  
 Carex nigra  
 Agrostis stolonifera  
 Plantago lanceolata  
 Festuca rubra  
 Chlorocypripus polyanthus  
 Lophocolea heterophylla  
 Galium uliginosum  
 Luzula campestris  
 Anthoxanthum odoratum

Other species  
 Carex panicea(1);  
 Campyllum stellatum(1);  
 Festuca tenuifolia(1);  
 Hydrocotyle vulgaris(2);  
 Cirsium arvense(2);  
 Rosa pimpinellifolia(3);  
 Vicia cracca(3);  
 Elytrigia pungens(6);  
 Carex pulicaris(4);  
 Cladonia pyrr. var. chlorophaea(4);  
 Aulacomium palustre(4);  
 Phragmites australis(5);  
 Hypericum tetraeterum(5);  
 Dryopteris filix-mas(6);  
 Parnassia palustris(7);  
 Mentha aquatica(7);  
 Mnium hornum(8);

Table 5 Empetro - Ericetum

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of relevé	43	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Author of relevé	v5	v5	v5	v5	v5	v5	v5	v5	v5	v5	v5	v5	v5	v5	v5
Locality	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI
Height (cm)	90	45	85	100	90	75	—	30	60	80	65	95	95	90	90
Coverage dwarfshrub layer (%)	12	19	19	12	17	19	12	9	12	12	7	10	6	15	15
Coverage moss layer (%)															
Species number															

Regional char. and diff. species  
 Ass. Empetro-Ericetum  
 Oxyccoccus macrocarpos  
 Salix repens ssp. atg.  
 Calamagrostis epigejos  
 Carex trinervis  
 Juncus strict. ssp. balticus  
 Juncus sphino-art. ssp. att.  
 Empetrum Cl. char. species  
 All., O. and Cl. char. species  
 Oxyccoccus-Sphagneta  
 Erica tetralix  
 Aulacomium palustre  
 Companions  
 Potentilla erecta  
 Agrostis canina  
 Carex panicea  
 Carex nigra  
 Eriophorum angustifolium  
 Siaglingia decumbens  
 Lotus corniculatus  
 Calliergonella cuspidata  
 Carex flacca  
 Potentilla anserina  
 Eleocharis multicaulis  
 Helcus lanatus  
 Festuca tenuifolia  
 Juncus subuliflorus  
 Juncus effusus  
 Lophocolea bidentata  
 Hydrocotyle vulgare  
 Drepanoladus fluitans  
 Molinia coerulea  
 Phragmites australis

Other species  
 Parmelia phytodes(13);  
 Eurhynchium praelongum(11);  
 Drepanoladus aduncus(11);  
 Betula pubescens(10);  
 Trifolium repens(7);  
 Pteronidium schreberi(10);  
 Cladonia tenuis(11);  
 Brynum cupr. var. lacunosum(10);  
 Platanchera bifolia(6);  
 Polygala serpyllifolia(6);  
 Eleocharis cf. palustris(2);  
 Eleocharis quinqueflora(2);  
 Juncus articulatus(2);  
 Agrostis tenuis(13);  
 Carex arenaria(4);  
 Pedicularis sylvatica(6);  
 Anthoxanthum odoratum(7);  
 Schoenus nigricans(5);







Table 7 *Erico - Sphagnetum magellanici*

Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Author of relevé	dS	CK	CK	dS	CK	B	CK	CK	B	B	B	B	CK	CK
Locality	Br	Ge	Ge	Op	Hc	Br	Ge	Du	Br	Br	Br	Br	Qu	Ge
Exposure	-	-	-	-	-	-	-	-	NE	N	N	-	-	-
Inclination (°)	-	-	-	-	-	-	-	-	4	33	11	-	-	-
Height (cm)	25	45	40	60	45	50	35	40	57	65	65	-	25	30
Coverage dwarfshrublayer (Σ)	95	95	90	95	95	30	80	90	50	70	75	-	90	95
Coverage mosslayer (Σ)	95	70	5	90	70	95	100	100	90	60	70	-	5	90
Species number	10	13	15	13	12	11	12	10	18	22	17	14	6	6
<b>Diff. species ass. <i>Erico-Sphagnetum</i></b>														
<i>Narthecium ossifragum</i>	3	.	2	3	.	+	.	.	+	.	.	.	.	.
<i>Odontoschisma sphagni</i>	.	.	+	.	.	.	.	+	3	.	.	.	.	.
<i>Mylia anomala</i>	.	.	.	+	.	+	.	.	.	.	.	.	.	.
<i>Eriophorum vaginatum</i>	.	.	+	.	.	.	.	.	.	.	.	.	.	.
<b>Char. and diff. sp. <i>Erico-Sphagnion</i> and <i>Sphagnetalia magellanici</i></b>														
<i>Oxycoccus palustris</i>	1	4	.	2	4	1	3	1	+	1	.	.	3	1
<i>Andromeda polifolia</i>	3	1	+	2	.	.	3	3	.	2	1	+	1	2
<i>Eriophorum angustifolium</i>	2	.	.	.	1	1	1	3	+	1	1	2	.	+
<i>Sphagnum papillosum</i>	.	.	.	5	.	5	.	.	5	3	3	2	.	.
<b>Char. and diff. species <i>Ericion tetralicis</i></b>														
<i>Erica tetralix</i>	3	3	3	3	4	2	3	1	2	2	2	2	4	5
<i>Scirpus caespitosus</i>	+	.	.	.	.	.	.	.	+	.	.	.	.	.
<b>Char. species <i>Oxycoco-Sphagnetea</i></b>														
<i>Drosera rotundifolia</i>	1	.	.	.	+	1	.	.	1	1	1	1	.	.
<i>Aulacomnium palustre</i>	.	.	.	.	.	+	.	.	+	1	1	+	.	.
<i>Cephalozia connivens</i>	.	.	.	.	.	.	2	+	.	+	+	+	.	.
<b>Companions</b>														
<i>Molinia coerulea</i>	4	2	4	3	1	2	+	3	2	2	3	2	1	1
<i>Sphagnum cuspidatum</i>	5	+	1	.	5	2	5	4	2	1	2	5	+	5
<i>Calluna vulgaris</i>	2	+	.	4	3	1	.	+	2	2	2	1	+	.
<i>Betula pubescens</i>	.	.	+	+	+	.	.	.	+	+	1	+	.	.
<i>Cephalozia bicuspidata</i>	.	.	.	.	+	.	1	.	2	2	3	1	.	.
<i>Calyptogeia trichomanis</i>	.	.	.	.	.	+	.	.	1	1	2	1	.	.
<i>Polytrichum commune</i>	.	3	.	.	.	.	.	.	+	1	+	.	.	.
<i>Fohlia nutans</i>	.	+	.	.	.	.	.	.	+	+	1	.	.	.
<i>Gymnocolea inflata</i>	.	.	.	.	+	.	+	+	.	+	.	.	.	.
<i>Quercus robur</i>	.	+	+	.	.	.	.	.	.	.	.	.	.	.
<i>Telaranea setacea</i>	.	.	.	+	.	.	.	.	+	+	.	.	.	.
<i>Hypnum cupr. v. ericetorum</i>	.	+	1	.	.	.	.	.	.	.	.	.	.	.
<i>Campylopus flexuosus</i>	.	+	+	.	.	.	.	.	.	.	.	.	.	.
<i>Orchis maculata</i>	.	+	+	.	.	.	.	.	.	.	.	.	.	.
<i>Cladonia impexa</i>	.	.	+	.	.	.	.	.	.	.	.	.	.	.
<i>Cephalozia cf. starkei</i>	.	.	.	.	.	.	+	.	.	.	.	.	.	.
<i>Pinus sylvestris</i>	.	.	+	.	.	.	.	.	.	.	.	.	.	.
<i>Salix aurita</i>	.	.	.	.	.	.	.	.	.	+	.	.	.	.
<i>Polygala serpyllifolia</i>	.	.	.	.	.	.	.	.	.	+	+	.	.	.
<i>Frangula alnus</i>	.	.	.	.	.	.	.	.	.	.	+	+	.	.
<i>Potentilla erecta</i>	.	+	.	.	.	.	.	.	.	.	+	.	.	.
<i>Gentiana pneumonanthe</i>	.	.	.	+	.	.	.	.	.	.	.	.	.	.
<i>Juncus scutiflorus</i>	.	.	.	.	2	.	.	.	.	.	.	.	.	.
<i>Juncus squarrosus</i>	.	.	.	.	.	.	.	+	.	.	.	.	.	.
<i>Campylopus fragilis</i>	.	.	.	.	.	.	.	.	.	+	.	.	.	.

developed *Ericetum*. JONAS (1932) presented a table on Emsland, with *Campylopus* in wet Sphagnum-rich *Ericetum* and drained bog.

BARKMAN & WESTHOFF (1969) considered the species as a pioneer species for much dryer heath vegetations, 2–6 years after a fire. These habitats might have similar light intensities, as *Campylopus* species are heliophilous. A few years after a fire, the heath canopy has not yet closed. In the *Ericetum*, the characteristic habitat of *Campylopus brevipilus* is on the fringes of hollows containing *Gymnocolea inflata*. In the present surveys, the species has only been found in Twente (SAALTINK 1962) and in Drente.

The essential ecological factor for the *Ericetum* is a high and not too much fluctuating groundwater table. During the winter the watertable rises to at least 40 cm below the surface, and generally for a shorter or longer period to as much as 10 cm above the surface. In summer, the watertable is not deeper than 1 m. The typical soil is a humic gley. The level of permanent reduction is not deeper than 1,20 m, but may also be found at – 0.80 m. (ZONNEVELD & BANNINK 1960; SAALTINK 1962; DE SMIDT 1966). This explains the vulnerability of our wet heaths, as the watertable is generally lowered for agricultural purposes.

