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Notes on Some Plant Communities of Bléfjell, S. Norway

Poznámky o rostlinných společenstvech pohoří Bléfjell v jižním Norsku

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Abstract — Hadač E. (1971): Notes on some plant communities of Bléfjell, S. Norway. — Preslia, Praha, 43 : 202—217. — The author gives association tables and some ecological data (pH, loss on ignition in soils etc.) of several communities of alpine vegetation in the Bléfjell mountains (S. Norway), which hitherto were not studied from the phytocoenological point of view. The comparison of his results from Bléfjell with the vegetation of Rondane (Dahl 1957) raises some syntaxonomic problems of more general interest.

Introduction

In summer 1940 I had the opportunity to spend about a month in the mountain group Bléfjell, SW. from Oslo and N. of Kongsberg. To get some idea about the plant communities of this district, I made a number of relevés, collected soil samples and measured their reaction and humus content. In the subsequent years I was not able to continue in my studies in Bléfjell and I thought that my notes were too fragmentary to be published. When my friend Eilif Dahl published his excellent monograph on Rondane vegetation (Dahl 1957) and when, thanks to his invitation, I was able to see the vegetation of Rondane myself, I changed my mind. I think that it would be of some interest to compare my fragmentary notes with monographs from other parts of Norway, e.g. with Nordhagens Sikilsdalen (Nordhagen 1943) and especially with Dahls Rondane. The geology of Rondane and Bléfjell is not very different, there is no significant difference in their geomorphology and history of the flora, so that the only greater factor responsible for the differences in vegetation is probably the climate.

I am indebted to prof. Dr. Eilif Dahl for identifying my lichens and for many suggestions during my work.

Geography and climate

The mountain group Bléfjell is composed mainly by grey-white quartzite and quartz. In some places mica-schists appear. The substrate is extremely poor.

The geomorphology of this region was influenced by two factors: the whole region was covered by the ice during the Ice Age; its surface got rounded forms typical for glaciated areas. Later dislocations, going from SE. to NW. slightly changed the morphology of the area in some places. — There are many lakes and streamlets in the whole area.

There is no meteorological station in the investigated area, but we can use data from Knutehytta, which is not very far from Bléfjell (cf. Nedbörn i Norge 1895—1943, Oslo, 1949, and Bruun I.: Standard Normals of the air temperature in Norway, Oslo, 1967).

Knutehytta (717 m), mean monthly precipitation (in mm) and temperature:

Jan.	Febr.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	year
51	38	54	53	63	70	113	143	108	103	95	75	1966
−5.2	−5.6	−2.6	0.7	5.8	10.8	13.2	11.7	8.0	2.4	−1.8	−3.2	2.9

Thus the precipitation in Bléfjell is about twice as high as in Rondane, where the years precipitation of 458 mm is indicated, and the temperature amplitude is lower in Bléfjell. — The influence of cattel grazing in Bléfjell is considerable, especially in the neighbourhood of outfarms.

Methods

Field methods used here are about the same as described in DAHL et HADAČ 1941, DAHL 1957. Homogeneous stands of vegetation were chosen, their ecology and the cover for all species present in the stand were noted, soil samples from each stand were collected and dried in the shade for further research. After returning to Oslo, i.e. after less than a fortnight from collecting the soil samples, the pH was measured with a glass electrode (cf. DAHL et HADAČ 1941), and the loss on ignition weight. For the assessment of abundance and dominance of plants Domin's scale (slightly modified) was used (cf. DAHL et HADAČ l.c., DAHL 1957), where:

\+ means odd individuals with reduced vitality,
1 rare, one or few individuals,
2 sparse,
3 frequent, cover below 5%,
4 cover about 5—15%,
5 cover 15—25%,
6 cover 25—33%,
7 cover 33—50%,
8 cover 50—75%,
9 cover 75—90%,
10 cover 90—100%.

Plant communities were arranged according to their floristic similarity, calculated by use of Jaccard's index:

$$K_J = \frac{100c}{a + b - c}, \text{ where:}$$

a is the total sum of average ratings on the Domin scale in the first community,
b the same in the second community,
c is the sum of average ratings shared by both.

e.g.	A ♂ in the ass. P	A ♂ in the ass. Q	ratings shared by both:
species x	4	2	2
species y	3	6	3
	a = 7	b = 8	c = 5

Kj(P/Q) = 500 : 15 − 5 = 50

The vegetation

My time in the mountains being limited, I choosed only some vegetation types for my studies. I did not study the peat bog vegetation and I have but a few notes on the vegetation of lakes and springs.

Litorellion uniflorae W. KOCH 1926

In the lake Holmevatn an interesting zonation could be seen: at a depth of 1.5 m a community of *Isoetes* and *Sparganium angustifolium* MICHX. occurred: *Sparganium angustifolium* MICHX. 4; *Isoetes* sp. (too young for identification) 4; *Utricularia vulgaris* L. 2.

In shallow water, about 80 cm deep, a *Lobelia dortmanna* community was developed: *Lobelia dortmanna* L. 6; *Isoetes* sp. 6; *Utricularia vulgaris* L. 3.

Montio-Epilobion hornemannii NORDH. 1936

Springs are represented in Bléfjell mainly by the association:

Philonoto-Saxifragetum stellaris NORDH. 1943

Localities:

1. Between Langevann and Gunnarsbunuten, 1.5 m², 1. 8. 1940.
2. N. side of Langevann, 4 m², 1. 8. 1940.

Relevé:	1	2
Altitude m:	1020	1139
Slope:	—	15°
Aspect:	—	S
Cover (herb layer) %:	50	30
(moss layer) %:	80	90
pH (humus layer)		4.7
Loss on ignition %:		41.8
Epilobium hornemannii RCHB.	7	5
Carex bigelowii TORR.	1	1
Rumex alpestris JACQ.	3	3
Saxifraga stellaris L.	.	4
Viola palustris L.	.	1
Philonotis fontana BRID.	8	9

In one relevé: No. 1.: *Eriophorum vaginatum* L. 3. *Solidago virgaurea* L. 1, *Scapania paludosa* K. M. 4, *Mnium pseudopunctatum* BR. et SCH. 4. — No. 2.: *Eriophorum angustifolium* HONCK 2, *Anthoxanthum odoratum* L. 1, *Phleum commutatum* GAUD. 1, *Scapania uliginosa* (SW.) DUM. 3, *Sphagnum teres* ANGSTR. var. *squarrosulum* WARNST. 4, *Sphagnum riparium* ANGSTR. 1.

Polygonion avicularis BR.-BL. 1931

Nitrophilous ruderal vegetation is best developed in the neighbourhood of the outfarms. A typical community of such places is:

Stellarietum mediae HADAČ 1969

Localities:

1. Gunnarsbusaeter, 5 m², on a cow dung accumulation, 29. 7. 1940.
2. Flesebekk, 12 m², on a cow dung accumulation, 7. 8. 1940.
3. Flesebekk, 6 m², on a sheep dung accumulation, 7. 8. 1940.

Relevé:	1	2	3
Altitude m:	820	804	804
Slope:	35°	40°	40°
Aspect:	NE	N	N
Cover (herb layer) %:	80	80	70
pH:	5.6	5.8	4.6
loss on ignition %:	90.1	89.4	93.0
Stellaria media (L.) VILL.	8	8	8
Poa annua L.	6	4	4
Poa trivialis L.	3	3	2
Ranunculus repens L.	.	2	2
Melandrium rubrum GARCKE	.	+	1
Urtica dioica L.	3	.	.
Rumex acetosella L.	.	1	.
Rumex domesticus HARTM.	.	1	.
Polygonum aviculare L.	.	1	.

