

## U8

### *Carex bigelowii*-*Polytrichum alpinum* sedge-heath

#### Synonymy

*Dicranum fuscescens*-*Carex bigelowii* sociation Poore 1955c; *Dicraneto-Caricetum bigelowii* McVean & Ratcliffe 1962; *Polytricheto-Caricetum bigelowii* McVean & Ratcliffe 1962 p.p.

#### Constant species

*Carex bigelowii*, *Dicranum fuscescens*, *Polytrichum alpinum*, *Cetraria islandica*, *Cladonia arbuscula*, *C. bellidiflora*.

#### Rare species

*Cetraria delisei*.

#### Physiognomy

The *Carex bigelowii*-*Polytrichum alpinum* sedge-heath comprises short swards, generally closed but often with a rather patchy structure, in which *Carex bigelowii*, *Polytrichum alpinum* and/or *Dicranum fuscescens* are typically the most abundant plants. Quite often, the sedge is strongly dominant, growing with some vigour where there is obvious irrigation in melt-water channels, but in other cases it is reduced to scattered clumps and rivalled or exceeded in cover by dull green carpets of the mosses. Other common species are few in number, but characteristically there is frequent but rather sparse representation of a number of lichens, *Cetraria islandica*, *Cladonia arbuscula*, *C. bellidiflora*, *C. uncialis* and *C. pyxidata* being found most often, *C. gracilis*, *C. coccifera*, *C. rangiferina*, *C. squamosa* and *C. floerkeana* more occasionally.

In contrast to the *Nardus*-*Carex* grass-heath, with which this vegetation is often found, *Nardus stricta* is only very occasional here and always of low cover, though *Deschampsia flexuosa* and *Festuca ovina*/*vivipara* occur fairly frequently and each can show modest abundance. There can also be some *Agrostis capillaris* and *D. cespitosa*, including obvious ssp. *alpina*, but the community only exceptionally has an overall grassy

appearance. Woody plants are also of limited occurrence: one kind of *Carex*-*Polytrichum* sedge-heath has quite common records for *Vaccinium myrtillus* but it is never really abundant and, though *Salix herbacea* can have locally high cover, it is in general a scarce plant on the fairly stable ground characterised by this vegetation. Among other herbaceous associates, only *Huperzia selago* and *Galium saxatile* occur with anything more than very occasional frequency, with *Luzula spicata*, *Juncus trifidus* and *Saxifraga stellaris* recorded rarely.

Apart from the two constant mosses, no other bryophytes are found frequently throughout, but *Ptilidium ciliare* occurs commonly in one kind of *Carex*-*Polytrichum* vegetation, and *Racomitrium lanuginosum* in the other and, less frequently, there is some *Dicranum scoparium*, *Pohlia nutans*, *Racomitrium fasciculare* and *Pleurozium schreberi*. In contrast to the more chionophilous kinds of *Deschampsia*-*Galium* vegetation, bulky hypnaceous mosses are never abundant.

#### Sub-communities

***Polytrichum alpinum*-*Ptilidium ciliare* sub-community:** *Polytricheto-Caricetum typicum* McVean & Ratcliffe 1962. *C. bigelowii* is generally a clear dominant in this vegetation, with *Polytrichum alpinum* constant but usually rather less abundant and *Dicranum fuscescens* somewhat patchy and of low cover. Other vascular plants are few, but there is sometimes a little *Deschampsia flexuosa* and *D. cespitosa* and it is in this kind of *Carex*-*Polytrichum* grass-heath that *Salix herbacea*, *Juncus trifidus* and *Luzula spicata* are occasionally found.

Both bryophytes and lichens tend to be rather more varied than in the other sub-community with *Dicranum scoparium* and particularly *Ptilidium ciliare* occurring more commonly and *Drepanocladus uncinatus* and *Lophozia sudetica* being preferential at low frequencies. *Cladonia arbuscula*, locally abundant, *C. bellidiflora*, *C.*

*uncialis* and *Cetraria islandica* are here often joined by *Cladonia pyxidata*, *C. coccifera* and the nationally rare *Cetraria delisei*.

***Dicranum fuscescens-Racomitrium lanuginosum* sub-community:** *Dicranum fuscescens-Carex bigelowii* sociation Poore 1955c; *Dicraneto-Caricetum bigelowii* McVean & Ratcliffe 1962. *C. bigelowii* is not so consistently abundant here and indeed it is often co-dominant with or subordinate to *D. fuscescens*, with *P. alpinum* very common but usually reduced to sparse tufts among the moss carpet. There is also frequently a little *Racomitrium lanuginosum* although, apart from occasional *Ptilidium ciliare*, this is usually the limit of variety among the bryophytes. The lichen element, too, tends to be not quite so diverse nor conspicuous as in the *Polytrichum-Ptilidium* sub-community, but *Cornicularia aculeata* is preferential at low frequencies and the rare *Cladonia macrophylla* sometimes occurs, being more or less exclusive to this vegetation.

Scattered through the carpet, vascular associates are rather more numerous and abundant than before, with *Vaccinium myrtillus*, *Festuca ovina/vivipara*, *Agrostis capillaris* and *Galium saxatile* all being found quite frequently and sometimes making this sub-community look transitional to a grass-heath.