Geographically, the *Ericetum* always had a restricted distribution. It is essentially restricted to a belt near the coast from Antwerp to Schleswig-Holstein, but it avoids the coast proper. At present it is limited to a zone from Central Brabant to North Drente. This means that nearly all remaining *Ericetum* is located in the Netherlands. The largest wet heaths are found on the Kampina, Strabrechtse heide, Appelse heide, Achterveld van Neede, Boeteler veld, Twickel, Dwingelose and Kralose heide. A number of small but well-developed wet heaths can still be found in North Limburg, het Gooi, de Veluwe, and de Achterhoek. Some of these represent small relicts of species-rich wet heaths, the larger ones of which were destroyed by agricultural reclamation. Examples of species-rich relicts are found in parts of the Eexterveld and in some localities in Twente and Southeast Friesland.

### 3.1 Subassociation *cladonietosum* R. Tüxen 1937 (Table 6)

Differential species: *Cladonia uncialis*, *Cl. squamosa*, *Cl. arbuscula*, *Cl. crispata*, *Cl. gracilis*, *Cornicularia aculeata*.

TÜXEN (1937) mentioned also *Cladonia pyxidata* var. *chlorophaea* as differential species, but this does not apply to the Netherlands. The species is even more frequent in the subassociation *sphagnetosum*.

WESTHOFF & DEN HELD (1969) did not distinguish a subassociation *cladonietosum*. They regarded *Cladonia uncialis* as a differential species of the subassociation *typicum*. *Cladonia crispata* and *Cl. squamosa* were listed by these authors as character species of the association.

The typical soil consists of 20–100 cm postglacial niveo-aolian sandy

sediment on glacial till, wet or even inundated in winter, but drying out at the surface in summer.

As lichens need high light intensity, they are dependent on an open structure of the dwarf shrub layer (Table B). It is not certain whether such conditions must be permanent. An open structure may appear some years after sods have been cut, after an attack of the »bell heather beetle« *Altica ericeti*, or after an exceptional and all summer lasting inundation that kills *Erica*.

This subassociation is probably restricted to small areas in Twente and in de Achterhoek.

### 3.2 Subassociation sphagnetosum Allorge 1926 (Table 6)

Differential species: *Gymnocolea inflata*, *Odontoschisma sphagni*, *Cephalozia connivens*, *Sphagnum cuspidatum*, *Sphagnum papillosum*, *Lophozia ventricosa*.

Hepatics normally outnumber the *Sphagna* in this community. ALLORGE (1926) mentioned also *Odontoschisma sphagni* and *Gymnocolea inflata* as exclusive and selective species respectively. Other species listed were *Spagnum papillosum*, *Sph. magellanicum* and *Sph. subsecundum*. The last two species, however, are found under real bogconditions of the *Erico - Sphagnion*. This may be explained by a gradual transition of the *Ericion tetralicis* into *Erico - Sphagnion*. Within the *Ericion*, the community is most related to the *Erico - Sphagnion*. The next step in this transition is illustrated in table 7. Character and differential species of the *Ericetum tetralicis sphagnetosum* are absent or infrequent, except for *Sphagnum cuspidatum*, while *Spagnum papillosum* can become predominant. On the other hand, the high constancy and in some places the predominance of *Andromeda polifolia* and *Oxycoccus palustris* indicate this community to fall within the alliance of raised bogs *Erico - Sphagnion* rather than in the *Ericion tetralicis*. The relevés in table 7 are located in boggy depressions in wet heaths, in the marginal areas of fens, and near seepages on north exposures in heaths.

TÜXEN in 1937 mentioned *Spagnum papillosum* and *Andromeda polifolia* as character species; in 1958, however, he mentioned only *Sphagnum tenellum*.

WESTHOFF & DEN HELD (1969) listed eleven differential species: *Sphagnum molle*, *S. papillosum*, *S. tenellum*, *Andromeda polifolia*, *Oxycoccus palustris*, *Cephalozia connivens*, *Telaranea setacea*, *Odontoschisma sphagni*, *Mylia anomala*, *Calypogeia sphagnicola*, *Eriophorum vaginatum*. These authors apparently had a wider concept of the subassociation which, to our opinion, is transitional into the *Erico - Sphagnion*.

The typical habitat is a soil wet during the whole year. This can be found in a zone between *Erico - Sphagnetum* and *Ericetum typicum* or *cladonietosum*.

The geographic area is from Central Brabant to Southeast Friesland.

### 3.3 Subassociation *typicum* R. Tüxen 1937 (Table 6)

No differential species.

TÜXEN (1937) mentioned no differential species either. WESTHOFF & DEN HELD (1969) emendated the subassociation after a suggestion made by BARKMAN. They listed ten differential species: *Sphagnum auriculatum*, *Zygonium ericetorum*, *Cladonia uncialis*, *Carex panicea*, *Genista anglica*, *Potentilla erecta*, *Gentiana pneumonanthe*, *Pedicularis sylvatica*, *Salix repens*, *Lophozia ventricosa*. Their subassociation is apparently overlapping the *Nardo-Gentianetum*.

The subassociation *Orchietosum* Diemont apud Westhoff 1947 probably falls within the *Nardo-Gentianetum*. The soil conditions and the water regime resemble those of the subassociation *cladonietosum*: wet or inundated in winter, superficially drying out in summer. The floristic difference with this subassociation in the moss layer is caused by the denser structured dwarf shrub layer (Table B).

Table B

<i>Ericetum tetralicis</i> Number of relevés	Subass. <i>cladonietosum</i> 12	Subass. <i>typicum</i> 24
Mean cover perc. dwarf shrub layer	77	91
Mean cover perc. moss layer	85	61

This community is recorded from the central, eastern and northern parts of the country. It is the only wet heath type found as far west as Het Gooi.

### 3.4 Subassociation *vaccinietosum* subass. nov. (Table 6)

Differential species: *Vaccinium vitis-idaea*, *Vaccinium myrtillus*, *Leucobryum glaucum*, *Calypogeia fissa*, *Telaranea setacea*, *Sphagnum rubellum*, *Mylia anomala*, *Aulacomnium palustre*, *Nardus stricta*, *Carex nigra*.

No data on this community have been found in the literature. It might be endemic for the Netherlands. BÖCHER (1943) described an *Ericetum* with *Vaccinium vitis-idaea* (and *Empetrum nigrum*), but not *Vaccinium myrtillus* and other differentiating species. On the other hand, the Danish community is characterized by *Vaccinium uliginosum*, *Salix repens*, *Carex arenaria*, *Oxycoccus palustris* and *Juncus balticus*. This heath is found near the coast, generally humid dunevalleys. The Dutch *Ericetum* with *Vacciniums*, on the contrary, is an inland heath. Its main geographic area is East Veluwe. As the *Vaccinio-Callunetum* (see page 294) is found in about the same area, the question arises if this community should be also assigned the rank of association. In this wet heath, however, the character species of the *Ericetum tetralicis* are present, whereas in the *Vaccinium* rich dry heath the charac-



ter species of the *Genisto - Callunetum* are absent. The absence of own character species is also in support of the rank of subassociation.

The characteristic habitat of this community is at the foot of a north slope, with water supply from a seepage. Such places are attractive to boars for taking a mudbath. This causes a natural habitat for *Lycopodium inundatum* in the wet heath (VAN DER LAAN & RIJKEE 1967).

The *Vaccinum*-rich wet heath is best developed in the Uddeler Buurtveld (VAN DER LAAN & RIJKEE 1967). Other localities, all on the East Veluwe, are Asselse Veld (BROEKHUIZEN & VELTHUIS 1965) and Hoog Soerense Veld (VAN DER BURGH 1962; VAN BEEK 1967). It might also be present in Drente (BARKMAN & WESTHOFF 1969).

#### 4 *Genisto anglicae - Callunetum* R. Tüxen 1937

Syn.: *Genisto pilosae - Callunetum* R. Tx. 1937 em. Preising 1953.

*Calluneto - Genistetum pilosae subatlanticum* Duvign.

Character species: *Genista anglica*, *Genista pilosa*, *Dicranum spurium*, *Cuscuta epithymum*, *Lycopodium complanatum* var. *chamaecyparissus*.

Stands of *Genisto - Callunetum* are generally poor in character species. Both *Genista*'s have their optimum in the subassociation *sieglingietosum* and are infrequent in most of the other subtypes. *Dicranum spurium* is infrequent, except in the *typicum* variant of the subassociation *cladonietosum*. *Cuscuta epithymum* is a rare species. This parasite is mainly found on low and dense *Calluna* after a fire or following heavy grazing. Its scarcity might be related to an abandoning of this type of farming in this century. *Lycopodium complanatum* var. *chamaecyparissus* is recorded only incidentally.

Several suggestions were made in the synsystematics of heath vegetations. TÜXEN & KAWAMURA (1975) gave a detailed compilation on this subject. In 1937 the *Calluna* heath was divided by TÜXEN in a dry and a humid subassociation group. In both groups a subassociation for poor soil was found and one for relatively rich soil. TÜXEN & KAWAMURA (1975) mentioned a new synsystematic suggestion, made by PREISING during a lecture in 1955, for two subassociations. A subassociation of *Cladonia* with the differential species *Cladonia impexa*, *Cl. tenuis*, *Cl. mitis*, *Cl. chlorophaea*, *Cl. floerkeana*, *Cl. squamosa*, *Cl. uncialis*, *Cornicularia aculeata*, *Ptilidium ciliare* and *Dicranum spurium* on poor soils. The other subassociation of *Sieglingia* with the differential species *Sieglingia decumbens*, *Carex pilulifera*, *Luzula campestris*, *Hypochoeris radicata*, *Galium saxatile* *Hieracium pilosella*, was found on heath soils relatively rich in nutrients. Each subassociation had a variant with *Molinia coerulea*, *Erica tetralix*, *Juncus squarrosus* and *Scirpus caespitosus* in humid habitats. TÜXEN & KAWAMURA (1975) adopted this opinion. These authors pointed out that the soil profiles provide evidence of the subassociation *cladonietosum* having originated from the *Betulo - Quercetum*