Juncion trifidi scandinavicum (KRAJINA 1933) NORDHAGEN 1936

The alpine vegetation of Bléfjell can be grouped in five main groups according to their floristic similarity. To the first group belong *Cetrario islandicae-Loiseleurietum*, *Juncetum trifidi scandinavicum* and *Cetrario islandicae-Caricetum bigelowii*, to the second *Vaccinio-Empetretum hermaphroditi scandinavicum*, *Empetro-Betuletum nanae*, *Empetro-Callunetum* and *Phyllodoco-Vaccinietum myrtilli*, to the third group belongs *Anthoxantho-Deschampsietum flexuosae* and the fourth group is formed by *Nardetum chionophilum* and *Alchemillo alpinae-Nardetum*. Apart stands *Athyrietum alpestris chionophilum*.

I was not able to study their winter ecology, but it is probable that the wind-exposed first group has a relatively short or nearly no snow cover in winter, the second group a moderate snow cover, the third and fourth a relatively long snow cover; the last community has apparently a very long snow cover.

The first group of associations belongs to the alliance *Juncion trifidi scandinavicum* (ordre *Caricetalia curvulae*). This alliance was first recognized by KRAJINA 1933 in the Tatra as *Juncion trifidi*; later on, independently, R. NORDHAGEN described *Juncion trifidi* (*scandinavicum*), differing from the Carpathian alliance by various Scandinavian endemics.

Its communities are oligotrophic, acidiphilous, chionophobous or only slightly chionophilous, windexposed, poor in species. Characteristic or differential species of the alliance in the investigated area are *Juncus trifidus*, *Cladonia mitis*, *C. bellidiflora* and *Cetraria nivalis*.

Cetrario islandicae-Loiseleurietum HADAČ ass. n. provis.

This is a strongly windexposed community on gravelly, winderoded soil, covered by a thin raw humus layer, more acid than in *Juncetum trifidi*.

Its floristic similarity to *Juncetum trifidi scandinavicum* and to *Cetrario islandicae-Caricetum bigelowii*, as well as the occurrence of *Juncus trifidus*, *Cladonia mitis*, *C. coccifera*, *C. bellidiflora*, *Ochrolechia tartarea*, *O. frigida*, *Cetraria nivalis* etc. show that it belongs to the alliance *Juncion trifidi scandinavicum*, but it also contains some species from the *Vaccinio-Empetretum hermaphroditi*, like *Empetrum hermaphroditum* or *Vaccinium uliginosum*.

It is characterized by the dominance of *Loiseleuria procumbens* and by the occurrence of *Cladonia amaurocraea* and *C. squamosa*. It stands near to *Loiseleurio-Diapensietum* NORDHAGEN 1943, but there is no *Diapensia* in the Bléfjell community, nor *Alectoria ochroleuca*, *A. divergens* or *Stereocaulon paschale*, and on the other hand, in *Loiseleurio-Diapensietum* in Rondane *Carex bigelowii*, *Vaccinium vitis-idaea*, *Deschampsia flexuosa*, *Ptilidium ciliare*, *Cladonia rangiferina*, *C. bellidiflora* etc., do not occur so I do not think that the two communities are identical.

The average number of species in one relevé is 16, in 4 relevés 24 species were observed.

Localities:

1. Gunnarsbununten, northern slope, 3 m², 27. 7. 1940.
2. Gunnarsbununten, on the top, 5 m², 25. 7. 1940.
2. Gunnarsbununten, near the top, 3 m², 4. 8. 1940.
4. Numedals Blé, 4 m², 7. 8. 1940.

Cetrario islandicae-Loiseleurietum HADAČ

Relevé:	1	2	3	4	ø
Altitude m:	1140	1120	1130	1130	
Slope:	.	20—25°	20°	5°	
Aspect:	.	N	SE	N	
Cover (herb layer) %:	80	70	60	60	
(moss layer) %:	30	30	30	30	
Soil depth cm:	10—30	5—20	5—35	30	
pH (surface layer of the soil):	3.2	3.5	3.8	3.9	
Humus contents %:	82	72	12	73	
Subsoil: pH		4.0			
Loss on ignition %:		2.8			
Loiseleuria procumbens DESV.	8	8	8	8	7.6
Juncus trifidus L.	3	3	3	3	3.0
Carex bigelowii TORR.	4	2	3	1	2.5
Empetrum hermaphroditum HAGER.	5	+	2	4	2.9
Vaccinium vitis-idaea L.	3	2	.	1	1.5
Vaccinium uliginosum L.	3	+	+	.	1.0
Calluna vulgaris (L.) HILL	1	.	2	.	0.7
Deschampsia flexuosa (L.) TRIN.	2	2	.	.	1.0
Ptilidium ciliare (L.) HAMPE	4	3	.	+	1.9
Dicranum fuscescens TURN.	.	4	.	+	1.1
Cetraria islandica (L.) ACH.	6	4	5	5	5.0
Cladonia rangiferina (L.) WEB.	3	3	3	2	2.7
Cladonia mitis SANDST.	4	4	4	4	4.0
Cladonia bellidiflora (ACH.) SCH.	3	1	1	3	2.0
Cladonia elongata (JACQ.) HOFFM.	2	2	1	1	1.5
Cetraria nivalis (L.) ACH.	.	2	4	3	2.2
Cladonia uncialis (L.) WEB.	.	.	1	2	0.7
Cladonia coccifera (L.) ZOPF	.	.	1	+	0.4
Ochrolechia frigida (SW.) LYNGE	.	+	.	1	0.4

In one relevé: No. 2.: *Polytrichum juniperinum* HEDW. 2, *Cladonia amaurocrea* (FLK.) SCHAER. 1. — No. 3.: *Cladonia squamosa* (SCOP.) HOFFM. 1, *Cetraria crispa* (ACH.) NYL. 1. — No. 4. *Arctous alpina* (L.) NIEDENZU 3.

Juncetum trifidi scandinavicum NORDHAGEN 1943

A slightly wind-exposed community on sandy, gravelly soil, covered by a thin humus layer. The raw humus layer, about 2 cm thick, has pH 3.4 — 3.7—4.3, the subsoil pH 4.5—4.6.

The characteristic species of this association in Bléfjell is *Hieracium alpinum*. The average number of species in one relevé is 19, the total number in 5 relevés is 32.

Juncetum trifidi s. l. has a wide distribution not only in Scandinavia, but also in the Alps and Carpathians. Its floristic composition is relatively constant. So e.g. *Juncetum trifidi scandinavicum* and *tatricum* have the following species in common: *Juncus trifidus, Hieracium alpinum, Vaccinium vitis-idaea, V. myrtillus, Anthoxanthum odoratum, Solidago virgaurea, Deschampsia flexuosa, Ptilidium ciliare, Cetraria islandica, Cladonia rangiferina, C. sylvatica, C. uncialis, C. elongata, C. pyxidata* etc.