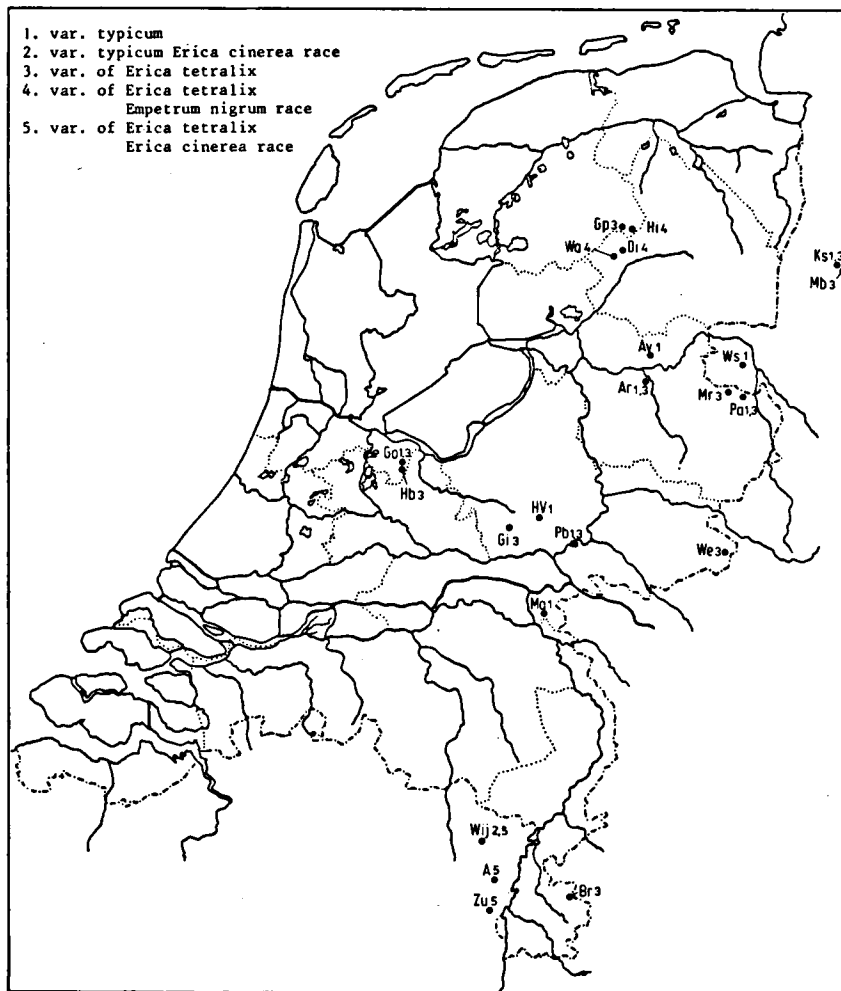


Fig. 4. Localities of *Genisto - Callunetum sieglingietosum*.









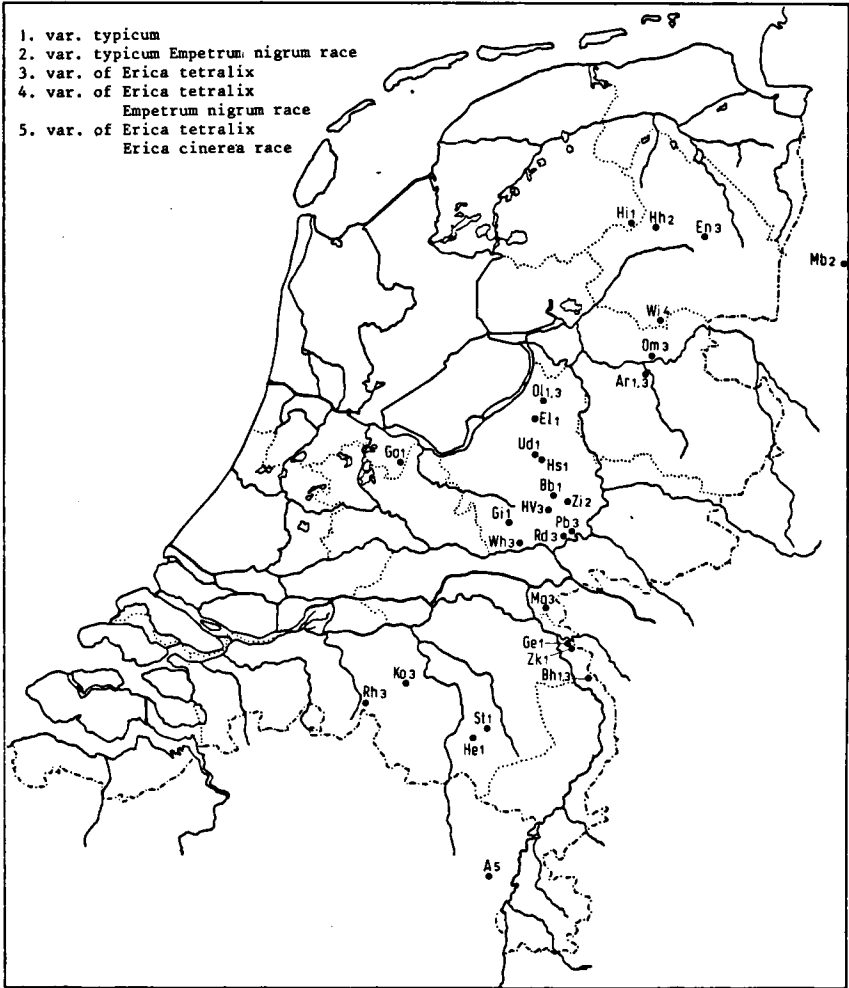


Fig. 5. Localities of Genisto - Callunetum cladonietosum uncialis.

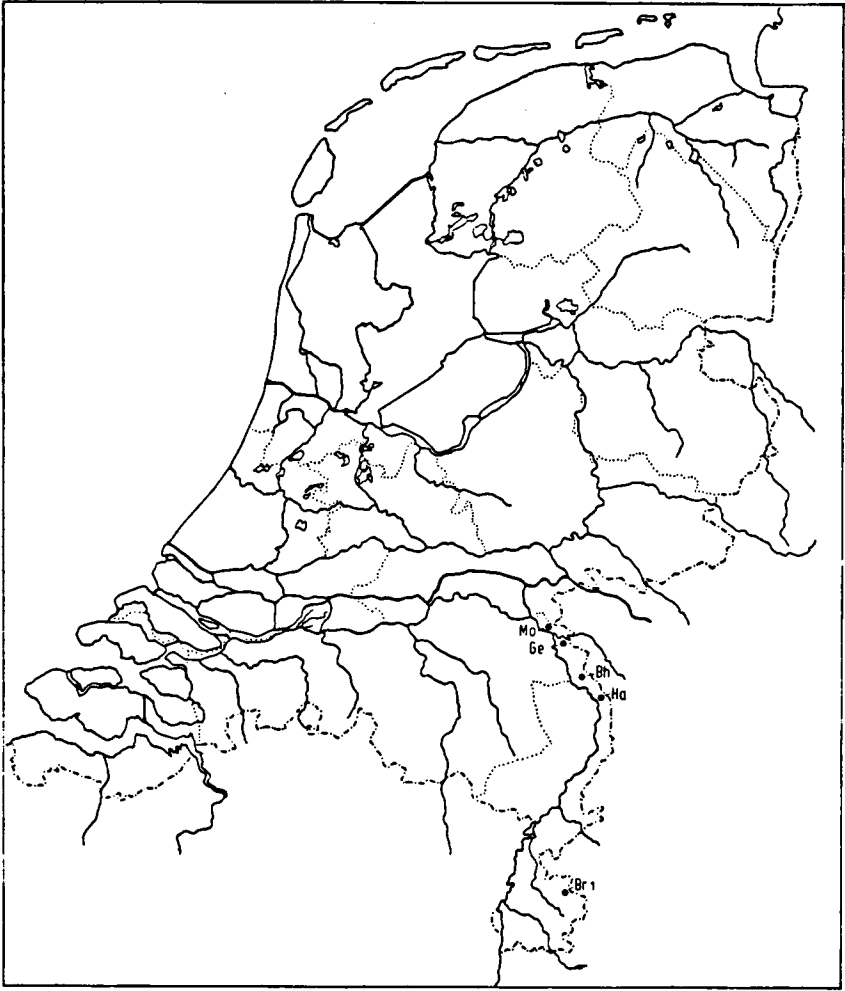


Fig. 6. Localities of *Genisto - Callunetum cladonietosum bacillaris*.



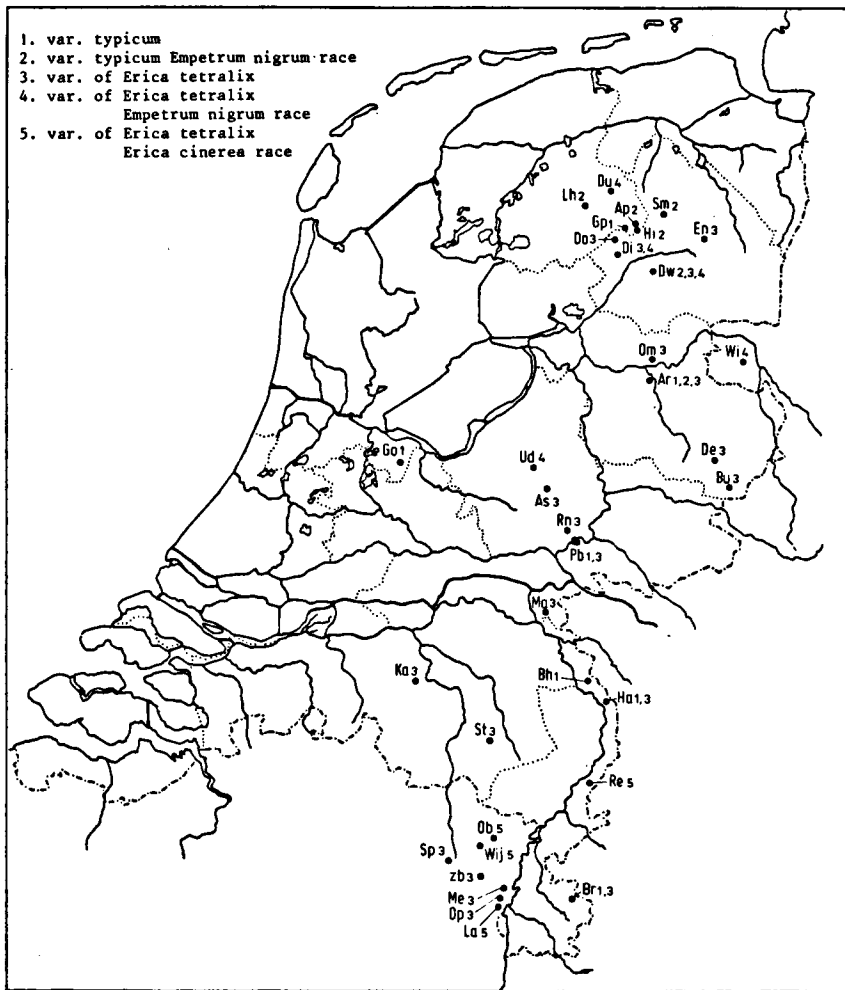


Fig. 7. Localities of Genisto - Callunetum typicum.

roboris and the subassociation sieglingietosum from the Fago-Quercetum. The soil types are humuspodzol and moderpodzol respectively. TÜXEN & KAWAMURA mentioned a smaller number of differential species than PREISING. For the cladonietosum they mentioned *Cladonia uncialis*, *Cl. chlorophaea*, *Cl. gracilis*, *Parmelia physodes*, *Ptilidium ciliare*; for the sieglingietosum *Sieglingia decumbens*, *Carex pilulifera*, *Potentilla erecta* and (weaker) *Agrostis tenuis*.

Data collected in the Netherlands support this subdivision of the Genisto-Callunetum. The great advantage is to have many differential species instead of only *Molinia coerulea* and *Erica tetralix*. Moreover it becomes evident from the vegetation tables that the presence of *Molinia* and of *Erica* cannot be distinctly correlated. This means that the separation of a subassociation molinietosum was practically based on the presence of only one differentiating species, and this makes not much sense.

In Limburg and East Kempen, *Molinia* is often present without *Erica tetralix*, in the northern Netherlands this is rare. In the North, *Erica* is often found without *Molinia*, this situation is rare in the South.

#### 4.1 Subassociation sieglingietosum R. Tüxen in R. Tüxen u. Kawamura 1975 (Table 8, Fig. 4)

Syn.: Calluneto-Sieglingietum Heinemann 1957.

Differential species: *Sieglingia decumbens*, *Carex pilulifera*, *Potentilla erecta*.

The authors used the name danthonietosum. According to the rules of nomenclature (BARKMAN et al. 1976), this epithet is not valid as the genusname *Danthonia* had been abandoned already. TÜXEN & KAWAMURA also mentioned *Agrostis tenuis* as differential species. Apparently this applies to Middle-Europe; in the Netherlands it is an infrequent species in the heath.

A particular herbrich form is found on the Bisschopsberg near Havelte. A table was published by WATERBOLK (1948). This heath on red glacial till contains *Hypericum pulchrum*, *Pimpinella saxifraga*, *Arnica montana*, *Solidago virgaurea*, *Orchis maculata*, *Lathyrus montanus*, *Anemone nemorosa* and *Campanula rotundifolia*.

The characteristic soil profile is a moder podzol on preglacial river sediments and loamy coversand.

The subassociation is mainly found in the South Veluwe, North Twente, and Drente, but it is also recorded from Brunssumse Heide and Gooi.

##### 4.1.1 Variant typicum

No differential species.

Variant on dry sandy soils.

#### 4.1.2 Variant of *Erica tetralix*

Differential species: *Erica tetralix*, *Molinia coerulea*.

In places with periodically a wet soil. *Erica* prefers a more regulated humidity regime than *Molinia*. *Erica* is found in particular on soils with much loam, löss or silt, consequently with a relatively good water retention capacity. *Molinia*, on the other hand, can flourish in pure sandy soils if an impervious layer is present not deeper than 1 m. This difference in ecological demands may explain why the two species are rather often found separate.

#### 4.2 Subassociation *cladonietosum uncialis* R. Tüxen in R. Tüxen et Kawamura 1975 (Table 9, Fig. 5)

Differential species: *Cladonia uncialis*, *Cl. gracilis*, *Cl. squamosa*, *Cl. arbuscula*, *Parmelia physodes*, *Cornicularia aculeata*, *Ptilidium ciliare*. TUXEN & KAWAMURA mentioned also *Cladonia chlorophaea* as differential species. In the Dutch heaths, however, this lichen is very frequent in all types. Three lichens have been added to their list: *Cladonia squamosa*, *Cl. arbuscula* and *Cornicularia aculeata*.

The characteristic soil profile is a well-developed humuspodzol in nutrient poor coversand.

The community is widely distributed and has its optimum in dry, sandy districts in North Brabant, North Limburg and the Veluwe.

##### 4.2.1 Variant *typicum*

##### 4.2.2 Variant of *Erica tetralix*

Differential species: *Erica tetralix*, *Molinia coerulea*.

#### 4.3 Subassociation *cladonietosum bacillaris* subass. nov. (Table 10, Fig. 6)

Differential species: *Cladonia bacillaris*, *Cl. macilenta*, *Carex arenaria*.

*Cladonia crispata* also shows some preference for this community. This species is found, however, also in the typical variant of the *cladonietosum uncialis*. *Pohlia nutans* may dominate the moss layer.

This type is found on stabilized inland dunes in places where litter is removed by erosion. This habitat is mostly found on south slopes of sanddunes; consequently, an *Erica* variant is absent.

The community seems to be characteristic of the sanddunes east of the river Maas in North Limburg. This location explains the predominance of *Pohlia nutans*, which is characteristic of the heath in the southern Netherlands.

#### 4.4 Subassociation *typicum* R. Tüxen 1937 (Table 11, Fig. 7)

No differential species.

This community was not mentioned for northwest Germany by TÜXEN & KAWAMURA. The table published by TÜXEN in 1937 showed high presences of *Ptilidium ciliare* and some *Cladonia*'s; the subassociation *cladonietosum* had not yet been distinguished in that year. Therefore, the subassociation as presented in this paper is slightly different. There is no need to use the epithet *inops*, as suggested by WESTHOFF (1969) in a similar case. This community is not at all inoptimal. Character species of the association and higher ranked syntaxa are present just as in the other subassociations, and this applies also to the companions. The absence of differential species does not affect the optimal condition, unless the number of species is under discussion. A mean of 8,5 to 9,9 species represents the poorest type. But with a normal set of character species and companions, the epithet *typicum* is quite appropriate.

The characteristic soil is a strongly leached humic podzol on cover sand.

The community is widely distributed, most records are either from the South or from the North, and fewer from central and eastern parts of the country.

#### 4.4.1 Variant *typicum*

Most records are from the Brunssumse heide, on a very deep podzol (A-horizon up to 1 m. thick) in sandy river deposits upon Tertiary silversand.

#### 4.4.2 Variant of *Erica tetralix*

In the South, this variant can be differentiated only by *Molinia coerulea*.

#### 4.5 Subassociation *lophozietosum ventricosae* subass. nov.

(Table 12, Fig. 8)

Differential species: *Lophozia ventricosa*, *Gymnocola inflata*, *Barbilophozia barbata*, *Leucobryum glaucum*, *Scapania nemorosa*, *Lophocolea cuspidata*. Species lists and vegetation tables suggest that a similar heath rich in hepatics might be found in northern European countries also. BARKMAN & WESTHOFF (1969) reported related *Empetrum* heaths from West Drenthe and Southeast Friesland. Also in the subassociation *lophozietosum Empetrum* is frequent and sometimes predominant when it is located within the geographic area of the species. Some records, however, are from locations far South of this boundary. BARKMAN & WESTHOFF mentioned a number of mosses that have not or just incidentally been found in our relevés: *Hylocomium splendens*, *Lophozia lycopodioides*, *Lophozia kunzeana*, *Drepanocladus uncinatus*, *Aulacomnium androgynum*, *Brachythecium rutabulum* and *Plagiothecium laetum*. Another difference is the much higher frequency of *Leucobryum glaucum* and *Gymnocola inflata* in our inventory.

BARKMAN & WESTHOFF drew attention to a certain relationship with the *Empetrum* heath of the coastal dunes, based on the presence of *Lophocolea*

*cuspidata*, *Pseudoscleropodium purum*, *Hylocomium splendens* and *Salix-repens* ssp. *arenaria*. Except for *Lophocolea*, these species are scarce in the inland heath.

*Empetrum* proper is not found further inland than 100 – 120 km. Its preference for sand dunes is in agreement with its preference for coastal environments. On the other hand, the floristic differences are so great that at best it can be called a very weak relationship, to which the two authors finally concurred.

This community has a preference for north exposure. The characteristic habitat is on short steep slopes in stabilized inland dunes (VAN DER LAAN & RIJKEE 1967; DANIELS, HOOFT & DE MOLENAAR 1965). Other preferred localities are on push moraines in de Veluwe and in Salland (BROEKHUIZEN & VELTHUIS 1965; LAMMERÉE & POWELS 1965).

All localities are arranged in a narrow zone, nearly North-South, from Appelscha to de Brunssumse heide.

#### 4.5.1 Variant typicum

#### 4.5.2 Variant of *Erica tetralix*

### 4.6 Subassociation bazzanietosum subass. nov. (Table 12, Fig. 8)

Differential species: *Bazzania trilobata*, *Orthocaulis attenuatus*, *Dicranum polysetum*.

This community has a rather marginal position within the *Genisto-Callunetum*. *Calluna vulgaris* and *Hypnum cupressiforme* var. *ericetorum* are the only character species from any syntaxonomic level within the *Nardo-Callunetea*. Next to these two species, also the companions are corresponding to those of the *Genisto-Callunetum*, and the type is considered to fall within this association. In the field, this heath can be easily recognized by the dense 5–10 cm thick layer of hepatics.

The type is found on the banks of erosion valleys with löss deposits. The exposure is mostly south, although the differential species prefer north exposures; these, however, are occupied by the *Vaccinio-Callunetum*. The soil has a hardly podzolised AC-profile.