Juncetum trifidi scandinavicum from Bléfjell has much in common with *Chiono-Juncetum trifidi* DAHL 1957 (alliance *Deschampsio-Anthoxanthion*). This is a strange thing, because *Juncetum trifidi* from Bléfjell does not occur on places which are likely to be covered by much snow in winter. There are on the other hand several species occurring in *Chiono-Juncetum trifidi* and not in *Juncetum trifidi scandinavicum* in Bléfjell, e.g. *Empetrum hermaphroditum, Phyllodoce coerulea, Salix herbacea, Carex lachenalii, Gnaphalium supinum, Sibbaldia procumbens, Lophozia*

alpestris, Webera nutans, Stereocaulon paschale, Crocynia neglecta, Lecidea granulosa etc. Those two communities have some features in common, but they are certainly not identical. There is also some similarity between our *Juncetum trifidi scandinavicum* and *Cetrarietum nivalis trifidetosum* DAHL 1957 (alliance *Arctostaphyllo-Cetrarion nivalis*), but the Bléfjell community has no *Cetraria nivalis, Cladonia alpestris, C. amaurocraea, C. deformis* etc., and in the Rondane community does not grow *Deschampsia flexuosa, Trientalis europaea, Dicranum scoparium, D. fuscescens, Cladonia uncialis* etc.

Localities:

1. Svartekulpen, 5 m², 26. 7. 1940.
2. Svartekulpen, 3 m², 1. 8. 1940.
3. Graafjell, 10 m², 2. 8. 1940.
4. N. slope of Svartekulpen, 5 m², 2. 8. 1940.
5. Storevassnuten, W. slope, 4 m², 5. 8. 1940.
6. Numedals Blé, 2 m², 7. 8. 1940.
7. Numedals Blé, 2 m², 7. 8. 1940.

Juncetum trifidi scandinavicum NORDH.

Relevé:	1	2	3	4	5	6	7	K	A
Altitude, m:	1100	1250	1280	1220	1230	1150	1150		
Slope:	30°	18°	10°	12°	42°	15°	20°		
Aspect:	NNW	W	SW	W	W	E	SW		
Cover (herb layer) %:	50	70	60	60	90	60	60		
(moss layer) %:	50	40	40	60	10	60	55		
Soil depth cm:	5—10	15	15	5—15	25	5	5—15		
Humus layer pH:	3.7	4.1	3.4	3.9	4.3	3.6	4.1		
Loss on ignition %:	62.9	55.7	86.6	81.9	10.1	88.5	54.6		
Subsoil pH:	4.6			81.9					
Loss on ignition %:	2.2			1.6					
Juncus trifidus L.	6	7	7	7	9	7	7	V	7.1
Carex bigelowii TORR.	4	2	3	4	3	4	3	V	3.3
Deschampsia flexuosa TRIN.	5	1	2	4	4	4	4	V	3.4
Trientalis europaea L.	.	2	2	2	4	3	4	V	2.4
Vaccinium myrtillus L.	.	1	.	.	1	1	+	III	0.5
Hieracium alpinum L.	2	1	.	.	1	1	.	III	0.7
Vacc. vitis-idaea L.	.	3	3	.	.	2	3	III	1.1
Solidago virgaurea L.	.	.		1	.	1	1	III	0.4
Carex brunnescens POIR.	1	.	3	.	3	2	.	III	1.3
Loiseleuria procumbens (L.) DESV.	.	2	.	.	.	.	+	II	0.3
Diphasium alpinum ROTHM.	.	6	4	.	.	.	.	II	1.4
Anthoxanthum odoratum L.	.	1	2	.	.	.	.	II	0.4
Dicranum scoparium HEDW.	2	2	+	5	1	2	4	V	2.3
Dicranum fuscescens TURN.	6	2	.	3	3	1	.	IV	2.1
Ptilidium ciliare HAMPE	.	.	.	.	.	1	1	II	0.3
Lophozia floerkei W. et M.	.	4	2	.	.	.	.	III	1.5
Cetraria islandica ACH.	5	4	6	7	2	5	6	V	5.0
Cladonia bellidiflora (ACH.) SCHAER.	.	3	2	4	1	2	3	V	2.1
Cladonia mitis SANDST.	2	3	.	2	.	3	5	IV	2.1
Cladonia elongata HOFFM.	.	2	5	.	2	4	2	IV	2.1
Cladonia uncialis WEB.	.	1	.	.	1	1	2	III	0.7
Cladonia pleurota FLK.	3	1	1	3	.	1	.	III	1.3
Cladonia crispata FLOR.	1	.	.	1	1	1	.	III	0.6
Cladonia ecmocyna NYL.	.	1	.	3	1	.	.	III	0.7
Cladonia rangiferina WEB.	.	2	2	.	.	6	4	III	2.0
Cladonia pyxidata(L.) FR.	.	4	3	.	1	.	.	III	1.1
Ochrolechia frigida (SW.) LYNGE	1	1	.	.	.	+	.	III	0.4
Ochrolechia tartarea (L.) MASS.	.	1	+	1	.	.	.	III	0.4
Cetraria crispa NYL.	.	1	.	.	.	1	.	II	0.3
Cladonia sylvatica (L.) RABH.	.	.	1	.	2	.	.	II	0.4

In one relevé: No. 1.: *Huperzia selago* (L.) BERNH. 2, *Polytrichum commune* HEDW. 1, *Cetraria delisei* (BORY) TH. FR. 1, *Cladonia squamosa* (SCOP.) HOFFM. 1. — No. 2.: *Biatora* sp. +. — No. 5.: *Lophozia* sp. 1. — No. 6.: *Lecanora* sp. +.

Cetrario islandicae-Caricetum bigelowii HADAČ ass. n. provis.

This is a slightly wind-exposed, strongly acidophilous community on shallow mineral soil facing N. or W. Lichens cover about as much ground as higher plants, sometimes even more. The occurrence of species like *Juncus trifidus*, *Cetraria nivalis*, *Cladonia uncialis*, *C. bellidiflora* etc. shows that this community belongs to *Juncion trifidi scandinavicum*. It stands near both to *Cladonietum alpestris caricetosum bigelowii* DAHL '1957 (alliance *Arctostaphyllo-Cetrarion nivalis*), and to *Polytricho-Caricetum bigelowii* (all. *Nardo-Caricion bigelowii*). This is not strange, as *Cladonietum alpestris* and *Polytricho-Caricetum bigelowii* of Rondane are very similar in their floristic composition. The question is whether the placing of the later association in the alliance *Nardo-Caricion bigelowii* is well founded.

Cetrario islandicae-Caricetum bigelowii is closely related to *Juncetum trifidi scandinavicum* as well as to *Cetrario islandicae-Loiseleurietum*, but very little to *Vaccinio-Empetretum hermaphroditi*.

The average number of species in one relevé is 17.