The *Bazzania* heath is found in a very small area in the national park Veluwezoom near Velp. The status of subassociation seems justified by its pronounced floristic character, which is supported by a special habitat.

## 5 *Vaccinio-Callunetum* Büker 1942 (Table 13, Fig. 9)

Syn.: *Calluneto-Vaccinietum* Büker 1941

*Calluno-Vaccinietum* Büker 1942

*Genisto-Callunetum boreo-euatlanticum* Schwick. 1944  
p. p.

Table 10 Genisto - Callunetum cladonietosum bacillaris

Number of relevé	1	2	3	4	5	6	7	8	9	10
Author of relevé	CK	B	CK	CK	CK	CK	CK	CK	CK	CK
Locality	Bh	Bh	Mo	Ge	Mo	Bh	Bh	Ge	Ge	
Exposure	SWS	SW	W	SW	W	ME	W	S	W	
Inclination	10	14	-	15	5	-	5	5	10	20
Height (cm)	60	80	80	50	80	15	100	70	90	100
Coverage dwarfshrublayer (Σ)	100	75	100	100	85	90	80	90	90	100
Coverage mosslayer (Σ)	75	40	80	40	25	85	60	40	45	100
Species number	14	17	12	15	11	15	17	12	16	18
<b>Ass. char. species Genisto-Callunetum</b>										
Genista pilosa	+	.	.	1	1	.	1	1	.	+
Genista anglica	.	.	.	2	.	.	.	.	.	.
<b>All., O. and Cl. char. species</b>										
Nardo-Callunetea	.	.	.	.	.	.	.	.	.	.
Calluna vulgaris	5	5	5	5	5	4	5	5	5	5
Hypnum cupr. v. ericetorum	.	.	1	.	.	.	.	.	.	3
<b>Diff. species subass.</b>										
cladonietosum bacillaris	.	.	.	.	.	.	.	.	.	.
Cladonia bacillaris	+	+	+	+	+	+	+	+	+	+
Cladonia macilenta	+	+	+	+	+	+	+	+	+	+
Carex arenaria	.	.	.	.	.	.	.	+	+	+
<b>Companions</b>										
Pohlia nutans	4	3	3	3	1	3	2	3	+	+
Festuca tenuifolia	3	.	.	.	1	.	2	1	1	+
Cladonia pyx. v. chlorophaea	1	1	+	.	1	1	.	.	+	.
Campylopus fragilis	.	.	3	.	+	.	3	+	+	+
Campylopus flexuosus	+	.	.	.	.	.	.	+	+	2
Cladonia floerkeana	+	+	+	.	1	.	.	.	.	.
Deschampsia flexuosa	.	2	.	.	+	+	.	.	+	+
Cladonia impexa	.	.	.	.	2	.	.	.	2	1
Polytrichum piliferum	+	1	.	.	.	+	.	.	.	+
Cladonia cocc. v. pleurota	1	+	.	1	.	.	.	.	.	.
Cephaloxiella cf. starkai	1	+	.	.	.	1	.	.	+	.
Rumex acetosella	.	1	.	.	.	4	+	.	.	.
Gymnocola inflata	1	.	.	.	.	.	.	.	+	+
Agrostis canina v. montana	.	.	.	.	+	.	.	.	+	+
Dicranum scoparium	.	.	.	.	.	.	+	.	.	.
Cladonia crispata	+	+	.	.	.	.	.	.	1	3
Betula verrucosa	.	1	.	.	.	.	.	.	.	.
Pleurozium schreberi	.	.	.	.	.	.	.	.	.	+
Polytrichum comm. v. perigoniale	.	.	.	.	.	+	.	.	.	.
Parmelia physodes	.	.	.	.	.	2	.	.	.	.
Cladonia squamosa	.	.	.	.	.	.	1	.	.	.
Quercus robur	.	.	.	.	.	.	.	.	+	+
<b>other species</b>										
Cladonia subulata (2)										
Hieracium laevigatum (2)+										
Campylopus introflexus (2)+										
Cladonia verticillata (2)+										
Lophocolea bidentata (3)+										
Lophocolea heterophylla (3)+										
Steglingia decumbens (4)+										
Isopaches bicrenatus (4)+										
Luzula campestris (6)										
Polytrichum juniperinum (6)										
Dryopteris carthusiana (7)+										
Plagiothecium laetum (7)+										
Frilidium ciliare (10)										

Table 11 Genisto - Callunetum typicum

Number of relevé	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		
Author of relevé	CK	LP	BH	B	ds	B	B	LU	ds	U	B	LP	BH	B	ds	ds	ds	LP	ds	DM	ds	ds	ds	ds	ds	ds	CK	ds		
Locality	Ho	Sw	Go	Er	E	Er	Ptg	Gp	Br	Br	Ar	Bh	Bh	Sw	Sm	Ap	Dw	Ar	Lh	Hi	Hi	Do	En	En	Rh	De	Ho	Di		
Exposure	SW	E	E	E	E	E	S	—	SE	SW	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
Inclination (°)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
Height (cm)	50	30	25	25	—	25	50	—	80	—	35	25	50	15	70	25	30	35	50	30	20	70	45	40	50	60	45	30		
Coverage dwarfshrub layer (X)	100	95	100	60	80	75	75	70	100	85	55	99	95	65	90	95	98	100	95	75	95	100	100	100	90	100	98	98		
Coverage moss layer (X)	70	40	60	25	80	<5	40	3	70	70	30	70	80	<5	100	90	25	50	30	30	85	10	25	<5	60	100	85	85		
Species number	10	6	6	11	9	13	13	9	12	10	11	9	8	8	7	7	9	8	7	11	13	7	7	6	8	6	9	10		
<b>Ass. char. species Genisto-Callunetum</b>																														
Genista pilosa	.	.	.	.	.	.	.	.	+	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Genista anglica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	
Dicranum spurium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Cuscuta epithymum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
<b>All., O. and Cl. character species</b>																														
<b>Nardo-Callunetea</b>																														
Calluna vulgaris	5	5	5	4	5	4	4	4	5	4	4	5	5	2	5	2	2	1	2	2	1	4	5	4	5	5	5	4	4	
Hypnum cupr. v. ericetorum	.	1	3	.	.	.	.	.	2	1	.	.	.	.	.	5	4	+	3	3	2	1	1	2	.	3	1	.	5	
<b>Diff. species var. of Erica tetralix</b>																														
Erica tetralix	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	3	4	1	+	3
Molinia coerulea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	1	3	.	.	.	2	1
<b>Diff. species Empetrum nigrum race</b>																														
Empetrum nigrum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	5	5	5	5	4	5	.	.	.	.	.	.	.	.
<b>Diff. species Erica cinerea race</b>																														
Erica cinerea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<b>Companions</b>																														
Pohlia nutans	4	.	.	.	.	.	.	2	.	3	4	2	.	3	2	.	.	1	1	.	.	.	.	1	.	.	.	.	3	
Cladonia pyx. v. chlorophaea	+	+	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	+	1	+	+	+	.	.	.	.	.	.	.	
Dicranum scoparium	.	.	+	+	.	.	.	1	.	.	+	2	.	+	.	.	.	1	1	+	1	2	+	+	+	.	+	.	+	
Cladonia impeza	.	.	3	1	.	4	.	.	.	.	+	1	.	.	4	.	.	.	1	.	.	+	.	.	+	.	.	.	.	
Festuca tenuifolia	.	.	.	.	2	1	2	+	.	1	.	1	.	.	.	.	.	+	1	+	+	.	.	.	.	.	.	.	.	
Pinus sylvestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Deschampsia flexuosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Polytrichum comm. v. perigoniale	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Cladonia subulata	.	.	.	.	.	+	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Betula verrucosa	.	.	.	.	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Campylopus flexuosus	.	.	.	.	.	.	.	.	+	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Campylopus fragillis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Cephalozia cf. starkei	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	.	.	.	.	.	+	.	.	.	.	.	.	.	
Quercus robur	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Pleurozium schreberi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Rumex acetosella	1	.	.	1	.	1	1	.	.	+	1	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Polytrichum piliferum	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Isopaches bicrenatus	.	.	.	.	1	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Cladonia floerkeana	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Cladonia cocc. v. pleurota	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Agrostis canina v. montana	.	.	.	.	.	.	.	.	.	1	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Lophocolea heterophylla	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	1	.	.	+	.	.	.	.	.	.	1	
Frunus serotina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Ptilidium ciliare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Ceratodon purpureus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Frangula alnus	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Epilobium angustifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	
Dicranella heteromalla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Agrostis tenuis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Epilobium angustifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

**Other species:**

Polytrichum juniperinum (11); Luzula campestris (11); Cladonia glauca (4)+; Cephalozia bicuspidata (4)2; Cephalozia bicuspidata (6)+; Hypochaeris radicata (6)+; Agrostis stolonifera (7)+; Cladonia macilenta (13)1; Cladonia crispata (14)+; Salix repens (22)1; Juncus squarrosus (24)+; Leucobryum glaucum (25)2; Cladonia glauca (28)+; Lophozia ventricosa (32)1; Potentilla erecta (41)+; Hieracium lacvigatum (43)+; Polytrichum juniperinum (44)1; Teucrium scorodonia (52)+; Agrostis stolonifera (54)+; Juniperus communis (57)+; Cladonia glauca (60)+; Cladonia uncialis (60)+; Scirpus caespitosus (60)+; Carex panicea (60)2; Barbilophozia barbata (63)+; Lophocolea cuspidata (63)+; Barbilophozia barbata (64)+; Plagiothecium denticulatum (64)2; Cladonia squamosa (65)1; Sorbus aucuparia (67)1; Hieracium lachenalii (67)1; Cladonia crispata (68)1.







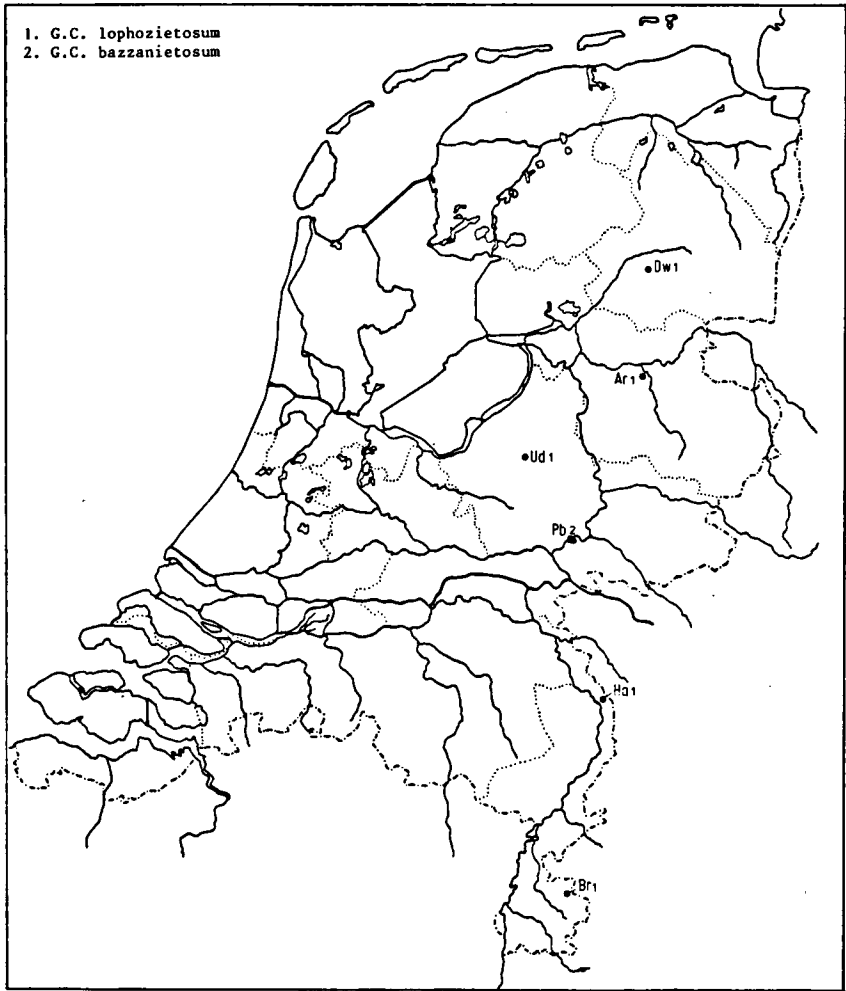


Fig. 8. Localities of *Genisto - Callunetum lophozietosum* and *G. - C. bazzanietosum*.

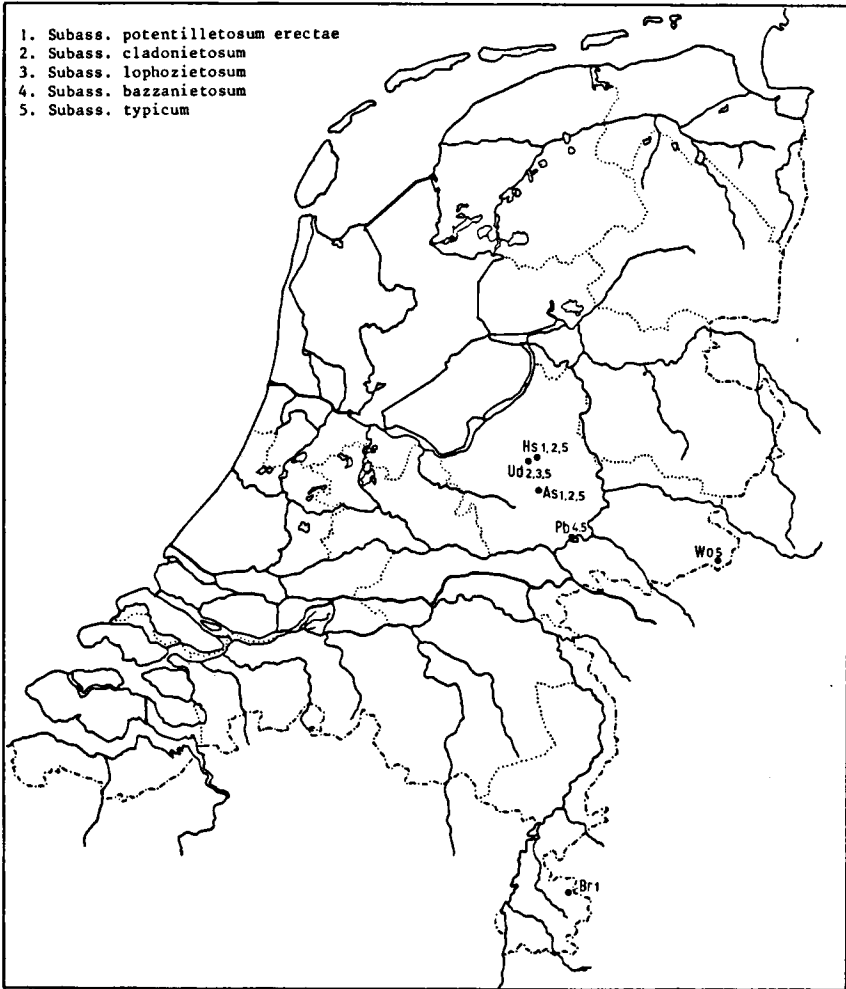


Fig. 9. Localities of *Vaccinio - Callunetum*.

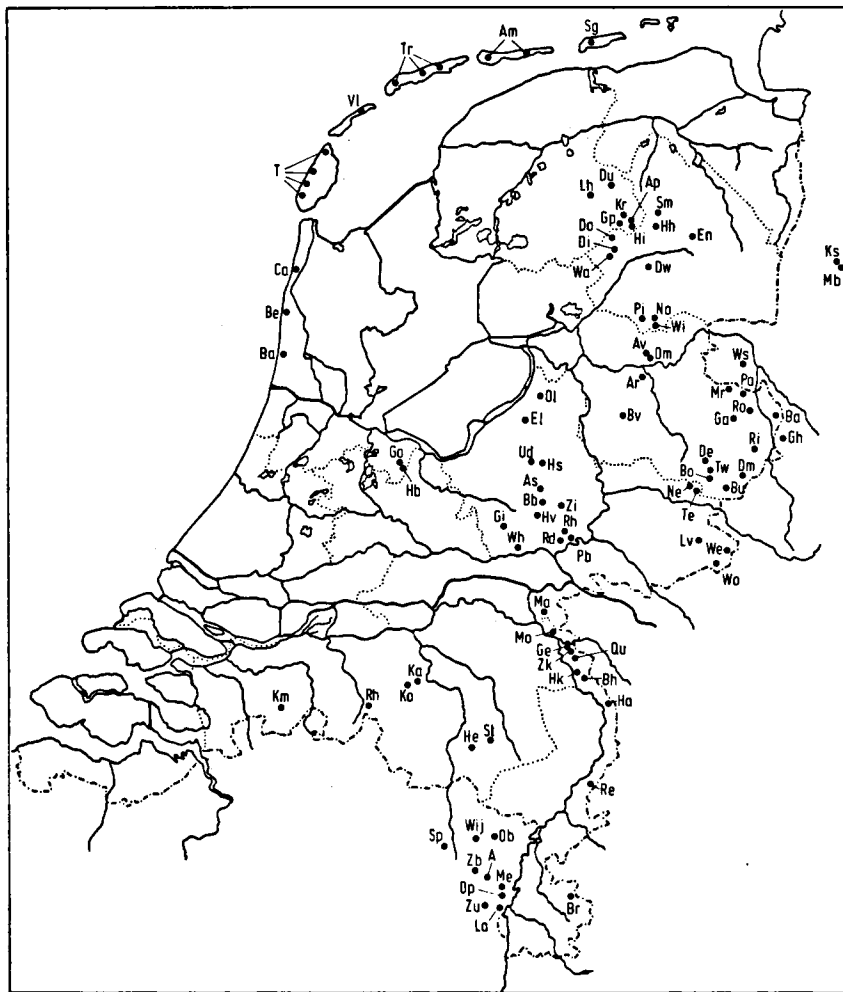


Fig. 10. Survey of localities.











Table 14 Carici - Empetretum

Subassociations Variants	2	3	1	a	b	c
Number of relevés	9	27	29	15	10	8
Average species number	12	16	15	16	18	19
Caric stenaria	V	V	IV	V	II	-
Empetrum nigrum	IV	IV	IV	V	II	II
Salix repens sep. arg.	IV	III	V	V	V	IV
Genista tinctoria	-	-	I	V	V	-
Erica tetralix	-	-	V	IV	V	V
Potentilla erecta	-	-	V	III	V	V
Carex trinervis	-	-	III	V	IV	-
Risectum umbellatum	-	-	-	-	-	-
Polypodium vulgare	-	-	-	-	-	-
Asperula arenaria	-	-	-	-	-	-
Coronilla aculeata	-	-	-	-	-	-
Corynephorus canescens	-	-	-	-	-	-
Hyadonia foliacea v. alicicornis	III	V	V	IV	III	IV
Prinum cupr. v. ericetorum	-	-	-	-	-	-
Stellaria vulgaris	III	IV	IV	III	IV	V
Plantago lanceolata	I	I	III	I	IV	-
Galium multiflorum	-	-	II	I	I	I
Genista anglica	-	-	I	II	III	-
Veronica officinalis	-	-	I	-	-	-
Pedicularis saxifraga	-	-	I	-	-	-
Compositae	-	-	-	-	-	-
Bidens scoparium	IV	V	III	III	II	-
Festuca tenuifolia	III	IV	III	III	IV	IV
Galium aparine	IV	III	III	IV	III	V
Cladonia implexa	IV	IV	II	-	-	-
Cladonia pyr. v. chlorophaea	IV	III	II	I	II	IV
Pseudoclethrodium purum	III	II	II	II	II	-
Lotus corniculatus	III	II	II	II	II	IV
Lophocolea bidentata	I	II	II	II	II	IV
Pleuronium schreberi	I	II	II	III	II	-
Paraselia phytodes	IV	II	II	II	II	-
Rosa spinosissima	-	-	-	-	-	-
Anthraxanthum odoratum	IV	II	II	II	II	II
Agrostis tenuis	II	II	+	III	III	II
Luzula campestris	II	II	+	III	III	II
Molinia coerulea	-	-	+	I	I	II
Viola canina	III	I	+	I	I	-
Holcus lanatus	I	I	I	III	IV	III
Hypochaeris radicata	-	-	+	-	-	-
Cerastodon purpureus	-	-	II	II	I	-
Agrostis stolonifera	-	-	II	I	-	II
Oxyccoccus macrocarpos	-	-	II	I	-	III
Carex nigra	-	-	I	-	II	III
Gymnoclelea inflata	I	I	+	-	-	-
Cladonia arbuscula	II	+	+	-	-	-
Polytrichum juniperinum	II	+	+	-	I	-
Cladonia glauca	I	I	+	-	-	-
Cladonia tenuis	I	I	+	-	-	-
Carex panicea	-	-	+	-	V	-
Hydrocotyle vulgaris	-	-	+	-	II	-
Galium verum	II	+	-	-	-	-