Localities:

1. Storevassnuten, on the top, 3 m², 5. 8. 1940.
2. Numedals Blé, 3 m², 7. 8. 1940.

Cetrario islandicae-Caricetum bigelowii HADAČ

Relevé	1	2
Altitude m:	1242	1160
Slope:	15°	5°
Aspect:	W	N
Cover (herb layer) %:	50	50
(moss layer) %:	60	60
Sooil depth cm:	5—20	5—20
pH:	3.8	3.7
Loss on ignition %:	17.3	22.2
Carex bigelowii TORR.	7	6
Juncus trifidus L.	2	2
Trientalis europaea L.	2	3
Salix herbacea L.	1	.
Vaccinium vitis-idaea L.	.	5
Deschampsia flexuosa (L.) TRIN.	.	3
Carex brunnescens (PERS.) POIR	.	2
Polytrichum juniperinum HEDW.	3	2
Dicranum scoparium HEDW.	+	.
Dicranum fuscescens TURN.	.	4
Lophozia hatcheri EVANS	.	2
Cetraria islandica (L.) ACH.	6	6
Cladonia rangiferina (L.) WEB.	6	4
Cladonia mitis SANDST.	5	6
Cladonia elongata (JACQ.) HOFFM.	3	3
Cladonia uncialis (L.) WEB.	2	2
Cladonia alpestris (L.) RABH.	4	.
Cladonia coccifera (L.) ZOPF	+	.
Cladonia bellidiflora (ACH.) SCHAER.	.	2

Vaccinio-Empetrum hermaphroditi scandinavicum HADAČ

Relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	K	A∅
Altitude m:	1005	925	1150	1085	1140	1175	1170	1000	1110	1148	1085	1100	1120	1135		
Slope:	30°	15°	15°	22°	22°	32°	20°	17°	15°	—	10°	7°	—	10°		
Aspect:	NE	NE	E	E	N	E	N	E	NE	—	NE	ENE	—	E		
Cover (herb layer) %:	85	80	70	80	70	90	80	80	85	80	80	75	80	80		
(moss layer) %:	50	60	60	45	50	30	55	50	30	40	55	50	60	50		
Soil depth cm:	14–35	5–25	16	25	10	17	3–20	25	25	15	35	10–20	13	5–20		
Humus layer pH:	3.3	3.4	3.2	3.2	3.2	3.4	3.3	3.4	3.2	3.2	3.7	3.2	3.0	3.2		
Loss on ignition %:	94.0	95.6	96.0	95.5	90.3	84.0	94.3	91.4	95.8	96.2	85.4	84.5	95.0	95.3		
Subsoil pH:							4.3									
Loss on ignition %:							2.0									
Empetrum hermaphroditum HAGER.	7	6	6	6	7	6	6	5	6	6	6	6	7	6	V	6.1
Vaccinium myrtillus L.	6	2	6	6	6	6	6	5	6	6	6	6:	6	6	V	5.6
Deschampsia flexuosa (L.) TRIN.	3	1	4	3	3	3	3	3	3	3	3	3	4	3	V	3.0
Vaccinium vitis-idaea L.	3	3	4	3	.	4	4	4	.	1	5	5	.	4	IV	2.8
Vaccinium uliginosum L.	2	7	4	4	.	5	4	6	4	.	.	4	5	4	IV	3.5
Loiseleuria procumbens (L.) DESV.	+	2	3	5	.	.	.	.	3	4	3	4	5	4	IV	2.6
Carex bigelowii TORR.	3	3	1	.	.	1	.	3	2	2	3	2	.	3	IV	1.6
Betula nana L.	5	4	.	+	.	.	.	1	4	.	5	.	.	.	III	1.3
Rubus chamaemorus L.	2	1	.	.	.	.	.	.	3	2	+	.	.	1	III	0.6
Cornus suecica L.	3	.	.	.	.	3	.	4	.	.	+	.	.	.	II	0.7
Calluna vulgaris (L.) HILL.	.	.	2	.	.	.	.	2	3	.	4	.	.	.	II	0.7
Andromeda polifolia L.	.	.	.	.	.	.	.	.	1	+	3	.	.	.	II	0.3
Arctous alpina (L.) NIED.	.	2	.	.	.	.	.	5	.	.	.	.	.	.	I	0.5
Gentiana purpurea L.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	I	0.1
Dicranum scoparium HEDW.	6	3	5	4	5	5	5	.	4	5	2	.	7	7	V	4.1
Ptilidium ciliare (L.) HAMPE	3	3	2	.	.	.	2	1	2	2	2	2	.	2	IV	1.5
Dicranum fuscescens TURN.	3	5	.	5	.	.	.	3	.	.	6	4	.	.	III	1.1
Pleurozium schreberi BRID.	5	5	.	.	.	4	.	6	.	.	1	.	.	.	II	1.6
Polytrichum commune HEDV.	1	2	.	.	.	.	.	3	.	.	3	.	.	.	II	0.5
Lophozia floerkei (W. et M.) SCHIF.	.	.	.	3	.	.	5	.	.	.	3	.	3	.	II	1.0
Holocomium splendens BR. et SCH.	3	.	.	.	.	.	.	3	.	.	.	.	.	.	I	0.4
Cetraria islandica (L.) ACH.	3	5	5	5	6	4	5	4	5	5	5	7	4	5	V	4.8
Cladonia rangiferina (L.) WEB.	.	5	4	3	.	1	1	4	3	4	5	2	5	4	IV	2.8
Cladonia elongata HOFFM.	.	.	1	3	4	.	3	.	1	1	2	1	1	2	IV	1.3
Cladonia sylvatica (L.) RABH.	.	.	.	2	.	.	4	2	1	.	.	.	1	3	III	0.9
Cladonia mitis SANDST.	.	4	4	.	3	3	.	.	.	1	.	3	.	.	III	1.3
Cladonia alpestris (L.) RABH.	.	2	2	.	.	.	1	.	.	1	.	.	.	.	II	0.4
Cladonia ecmocyna (ACH.) NYL.	.	.	.	1	.	3	1	.	.	.	.	.	.	1	II	0.4
Cl. crispata FLOT. v. *virgata* TOPF.	+	.	.	.	.	.	.	.	.	.	+	.	3	.	II	0,3
Cladonia pleurota (FLK.) SCHAER.	2	.	.	.	.	.	.	.	.	1	.	.	1	.	II	0,3
Cladonia uncialis (L.) WEB.	.	.	.	.	+	.	.	.	.	1	.	.	2	2	II	0.4
Cladonia bellidiflora (ACH.) SCHAER.	.	.	.	.	+	.	.	.	.	.	.	.	1	3	II	0.3

In one relevé: No. 1. *Lophozia hatcheri* EVANS 2. — No. 4. *Polytrichum juniperinum* HEDW. 1, *Cetraria crispa* (ACH.) NYL. 1. — No. 5. *Cladonia pyxidata* (L.) FR. 1. — No. 6. *Lophozia lycopodioides* (WALLR.) COGN. 1. — No. 7. *Plagiothecium denticulatum* (HEDW.) BR. et SCH. 2. — No. 10. *Juncus trifidus* L. +. No. 11. *Huperzia selago* (L.) BERNH. +, *Nephroma arcticum* (L.) TORSS. 3, *Peltigera canina* (L.) WILLD. 1.

Cladonia ecmocyna (Ach.) Nyl.	.	1
Cl. crispata Flot. v. *virgata* Vain.		1
Ochrolechia tartarea (L.) Mass.	.	+
Cetraria crispa (Ach.) Nyl.	2	.
Cetraria nivalis (L.) Ach.	3	.

Phyllodoco-Vaccinion myrtilli Nordhagen 1936, 1943, Dahl 1957

The following group of associations belongs most probably to the alliance *Phyllodoco Vaccinion myrtilli*. Characteristic or differential species of the alliance in Bléfjell seem to be *Betula nana*, *Empetrum hermaphroditum*, *Calluna vulgaris*, *Pleurozium schreberi*, *Ptilidium ciliare*, and also *Vaccinium myrtillus* has its optimum in communities of this alliance.

The following associations belong here: *Vaccinio-Empetretum hermaphroditi scandinavicum*, *Empetro-Betuletum nanae*, *Empetro hermaphroditi-Callunetum* and *Empetro-Phyllodocetum coeruleae*.

Vaccinio-Empetretum hermaphroditi scandinavicum Hadač ass. n.

A moderately protected, strongly acidophilous chamaephytic community on humose soil, facing E., NE. or N. Mineral subsoil (with cca. 2% organic matter) is very shallow or entirely lacking, the 15—30 cm thick black brown humus layer contains about 91% organic matter. Its reaction is pH 3.0 — 3.2—3.7.

Average number of species is 18, in 14 relevés 72 species were observed. Chamaephytes dominate, lichens have a slightly higher cover than mosses.

The association is characterized by the occurrence of *Vaccinium uliginosum*, *Cornus suecica*, *Hylocomium splendens*, *Nephroma arcticum* and *Peltigera canina*. Not without interest is the absence of *Phyllodoce coerulea* in this community. *Phyllodoce* is fairly rare in Bléfjell, due perhaps to the Atlantic climate.

Similar, but not quite identical communities were described from different parts of Scandinavia and Central Europe; it stands near to *Empetro-Betuletum nanae*.

Localities:

1. NE. slope of Gunnarsbununten, 3 m². The whole soil profile is formed by a black brown humus, 25. 7. 1940.
2. Numedals Blé, 5 m², 1. 8. 1940.
3. Svartekulpen, E. slope, 4 m², deep black brown humus, 1. 8. 1940.
4. E. slope of a hill W. for Gunnarsbununten, 4 m², 1. 8. 1940.
5. Between Gunnarsbununten and Graafjell, above a lake, 8 m², 2. 8. 1940.
6. NW. shore of Langevatn, 4 m², 3. 8. 1940.
7. Kongljan, 4 m², 3. 8. 1940.
8. E. slope of Gunnarsbununten, 4 m², 4. 8. 1940.
9. Gunnarsbununten, below the top, 4 m², 4. 8. 1940.
10. Gunnarsbununten, near the top, 3 m², 4. 8. 1940.
11. Slope above Langevatn, 4 m², 5. 8. 1940.
12. E. slope of Gunnarsbununten, 4 m², 4. 8. 1940.
13. At the spring of Gunnarsbuelva, 4 m², 6. 8. 1940.
14. Numedals Blé, 4 m², 7. 8. 1940.

See the table on p. 208.

Empetro-Betuletum nanae Nordh. 1943

Empetro-Betuletum nanae is a well protected, strongly acidophilous community on humose soil, covered sometimes by an up to 4 cm thick litter. Lichens have a slightly higher cover than mosses. The average number of species is 15, in 8 relevés 28 species were observed. It is thus poorer in species than *Vaccinio-Empetretum hermaphroditi*.

Empetro-Betuletum nanae in Bléfjell is characterised by the absolute dominance of *Betula nana* and practical absence of *Loiseleuria procumbens*, which is frequent in other communities of the alliance.

Empetro-Betuletum nanae Nordh. has much in common with *Cladonietum alpestris betuletosum nanae* Dahl 1957, but lichens do not dominate in our community and *Cladonia alpestris* is represented only by scattered individuals.

Localities:

1. Gunnarsbunuten, 4 m², 4. 8. 1940.
2. Storevassnuten, 4 m², 5. 8. 1940.
3. Flesebekknuten, 3 m², 5. 8. 1940.
4. Numedals Blé, 4 m², 7. 8. 1940.
6. Above the springs of Gunnarsbuelva, 4 m², 6. 8. 1940.
7. Gunnarsbunuten, 4 m², 4. 8. 1940.
8. Graafjell, northern slope, 4 m², 9. 8. 1940.

Empetro-Betuletum nanae Nordh.

Relevé	1	2	3	4	5	6	7	8	K	A ∅
Altitude m:	1125	1150	1055	1100	1080	1125	1135	1120		
Slope:	5°	—	10°	17°	10°	—	5°	5°		
Aspect:	NE	—	W	E	E	—	N	NNE		
Cover (herb layer) %:	80	75	85	85	90	80	80	85		
(moss layer) %:	60	70	50	85	40	70	50	80		
Soil depth cm:	5–35	5–25	5–15	15	15	15	5–25	15		
pH:	3.2	3.3	3.4	3.5	3.4	3.3	3.1	3.1		
Loss on ignition %:	82.0	24.8	71.3	95.0	90.9	90.4	58.1	80.0		
Betula nana L.	8	7	7	7	7	7	7	7	V	7.1
Empetrum hermaphroditum Hager.	6	5	6	4	5	5	6	6	V	5.4
Vaccinium myrtillus L.	4	5	6	5	6	5	3	4	V	4.7
Vaccinium vitis-idaea L.	2	4	4	3	4	4	4	5	V	3.7
Deschampsia flexuosa Trin.	4	4	4	3	2	4	6	2	V	3.6
Carex bigelowii Torr.	1	2	+	3	4	1	1	3	V	1.9
Vaccinium uliginosum L.	2	.	.	3	5	.	.	5	III	1.9
Rubus chamaemorus L.	3	.	.	.	.	.	.	.	II	0.5
Ptilium ciliare Hampe	3	3	3	1	1	2	1	2	V	2.0
Dicranum scoparium Hedw.	7	1	7	2	.	6	5	.	IV	3.5
Dicranum fuscescens Turn.	.	4	.	6	2	.	5	7	IV	3.0
Pleurozium schreberi Mitt.	.	4	.	7	5	.	.	4	III	2.5
Polytrichum juniperinum H.	.	1	.	.	1	.	.	.	II	0.3
Lophozia hatcheri Evans	.	1	.	.	.	.	.	2	II	0.4
Cladonia rangiferina Web.	3	4	3	3	4	4	3	3	V	3.3
Cladonia elongata Hoffm.	2	3	1	3	1	3	.	2	V	1.9
Cetraria islandica Ach.	5	7	4	4	5	6	6	6	V	5.1
Cladonia sylvatica Rabh.	2	4	.	.	1	2	.	.	III	1.1
Cladonia ecmocyna Nyl.	.	1	.	1	1	.	1	.	III	0.5
Cladonia mitis Sandst.	.	.	1	.	1	.	.	.	II	0.3
Cladonia pleurota Sch.	.	.	.	.	.	2	.	1	II	0.4

In one relevé: No. 1.: *Cladonia uncialis* (L.) WEB. 1, *C. crispata* (ACH.) FLOT. 1. — No. 4.: *Plagiothecium denticulatum* (HEDW.) B. et S. 1, *Cladonia pyxidata* (L.) FR. 1. — No. 6.: *Lophozia lycopodioides* (WALLR.) COGN. 3. — No. 7.: *Loiseleuria procumbens* (L.) DESV. 3, *Cladonia furcata* (HUDS.) SCHRAD. 1.

Empetro hermaphroditi - Callunetum HADAČ ass. n. provis.

Empetro hermaphroditi — Callunetum differs from other communities of this alliance by the dominance of *Calluna vulgaris* and the absence of *Betula nana, Carex bigelowii, Juncus trifidus* and *Vaccinium uliginosum*. Its soil is very acid and contains very low amounts of mineral nutrients.

Locality: Numedals Blé, 1020 m alt., 2 m², 20° E., soil depth 5—20 cm, pH 3.3, loss on ignition 97.1%, cover (herb layer) 90%, (moss layer) 20%, 7. 8. 1940.