Subassociations  
Variants

Aulacomnium palustre  
 Betula pubescens  
 Cladonia gracilis  
 Juncus alpinus-art. esp. str.  
 Festuca rubra  
 Schoenus nigricans  
 Hylocomium splendens  
 Rhipophis rhamnoides  
 Rhytidadelphus triquetrus  
 Lonchocarpus periclymenum  
 Eurythuchium praelongum  
 Rubus caesius  
 Lotus uliginosus  
 Galium palustre  
 Lophocolea cuspidata  
 Poa pratensis  
 Epilobium montanum  
 Lophocolea cuspidata  
 Vicia sativa  
 Trifolium repens  
 Drepanocladus fluitans  
 Salix aurita  
 Cladonia furcata  
 Hypnum cupr. v. lacunosum  
 Juncus subuliflorus  
 Rhytidadelphus squarrosus  
 Cephalozia bicuspidata  
 Eriophorum angustifolium  
 Cirsium dissectum  
 Mnium hornum  
 Calypogeia trichomanis  
 Carex pulicaris  
 Bryum pseudotriquetrum  
 Cirsium palustre  
 Plantago lanceolata  
 Chiloecyphus polyanthus  
 Lophocolea heterophylla  
 Galium uliginosum

## Legend

1. ericetum
- a. Var. of Genista tinctoria
- b. Var. of Carex panicea
- c. Var. of Schoenus nigricans
2. typicum
3. polypodietosum

Differential species: *Vaccinium myrtillus*, *Vaccinium vitis-idaea*, *Leucobryum glaucum*.

BÜKER named his association *Calluneto-Vaccinietum* Bükér 1941. It has become common practice, however, to use the dominant species in the first place. For that reason, *Vaccinio-Callunetum* must be preferred. According to the rules of nomenclature (BARKMAN et al. 1976), 1942 should be mentioned as date of publication.

Next to the differential species, other species with an optimum within the Dutch heaths in the *Vaccinio-Callunetum* are *Deschampsia flexuosa*, *Galium hercynicum*, *Pleurozium schreberi* and *Melampyrum pratense*.

This association is without character species, and its status is questionable. According to the criteria of the BRAUN-BLANQUET school, the correct solution is to decide on a synsystematic rank below that of association. For the rank of subassociation, the problem arises that the character species of the *Genisto-Callunetum* are nearly absent, with presences of 0 to 4%. This would cause a chaotic situation; a great number of variants, subvariants and even sub-subvariants would have to be distinguished. The level of association, however, poses no problem at all, as the lower syntaxa are exactly parallel with those of the *Genisto-Callunetum*.

The exact parallel subdivision offers another solution. Among all lower syntaxa within the *Genisto-Callunetum*, a *Vaccinium* race could be distinguished. Two objections may be raised against this suggestion. The first one, mentioned above, is the absence of character species of *Genisto-Callunetum*. The second is the lack of a phytogeographic base for this *Vaccinium* heath. Neither the two *Vacciniums* nor *Leucobryum* reach the limit of their phytogeographic distribution in the Netherlands. As overlapping of distribution areas is essential for establishing a phytogeographic race, this solution is not satisfactory either.

The conclusion is that the *Vaccinium* heaths apparently can best be ranked on the level of association.

The absence of character species seems to be linked with the presence of *Vacciniums*. BÜKER (1942) described the *Vaccinio-Callunetum* from the so-called Hochheide in Sauerland, in the *Fagus*-belt at an altitude of 750–800 m. He mentioned the local character species: *Calluna vulgaris*, *Vaccinium vitis-idaea*, *Lycopodium clavatum*, *Cetraria islandica*, *Lycopodium alpinum*, *Empetrum nigrum*, *Genista pilosa*, *Sieglingia decumbens*. None of these species, however, answers the criteria of character species on the association level. Most of them are character species of higher ranks within the *Nardo-Callunetea*. This does not apply to *Lycopodium alpinum*, but this is a rare species. RUNGE (1969) did not mention *Lycopodium* for the *Vaccinio-Callunetum*. Next to the character species of the order-level *Calluna vulgaris*, the author only listed companions, viz. *Vaccinium myrtillus*, *Vaccinium vitis-idaea*, *Deschampsia flexuosa*, *Galium hercynicum*,

*Potentilla erecta*, *Sorbus aucuparia*, *Pleurozium schreberi*, *Cladonia arbuscula*, all in presense class V. This composition approaches that of the subassociation *sieglingietosum* of the Dutch *Vaccinium* heath, in which only *Sorbus* and *Cladonia arbuscula* are absent. Comparing our data with those of BÜKER and RUNGE learns that the *Vaccinium* heaths of Sauerland and Veluwe belong to the same association *Vaccinio-Callunetum*. The problem of the absence of character species remains unsolved.

In Sweden, the same problem is found. DAMMAN (1957) studied the South Swedish heath, which he named *Hylocomio-Vaccinietum*. His reason to distinguish a Swedish association from the German was the presence in Sweden of *Hylocomium splendens*, *Dicranum polysetum*, *Hypnum cupressiforme* var. *ericetorum*, *Scorzonera humilis* and *Arctostaphylos uva-ursi*, and the absence of *Genista anglica*. None of the Swedish species, however, can be maintained as character species on the association level. Noteworthy is the intermediate position of the Dutch *Vaccinium* heath. With the Swedish heath it has in common: *Dicranum*, *Hypnum* and (rare) *Scorzonera*.

The question arises whether the German, Swedish and Dutch *Vaccinium* heath possibly belong to one and the same association, but again without character species.

Some authors did not accept a separate *Vaccinio-Callunetum*. SCHWICKERATH (1944) considered the *Vaccinium* heath of the Eifel to fall within the association *Genisto-Callunetum-boreo-euatlanticum* Schwick. 1944. BUDDÉ & BROCKHAUS (1954) included the Hochheide again in the *Calluneto - Genistetum pilosae*. Some Belgian phytosociologists, on the other hand, supported BÜKER's conception for the Ardennes (DUVIGNEAUD, 1945; LEBRUN et al. 1949) and so did OBERDORFER (1967) for Germany. PREISING (1949) mentioned the absence of character species on the level of the alliance. He suggested that the *Vaccinion boreale* Böcher 1943 might not belong to the *Calluno - Ulicetalia* Tüxen 1937, as this alliance has only differential species. He pointed out that many species of the *Vaccinio - Piceetalia* are present, generally with high presences. According to SCHUBERT (1960), to the *Vaccinion vitis-idaea* Böcher 1943 em. Schubert 1960 actually belong the subatlantic to subcontinental European heaths. For this alliance he listed the following species: *Vaccinium vitis-idaea* V. *myrtilus*, *Calluna vulgaris*, *Melampyrum pratense*, *Deschampsia flexuosa* and *Luzula luzuloides*. With the exception of *Luzula*, the Dutch *Vaccinium* heath answers this composition. The list neither contains character species; all species except *Calluna* are woodland species. OBERDORFER (1967) did not recognize the *Vaccinion* but placed the *Vaccinio - Callunetum* in the alliance *Calluno - Genistion pilosae* (Tx. 1937) Preising 1953.

For the time being this might be the best solution that avoids the problem of the character species on higher syntaxonomic levels. A study of the European *Vaccinium* heaths might provide more information on this matter.

The soil profile varies from humic podzol to moder podzol, and contains a thick litter layer ( $A_0$  horizon). From 200 measurements on the Asselse Veld (BROEKHUIZEN & VELTHUIS 1965), the average thickness of the  $A_0$ -horizon for *Vaccinium vitis-idaea* is 2.9 cm, for *V. myrtillus* 2.7 cm and for *Calluna* 2.1 cm.

The diversity in degree of podzolization is another intermediate feature between the strongly podzolized soils in Sweden and the weakly podzolized soils of the Hochheide in Germany.

The *Vaccinium* heath is frequent in a small area on the East Veluwe. Outside this area it is scarce in the East and North of the country, where this type has been recorded from Archemerberg and the vicinity of Winterswijk. This heath is probably also present in scattered localities in Drenthe and Southeast Friesland.

STOUTJESDIJK in 1959 mentioned the *Vaccinium*-rich heath of the East Veluwe. He assumed a relation between the presence of the *Vacciniums* outside the woodland in the open heath and the high precipitation in this area. A maximum precipitation is found on the westside of the ridge near Apeldoorn; this must be caused by the rising prevailing western winds. The largest heaths of this type are Asselse veld (BROEKHUIZEN & VELTHUIS 1965), Hoogsoerense veld (VAN DER BURGH 1962; VAN BEEK 1967); Uddeler Buurtveld (VAN DER LAAN & RIJKEE 1967) and the heath near de Posbank (LIEFTINCK & UIJTERWAAL 1970). Smaller localities are Terletse veld, Schenkenshul, Leesten and Braamberg.

The subdivision of the association in subassociations and variants is nearly similar to the subdivision of the *Genisto - Callunetum*, and will be briefly mentioned.