Calluna vulgaris (L.) HILL 7
Empetrum hermaphroditum HAGER. 7
Vaccinium vitis-idaea L. 3
Vaccinium myrtillus L. 3
Deschampsia flexuosa (L.) TRIN. 2
Loiseleuria procumbens (L.) DESV. 3
Dicranum fuscescens TURN. 4
Pleurozium schreberi MITT. 3
Ptilidium ciliare (L.) HAMPE 3
Cetraria islandica (L.) ACH. 2
Cladonia rangiferina (L.) WEB. 4
Cetraria crispa (ACH.) NYL. 1
Cladonia sylvatica (L.) RABH. 4
Cladonia alpestris (L.) RABH. 3
Cladonia elongata (JACQ.) HOFFM. 1

Phyllodoco-Vaccinietum myrtilli NORDHAGEN 1943

This is a strange community, dominated by *Empetrum hermaphroditum, Phyllodoce* and *Vaccinium myrtillus*, where *Salix herbacea* meets with *Loiseleuria* and *Juncus trifidus*, a plant, which is supposed to be chionophilous with usually chionophobous species. Its soil is richer in mineral compounds and has a slightly lower acidity than other communities of the alliance.

Locality: E. slope of Gunnarsbunuten, 1085 m alt., 2.5 m², soil depth 5 cm, pH 3.7, loss on ignition 73.6%, cover (herb layer) 80%, (moss layer) 60%, 4. 8. 1940.

Phyllodoce coerulea (L.) BAB. 5
Empetrum hermaphroditum HAGER. 6
Vaccinium myrtillus L. 5
Betula nana L. 4
Salix herbacea L. 3
Loiseleuria procumbens (L.) DESV. 3
Juncus trifidus L. 2
Deschampsia flexuosa (L.) TRIN. 2
Carex bigelowii TORR. 2
Dicranum scoparium HEDW. 5
Polytrichum commune HEDW. 4
Lophozia lycopodioides COGN. 3
Ptilidium ciliare (L.) HAMPE 1
Cetraria islandica (L.) ACH. 5
Cladonia rangiferina (L.) WEB. 3
Cladonia elongata HOFFM. 2

According to NORDHAGEN (1943) this association belongs to the alliance *Phyllodoco-Myrtillion*. In Bléfjell *Phyllodoco-Vaccinietum* stands very near to *Empetro-Betuletum nanae*, which, according to the same author, belongs to the alliance *Loiseleurio-Arctostaphylion*. I do not think that they belong, at least in Bléfjell, to different alliances. For this reason I have placed both the above associations in the alliance *Phyllodoco-Vaccinion*.

Deschampsio-Anthoxanthion DURIETZ 1942

I observed only one community which belongs probably to this alliance in Bléfjell, *Alchemillo-Deschampsietum flexuosae*.

Alchemillo alpinae-Deschampsietum flexuosae HADAČ ass. n. provis.

This is probably a late snow bed community, being well protected against wind. Its soil is less acid if compared with previous communities, due perhaps

to the "flush" effect. Hemicryptophytes dominate, mosses and lichens are absent.

Locality: S. slope of a hill W. of Gunnarsbunuten, 1120 m alt., 4 m², 25° S, pH 4.4, humus contents 65.6%, cover (herb layer) 90—100%, 1. 8. 1940.

Deschampsia flexuosa (L.) TRIN. 8
Alchemilla alpina L. 5
Carex bigelowii TORR. 4
Anthoxanthum odoratum L. 4
Rumex alpestris JACQ. 3
Viola palustris L. 2
Solidago virgaurea L. 2
Trientalis europaea L. 2
Carex brunnescens (PERS.) POIR. 3
Gnaphalium norvegicum GUNN. 1
Vaccinium myrtillus L. 2

Alchemillo alpinae-Deschampsietum flexuosae stands near to *Deschampsio-Dicranetum fusci* DAHL 1957; both have the following species in common: *Deschampsia flexuosa, Carex bigelowii, Anthoxanthum odoratum, Rumex "acetosa", Solidago virgaurea, Trientalis europaea, Carex brunnescens* and *Vaccinium myrtillus*. The chief difference is in the total absence of mosses and lichens in our community; this fact signalizes some important difference in the ecology of the two communities.

Nardo-Caricion bigelowii NORDHAGEN 1943

This alliance can be characterized by *Nardus stricta* and *Luzula multiflora*. Its communities are seasonally hygrophilous, chionophilous, oligotrophic. We observed two associations belonging to this alliance in Bléfjell, *Nardetum chionophilum* and *Alchemillo alpinae-Nardetum*.

Nardetum chionophilum NORDHAGEN 1943

Nardetum chionophilum is a natural community, not much or scarcely influenced by grazing. It occurs in seasonally wet localities, well windprotected and very probably covered long time by snow. Its subsoil in Bléfjell is usually more acid than the humus layer, due perhaps to a slight "flush" effect. Characteristic species of this association is *Luzula frigida*.

Nardetum chionophillum in Bléfjell has much in common with the corresponding community in Rondane, analysed by DAHL (1957). They have 22 species in common, which seems to be a fairly high number.

Localities:

1. Flesebekknuten, S. slope, 4 m², 29. 7. 1940.
2. Slope on the N. shore of Slökjevann, 5 m², 30. 7. 1940.
3. NW. shore of Langevann, 4 m², 1. 8. 1940.
4. E. slope of Graafjell, 2 m², 2. 8. 1940.
5. Slope E. of Graafjell near Svartekulpen, 2 m², 2. 8. 1940.
6. Near Langevann, 1.5 m², 3. 8. 1940.
7. W. slope of Graafjell, 2 m², 9. 8. 1940.

Nardetum chionophilum NORDH.

Relevé:	1	2	3	4	5	6	7	K	A
Altitude m:	1080	1100	1145	1280	1240	1125	1170		
Slope:	17°	37°	30°	—	5°	15°	5°		
Aspect:	E	E	S	—	E	E	W		
Cover (herb layer) %:	95	90	95	95	95	95	95		
(moss layer) %:	+	.	+	20	10	+	20		

Soil: depth cm:	15–30	40	20	10	15	25	10–20		
humus layer pH:	4.2	4.5	4.0	3.5	4.1	4.0	5.0		
humus contents %:	78.1	3.6	83.2	78.4	75.9	89.4	85.1		
Subsoil: pH	3.7								
Loss on ignition %:	3.8	13.2							
Nardus stricta L.	9	8	9	9	8	7	9	V	8.4
Anthoxanthum odoratum L.	5	4	5	1	3	5	4	V	3.7
Carex bigelowii TORR.	4	3	3	4	3	4	3	V	3.4
Deschampsia flexuosa TRIN.	2	3	3	3	4	2	3	V	2.8
Vaccinium myrtillus L.	3	4	2		4	2	5	V	2.8
Gentiana purpurea L.	2	4	3	.	2	.	2	IV	1.8
Trientalis europaea L.	3	.	.	4	4	3	.	III	2.0
Solidago virgaurea L.	1	.	1	.	2	.	1	III	0.7
Hieracium alpinum L.	.	1	2	.	+	.	.	III	0.5
Carex brunnescens POIR.	.	.	.	3	3	3	.	III	1.3
Juncus trifidus L.	.	.	.	+	.	1	2	III	0.5
Viola palustris L.	.	2	1	.	.	.	.	II	0.4
Luzula frigida (BUCH.) SAM.	.	.	.	.	2	1	.	II	0.8
Empetrum hermaphroditum HAGER.	.	.	.	.	3	.	3	II	0.8
Vaccinium uliginosum L.	.	.	.	.	1	.	.	II	0.6
Dicranum scoparium HEDW.	3	.	+	.	4	.	.	III	1.0
Lophozia floerkei W. et M.	.	.	1	5	.	3	4	III	1.8
Lophozia lycopodioides COGN.	3	.	.	.	3	.	.	II	0.8
Cetraria islandica (L.) ACH.	.	.		.	+	.	2	III	0.4
Colponia ecmocyna NYL.	.	.	.	1	.	.	1	II	0.3

In one relevé: No. 2.: *Diphazium alpinum* (L.)ROTH 5, *Salix herbacea* L. 2. — No. 3.: *Luzula multiflora* (RETZ.) LEJ. 1. — No. 5.: *Polytrichum commune* HEDW. 1. — No. 6.: *Trichophorum auctriacum* PALLA 1. No. 7.: *Polytrichum alpinum* HEDW. 4, *P. juniperinum* HEDW. 2, *Sphagnum girgensohnii* RUSS. 4, *Marchantia polymorpha* L. 1, *Sphagnum compactum* DC. 2, *Cladonia elongata* (JACQ.) HOFFM. 1, *C. crispata* (ACH.) FLOT. v. *virgata* VAIN. 1.