### 5.1 Subassociation *potentilletosum erectae* subass. nov. (Table 13)

Differential species: *Carex pilulifera*, *Potentilla erecta*, *Festuca ovina* ssp. *tenuifolia*, *Galium hercynicum*

From the differential species, *Sieglingia decumbens* is replaced by *Festuca ovina* ssp. *tenuifolia*. This might be attributed to a strong leaching effect of the *Vaccinium*-humus rendering the soil too poor in nutrients for *Sieglingia*.

#### 5.1.1 Variant *typicum*

#### 5.1.2 Variant of *Erica tetralix*

#### 5.1.3 Variant of *Melampyrum*

Differential species: *Melampyrum pratense*, *Maianthemum bifolium*, *Pteridium aquilinum*.

Only on Hoogsoerense veld on moder podzol.

### 5.2 Subassociation *cladonietosum* subass. nov. (Table 13)

Differential species: *Cladonia uncialis*, *Cl. squamosa*, *Cl. arbuscula*. Compared with the corresponding subassociation of the *Genisto - Callu-*

netum, only three of the seven differential species continue to be present. *Cornicularia aculeata* is absent, *Cladonia gracilis* is rather infrequent; *Parmelia physodes* and *Ptilidium ciliare* cannot be used as they are frequent also in the subassociation lophozietosum.

#### 5.2.1 Variant typicum

#### 5.2.2 Variant of *Erica tetralix*

### 5.3 Subassociation typicum Bükér 1942

No differential species.

#### 5.3.1 Variant typicum

#### 5.3.2 Variant of *Erica tetralix*

### 5.4 Subassociation lophozietosum ventricosae subass. nov. (Table 13)

Differential species: *Lophozia ventricosa*, *Gymnocolea inflata*, *Barbilophozia barbata*, *Scapania nemorosa*, *Diplophyllum albicans*.

Compared with the subassociation lophozietosum of the Genisto - Callunetum, *Diplophyllum albicans* is added to the differential species and *Leucobryum glaucum* is missing. *Diplophyllum* is present in the other subassociation, but not frequent enough. *Leucobryum* is absent from this list, as it is a differential species of the whole association. In all relevés, *Empetrum* is present.

### 5.5 Subassociation bazzanietosum subass. nov. (Table 13)

Differential species: *Bazzania trilobata*, *Orthocaulis attenuatus*, *Dicranum polysetum*.

The three differentiating species are the same as in the corresponding subassociation of the Genisto - Callunetum. The two subassociations are closely related. As *Vaccinium vitis-idaea* is absent, the only clear diagnostic differences with the Genisto - Callunetum bazzanietosum is the constant presence, often predominantly, of *Vaccinium myrtillus*.

Finally, some remarks will be made on *Bazzania*. BÖCHER (1943) mentioned it as a characteristic species of the Mytillion boreale, which is rich in hygropytic mosses. Other species of this boreal-atlantic community are *Vaccinium myrtillus*, *V. vitis-idaea*, *Deschampsia flexuosa*, *Empetrum nigrum*, *Pleurozium schreberi*, *Melampyrum pratense* and *Maianthemum bifolium*. This heath is evidently related to the Vaccinio - Callunetum. HAMMAR PEDERSEN (1938) also reported *Bazzania* in *Vaccinium* heath in north exposures on Bornholm. KIELLAND-LUND (1967) described the woodland association Bazzanio - Pinetum from the hyperoceanic southwest coast

of Norway. Characteristic for this community are the hepatics *Bazzania trilobata* and *Orthocaulis attenuatus*. Other frequent species are *Dicranum polysetum*, the two *Vacciniums*, *Pleurozium schreberi*, *Ptilidium ciliare*, *Deschampsia flexuosa*.

Additional information will be required for an ecological and phytogeographic explanation of the isolated location of the *Vaccinium* heath with *Bazzania* in the Netherlands.

#### ***Empetrum nigrum* race**

Nearly all syntaxa of the heath have representatives in the northern Netherlands containing *Empetrum nigrum*. The same was noticed in North Germany. TÜXEN & KAWAMURA (1975) interpreted these as the *Empetrum* race of the respective syntaxa, in accordance with MATUSZKIEWICZ, who proposed to establish a race if a new phytogeographic element is added to an association, provided that this element is found in all subtypes. This is exactly what happened to *Empetrum*. The southern boundary of this boreal-atlantic species is in the central part of the Netherlands. North of this boundary, an *Empetrum* race is known from nearly all subassociations and variants of the *Ericetum tetralicis*, *Genisto - Callunetum* and *Vaccinio - Callunetum*.

#### ***Erica cinerea* race**

In the South the same situation is found for *Erica cinerea*. A race of this South Atlantic species has been found of the *Genisto - Gallunetum sieglingietosum* and of the *G.-C. typicum*. For the *G.-C. cladonietosum uncialis*, only one relevé with *Erica cinerea* is available and none of the *G.-C. cladonietosum bacillaris*.

*Erica cinerea*, as a result of the influence of the Gulfstream, is found as far north as the Norwegian southwest coast. The northern boundary of its main distribution area, however, is located in Flanders (STIEPERAERE 1968).

Isolated locations outside this area are known from the isle of Terschelling (VAN LEEUWEN & WESTHOFF 1961) and from the Belgian East Kempen and Dutch Central Limburg (DE SMIDT 1966; WILLEMS 1967).

#### **Heath with *Sarothamnus scoparius***

In several places on the river Maas in Dutch and Belgian Limburg, a tall heath is found with mixed stands of *Calluna vulgaris* and *Sarothamnus scoparius*. Isolated locations are recorded as far north as Velp (Posbank) and Huizer heide in Het Gooi. The synsystematic place of this heath cannot yet be explained. The soil is a characteristic AC-profile, containing much silt or löss, and with very little humus in the toplayer.

Apart from *Sarothamnus* and *Calluna*, frequent and sometimes predominant species are *Deschampsia flexuosa*, *Agrostis canina* ssp. *montana*, *Molinia*

*coerulea*, *Poblia nutans*, *Polytrichum piliferum*, *Isopachys bicrenatus*. A number of woodland species is regularly present: *Rubus plicatus* *Quercus robur*, *Pinus sylvestris*, *Betula verrucosa*, *Epilobium angustifolium*, *Vaccinium myrtillus*, *Teucrium scorodonia*, *Hieracium laevigatum*.

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#### List of localities (and municipalities)

B: Belgium    D: Germany

A	As (B)	De	Delden (Stad Delden)
Am	Ameland (Ameland)	Di	Diever (Diever)
Ap	Appelscha (Ooststellingwerf)	Dm	Derkingsmaten (Enschede)
Ar	Archemerberg (Ommen)	Do	Doldersum (Vledder)
As	Assel (Apeldoorn)	Du	Duurswoude (Opsterland)
Av	Arrierveld (Ommen)	Dw	Dwingelose heide (Ruinen)
Ba	Beuninger achterveld (Denekamp)	El	Elspeet (Ermelo)
Ba	Bakkum, in table 1 (Castricum)	En	Elpernoorderveld (Westerbork)
Bb	Braamberg (Apeldoorn)	Ga	Gammelkerveld (Weerselo)
Be	Bergen (Bergen N.H.)	Ge	Gennep (Gennep)
Bh	Bergerheide (Bergen L.)	Gh	Gildehauser venn (D.)
Bo	Boddenbroek (Delden)	Gi	Ginkel (Ede)
Bu	Buurserzand (Haaksbergen)	Go	Gooi (Hilversum)
Br	Brunssum (Brunssum)	Gp	Ganzenpoel (Ooststellingwerf)
Bv	Boetelerveld (Raalte)	Ha	de Hamert (Bergen L.)
Ca	Callantsoog (Callantsoog)		

Hb	Heidebloem (Hilversum)	Qu	't Quin (Bergen L.)
He	Heeze (Heeze)	Rd	Rozendaalse veld (Rheden)
Hh	Hooghalen (Beilen)	Re	Reuver (Beesel)
Hk	Heukelom (Bergen L.)	Rh	Rechteheide (Tilburg)
Hi	Hildenberg (Ooststellingwerf)	Ri	Rietbeek (Enschede)
Hs	Hoogsoeren (Apeldoorn)	Rn	Rheden (Rheden)
HV	Hoge Veluwe (Ede)	Ro	Rossum (Weerselo)
Ka	Kampina (Boxtel)	Sg	Schiermonnikoog (Schiermonnikoog)
Km	Ketelmeren (Zundert)	Sm	Smilde (Smilde)
Ko	Kleine Oosterwijkse heide (Oosterwijk)	So	Soerenseveld (Apeldoorn)
Kr	Kraaiheidepollen (Ooststellingwerf)	Sp	Spiekelspade (B. Heilchteren)
Ks	Klein Stabern (D. Meppen)	St	Strabrecht (Geldrop/Heeze)
La	Lanaken (B)	Te	Teeselink (Neede)
Lh	Lippenhuisterheide (Opsterland)	Tr	Terschelling (Terschelling)
Lv	Lievelderveld (Lichtenvoorde)	Tw	Twickel (Stad Delden)
Ma	Malden (Heumen)	Tx	Texel (Texel)
Mb	Mansenberge (D. Bentheim)	Ud	Uddel (Apeldoorn)
Me	Mechelen (B)	Vl	Vlieland (Vlieland)
Mo	Mook (Mook en Middelaar)	Wa	Wapserveld (Diever)
Mr	Mander (Tubbergen)	We	Weust (Winterswijk)
Ne	Neede (Neede)	Wh	Wolfheze (Ede)
No	Nolderveld (Zuidwolde)	Wi	Wildenberg (Zuidwolde)
Ob	Opglabbeek (B)	Wo	't Woold (Winterswijk)
Ol	Oldebroek (Oldebroek)	Ws	Wilsum (D. Bentheim)
Om	Ommen (Ommen)	Wij	Wijshagen (B)
Op	Opgrimbie (B)	Zb	Zwartberg (B)
Pa	Paardenslenkte (Tubbergen)	Zi	Zilvenseheide (Apeldoorn)
Pb	Posbank (Rheden)	Zk	Zwartekamp (Bergen L.)
Pi	Piepery (Zuidwolde)	Zu	Zutendaal (B)

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