Alchemillo alpinae-Nardetum strictae HADAČ ass. n. provis.

At lower altitudes than *Nardetum chionophilum* another *Nardetum* occurs, strongly influenced by cattle-grazing. It is doubtless secondary. It may be characterized by *Agrostis tenuis* and *Juncus filiformis* and should perhaps be classified as a community of the alliance *Nardo-Agrostidion tenuis* SILL., but its floristic affinity to *Nardetum chionophilum* in Bléfjell seems to be too high, so it is provisionally placed in the alliance *Nardo-Caricion bigelowii*.

Localities:

1. At Gunnarsbusaeter, near Gunnarsbuelven, 3 m², 4. 8. 1940.
2. Near Grötebustua, 4 m², 8. 8. 1940.

Alchemillo alpinae-Nardetum strictae HADAČ

Relevé:	1	2
Altitude m:	830	780
Slope:	—	—
Cover (herb layer) %:	90	95
(moss layer) %:	20	10
Soil: depth cm:	20	30
pH:	4.3	4.8
Loss on ignition %:	8.9	6.5

Nardus stricta L.	9	8
Alchemilla alpina L.	2	2
Anthoxanthum odoratum L.	4	3
Luzula multiflora (RETZ.) LEJ.	2	3
Deschampsia flexuosa (L.) TRIN.	3	1
Potentilla erecta (L.) RAEUSCH.	3	3
Viola palustris L.	2	4
Trientalis europaea L.	1	1
Solidago virgaurea L.	1	1
Vaccinium myrtillus L.	3	1
Polytrichum commune HEDW.	3	4

In one relevé: No. 1.: *Carex nigra* (L.) REICH. 4, *Juncus filiformis* L. 1, *Calluna vulgaris*, (L.) HILL 1, *Majanthemum bifolium* (L.) F. W. SCHMIDT 3, *Gentiana purpurea* L. 1, *Gnaphalium norvegicum* GUNN. 1, *Dicranum scoparium* HEDW. 4, *Pleurozium schreberi* (BRID.) MITT. 3, *Rhytidiadelphus squarrosus* WARNST. 2, *Lophozia lycopodioides* (WALLR.) COGN. 2, *Drepanocladus uncinatus* (HEDW.) WARNST. 1. — No. 2.: *Agrostis tenuis* SIBTH. 5, *Rumex alpestris* JACQ. 3, *Carex brunnescens* (PERS.) POIR. 2, *Carex bigelowii* TORR. 3, *Bistorta vivipara* (L.) S. F. GRAY 1.

Allosoro-Athyrion alpestris NORDH. 1936

The last community is a very poor *Athyrietum alpestris chionophilum*, which agrees well with the community described under this name by NORDHAGEN 1936 or DAHL 1957. NORDHAGEN places this community in the alliance *Allosoro-Athyrion alpestris* of the ordre *Salicetalia herbaceae*. DAHL (1957) is of the opinion that it belongs to *Lactucion alpinae* of the ordre *Adenostyletalia*. Its floristic affinity to other associations of *Lactucion alpinae* is relatively low. On the other hand, *Athyrietum alpestris chionophilum* has not much in common with the communities of *Salicetalia herbaceae*. I think it best to place it in NORDHAGENS *Allosoreto-Athyrion alpestris*, which belongs, according to its floristic composition and ecology, to the ordre *Calamagrostidetalia villosae* PAWL. 1928 (*Adenostyletalia* BR.-BL. 1930, *Aconitetalia* NORDHAGEN 1936).

Athyrietum alpestris chionophilum NORDH. 1943

This is an extremely chionophilous community. Its soil forms a thin layer between stones on steep slopes. Humus contents in soil is low, the soil acidity is high.

Localities:

1. N. slope of Gunnarsbunuten, at a brook, 7 m², 27. 7. 1940.
2. Slope NE. from Gunnarsbusaeter, near a brook, 8 m², 29. 7. 1940.

Athyrietum alpestris chinophilum NORDH.

Relevé:	1	2
Altitude m:	930	960
Slope:	35°	37°
Aspect:	NNE	S
Cover (nerb layer) %:	100	95
(moss layer) %:	+	.
Soil: pH	3.3	3.6
Loss on ignition %:	31.1	13.7
Athyrium distentifolim TSCH.	9	9
Gentiana purpurea L.	3	3

Trientalis europaea L.	2	3
Rubus chamaemorus L.	4	.
Dryopteris spinulosa WATT.	3	.
Rumex alpestris JACQ.	2	.
Deschampsia flexuosa (L.) TRIN.	2	.
Phegopteris polypodioides FEÉ	.	2
Melandrium rubrum GARCKE	.	1
Vaccinium myrtillus L.	.	+
Polytrichum alpinum HEDW.	2	

Discussion

The floristic affinity of the described communities of Bléfjell mountains may be seen from the following table of Jaccards indexes:

	1	2	3	4	5	6	7	8	9	10	11
1. *Cetr.-Loiseleurietum*	× ×	**36.5**	**35.6**	31.9	26.9	22.7	27.2	4.5	7.7	3.3	1.4
2. *Cetr.-Caric. bigelowii*	**36.5**	× ×	**40.3**	6.0	24.6	15.7	17.1	10.9	10.0	5.3	4.7
3. *Juncetum trifidi*	**35.6**	**40.3**	× ×	27.3	28.6	16.0	22.6	1.4	11.8	9.6	1.3
4. *Vaccin.-Empetretum*	31.9	6.0	27.3	× ×	**53.6**	**37.9**	**36.5**	8.3	12.5	7.2	3.8
5. *Empetr.-Betuletum*	26.9	24.6	28.6	**53.6**	× ×	**44.0**	**44.6**	12.3	13.6	8.9	2.4
6. *Empetro-Callunetum*	22.7	15.7	16.0	**37.9**	**44.0**	× ×	30.9	4.7	8.9	6.7	2.5
7. *Phyllod.-Vaccinietum*	27.2	17.1	22.6	**36.5**	**44.6**	30.9	× ×	7.0	11.3	13.2	2.5
8. *Alchem.-Deschapsietum*	4.5	10.9	1.4	8.3	12.3	4.7	7.0	× ×	31.2	26.2	10.5
9. *Nardetum chionophilum*	7.7	10.0	11.8	12.5	13.6	8.9	11.3	31.2	× ×	**41.2**	10.7
10. *Alchem.-Nardetum*	3.3	5.3	9.6	7.2	8.9	6.7	13.2	26.7	**41.2**	—	7.0
11. *Athyrietum alpestris*	1.4	4.7	1.3	3.8	2.4	2.5	2.5	10.5	10.7	7.0	—

Higher vegetation units are based on floristic similarity of associations, but we may use ecological data as a verification, if our system is right. Communities of the same higher units should have similar ecology and vice versa. Let us see how it is in our communities:

	altitude	aspect	pH	loss on ignition %
Juncion trifidi	1100—1280	W, N	3.2—4.3	20—48—63
Phyllodoco-Vaccinion	925—1175	E	3.0—3.7	74—84—97
Desch.-Anthoxanthion	1120	S	4.4	66
Nardo-Caricion	780—1280	E	4.0—5.0	8—39—70
Allosoro-Athyrion	930— 960	S, NNE	3.3—3.6	22

The correlation between the syntaxonomy and synecology of the discussed communities is evident: each alliance has its own characteristic combination of ecological factors, e.g. *Juncion trifidi scandinavicum* occurs on wind-exposed W. and N. slopes, has an acid soil and a relatively low humus contents; *Phyllodoco-Vaccinion* occurs on windprotected E. slopes, its soil is more acid and contains nearly twice as much humus etc.

Let us now compare vegetation units of Bléfjell mountains with the communities of Rondane, described by DAHL (1957). Since our methods are quite identical, the comparison will be easy.

Bléfjell:	Rondane:
Litorellion uniflorae	not studied
Montio-Epilobion hornemannii	***Mniobryo-Epilobion hornemannii*** **(synonym!)**
Philonoto-Saxifragetum stellaris	***Philonoto-Saxifragetum stellaris***
Polygonion avicularis	not studied

Bléfjell:	Rondane:
Caricetalia curvulae	*Caricetalia curvulae*
Juncion trifidi scandinavicum	*Arctostaphylo-Cetrarion nivalis*
Cetrario-Caricetum bigelowii	*Polytricho-Caricetum bigelowii*
	Cladonietum alpestris caricetosum bigelowii
Juncetum trifidi scandinavicum	*Cetrarietum nivalis juncetosum t.*
	(*Chiono-Juncetum trifidi*)
Cetrario islandicae-Loiseleurietum	*Loiseleurio-Diapensietum*
Phyllodoco-Vaccinion myrtilli	*Phyllodoco-Vaccinion myrtilli*
Vaccinio-Empetretum hermaphroditi	—
Empetro-Betuletum nanae	*Cladonietum alpestris betuletosum*
	(all. *Arctostaphylo-Cetrarion*!)
Empetro-Callunetum	—
Phyllodoco-Vaccinietum myrtilli	*Phyllodoco-Vaccinietum myrtilli*
Deschampsio-Myrtilletalia	*Deschampsio-Myrtilletalia*
Deschampsio-Anthoxanthion	*Deschampsio-Anthoxanthion*
Alchemillo-Deschampsietum flex.	*Deschampsio-Dicranetum fusci*
Nardeto-Caricion bigelowii	*Nardeto-Caricion bigelowii*
Nardetum chionophilum	*Nardetum chionophilum*
Alchemillo alpestris-Nardetum	—
Allosoreto-Athyrion alpestris	*Lactucion alpinae*
Athyrietum alpestris chionophilum	*Athyrietum alpestris chionophilum*
not studied	*Salicetalia herbaceae, Caricetalia fuscae, Scheuchzerietalia, Oxycocco-Ledetalia*

There are some few associations practically identical in both regions (*Philonoto-Saxifragetum stellaris, Nardetum chionophilum, Athyrietum alpestris chionophilum*), others are similar, but not identical. Most of the alliances are identical, but there are also certain discrepances. So, for example, *Empetro-Betuletum nanae* belongs in Bléfjell to the alliance *Phyllodoco-Vaccinion myrtilli*, whereas a very similar association *Cladonietum alpestris betuletosum nanae* in Rondane belongs to *Arctostaphyllo-Cetrarion nivalis*; (the Jaccards indexes of floristic similarity of the two associations are 48 for vascular plants and 25 for mosses and lichens). A strange thing is that the alliance *Phyllodoco-Vaccinion myrtilli*, belonging in Rondane to *Deschampsio-Myrtilletalia*, is nearest related to *Juncion trifidi scandinavicum* in Bléfjell mountains and forms together with this alliance a fairly natural ordre *Caricetalia curvulae*.

I do not doubt that the two results, DAHLS and mine, are correct for the areas investigated — but what can be done in a general review of plant communities of a larger area, where atlantic and continental communities occur? There is no doubt that the classification, based on the total qualitative and quantitative features of the communities, is more objective than a classification, based on characteristic species only. But our results, concerning *Caricetalia curvulae*, raise some questions.

If we compare the floristic composition of the communities of *Juncion trifidi scandinavicum* and *Arctostaphyllo-Cetrarion nivalis*, we can see that there is no big difference in the vascular flora and that even mosses and lichens do not differ much. The Jaccard's indexes, counted separately for vascular plants and for cryptogams, for corresponding associations are as follows:

Juncetum trifidi scandinavicum: *Cetrarietum nivalis juncetosum trifidi* — Kj 33 and 18;
Cetrario islandicae-Caricetum bigelowii: *Cladonietum alpestris caricetosum bigelowii* — Kj 40 and 36;
Cetrario islandicae-Loiseleurietum: *Loiseleurio-Diapensietum* — Kj 38 and 10. (As a base for counting the Kj the figures of the average abundance [A ∅] were taken).

The main difference between the two alliances seems to be quantitative: lichens practically dominate in all communities of *Arctostaphyllo-Cetrarion nivalis*, whereas in *Juncion trifidi scandinavicum* the dominant role belongs to higher plants. Is it right to maintain both alliances for this reason?

Our knowledge of the Norwegian alpine vegetation is not yet sufficient to give a definitive answer. Considering these problems I have some doubts whether our optical method of assessment of the plant abundance and dominance is always the best one for deciding about higher vegetation units, when comparing atlantic and continental vegetation. It is certainly right in most cases, but in the case of *Juncion trifidi scandinavicum: Arctostaphyllo-Cetrarion nivalis* we may ask: are the vascular and cryptogamic members of the communities of the same value from the point of view of the economy of nature? Vascular plants usually produce higher amounts of organic matter than lichens. In very oligotrophic conditions under continental climate lichens seem to be stronger in competition for space than most of higher plants and cover a relatively bigger area — but produce less organic matter than higher plants.

Our assessment of the vegetation cover respects the abundance and dominance, but not the amount of organic matter produced by the respective members of the community. In pure cryptogamic or in practically pure vascular communities the abundance and dominance corresponds roughly with the respective weight of dry matter, but in cases where lichens and vascular plants are on the same abundance level, it does not fit quite well. By comparing also dry weight of plants, the similarity of the corresponding associations of both alliances would in my opinion be much higher than it seems to be by using optical comparison.

I hope that further research of the alpine vegetation will throw more light on this interesting problem.

Souhrn

V této práci jsou popsána některá alpinská rostlinná společenstva v pohoří Bléfjell v jižním Norsku a uvedena některá data o jejich ekologii (pH, ztráta žíháním v půdě apod.). Srovnání s vegetací pohoří Rondane (Dahl 1957) je zajímavé z toho důvodu, že tu jde o území s prakticky stejným geologickým podkladem ale rozdílnými klimatickými podmínkami (Rondane je poměrně kontinentální, Bléfjell atlantické). Současně vyvstává řada syntaxonomických problémů, které bude třeba v budoucnu řešit.

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