### Habitat

The *Carex-Polytrichum* sedge-heath is confined to ground with long snow-lie at high altitudes through the coldest mountains of Scotland, occurring only rarely outside the central Highlands. It is most characteristic of flat or gently-sloping ground, often with a northerly or easterly aspect, in smaller snow-beds or around the margins of larger fields, on peaty podzols that are often strongly gleyed by melt-water.

Apart from a few outlying stands to the north of the Great Glen, notably on Ben Wyvis and in the Cannich Hills, the community is restricted to the range of mountains in the central Highlands between Ben Nevis in the west and Clova to the east, with a local extension southwards on to Carn Gorm and Ben Lawers. And, through this region, it occurs only over higher ground, being typical of low- and middle-alpine zones, mostly between 800 and 1200 m. Here, the climate is extremely harsh, with long and bitter winters and short, cool summers, annual accumulated temperatures being the lowest of any part of the country (Page 1982) and mean annual maxima rarely rising above 21 °C (Conolly & Dahl 1970). Rainfall across the range of the community varies considerably, from close to 3200 mm yr<sup>-1</sup> with over 220 wet days yr<sup>-1</sup> in the west (*Climatological Atlas* 1952, Ratcliffe 1968), to less than 1600 mm with below 180 wet days yr<sup>-1</sup> to the east, but in the cold and wetter winter months much of this falls as snow. Over the

higher slopes where the *Carex-Polytrichum* sedge-heath is found, there are generally at least 100 days of snow or sleet fall annually (Manley 1940) and, in the sheltered and shaded situations to which the community is characteristically confined, the snow can accumulate deeply and persist long: after heavy falls in the heart of its range, in the Cairngorms, the snow cover over this vegetation may last for more than five months, not melting finally until June (McVean & Ratcliffe 1962).

In general, then, the *Carex-Polytrichum* sedge-heath is characteristic of later snow-beds, marking out small hollows or more extensive slopes and plateaus which gather snow for moderately long periods or the fringes of the very latest fields. Although precise details of the snow regime are still lacking, compared with other kinds of chionophilous vegetation, the community probably experiences similar covers to those typical of higher-altitude stands of the *Nardus-Carex* grass-heath. In that vegetation, the shortening of the already cool and cloudy growing season at these altitudes by the locally marked prolongation of snow-lie is sufficient to limit severely the vigour of *V. myrtillus*, an important plant of moderately chionophilous vegetation through these mountains. That trend continues here, with the virtual extinction of those herbaceous associates which occur often with the bilberry in grass-heaths of less snow-bound slopes down through the low- and sub-alpine zones: compared with the *Nardus-Carex* community, *Deschampsia flexuosa*, *Festuca ovina* and *Galium saxatile* are all less common and *Potentilla erecta* and *Carex pilulifera* hardly ever occur.

This effect is compounded with the influence of the long snow-lie on soil moisture. Typically, the *Carex-Polytrichum* sedge-heath is a community of base-poor soils derived from lime-free rocks and, where the substrates become more calcareous, as in the late snow-beds through the Breadalbane Mountains, the vegetation tends towards richer kinds of *Deschampsia-Galium* grassland. *D. cespitosa* and the hypnaceous mosses characteristic of that community are scarce here, although transitional stands can sometimes be found where the ground is a little more basic: McVean & Ratcliffe (1962) classed these in a *Polytricheto-Caricetum rhytidiadelphetosum*. Typically here, though, the profiles show a strong tendency to leaching in the rainy climate and often accumulate a humose topsoil. Surface pH is usually around 4.5 and the soils are mostly peaty podzols, although downwash of fine fraction material sometimes obscures horizonation (McVean & Ratcliffe 1962). The community rarely shows any calcicolous or mull-loving elements, then, but as important as the generally lime-free character of the soils is the fact that they are kept very moist through the growing season by irrigation with melt-water and, increasingly to the west, by heavy rain. Many stands are associated with obvious

sluggish drainage channels running down over gentle slopes below snow-beds or are found in shallow ill-drained hollows or over stretches of flat ground where irrigating waters are concentrated. Often, therefore, the soils show strong signs of gleying right to the surface and, even where the community extends on to somewhat drier ground, as on raised soil patches over erosion surfaces, there is often a strong suggestion of drainage impedance in the fairly recent past (McVean & Ratcliffe 1962). The summer wetness of these soils is a further restriction on the vigour of *V. myrtillus* and its grass-heath associates and may be sufficient to account for the poor performance of *Nardus* in the *Carex*-*Polytrichum* vegetation: this plant grows well on damp, peaty soils but it prefers a humose top that is in an oxidising state in summer (Pearsall 1950). For *C. bigelowii*, on the other hand, and the dominant mosses of the community, such conditions are very favourable.

Variation in the length of snow-lie and the ease with which the melt-water drains away may account for the floristic diversity within the *Carex*-*Polytrichum* sedge-heath, although there is not much hard evidence for this. The two sub-communities show little preference for different slopes and aspects, although the soils beneath the *Dicranum-Racomitrium* type tend to be not so strongly gleyed in the upper horizons as with the *Polytrichum-Ptilidium* sub-community, and certainly the preferential occurrence of *V. myrtillus* and the grasses in that vegetation suggest a quicker run-off. Even there, however, the poorest rock types are usually avoided and this may be because drainage is just too sharp (McVean & Ratcliffe 1962).

### Zonation and succession

The *Carex*-*Polytrichum* sedge-heath occurs in the low- and middle-alpine zones of the central Highlands with a variety of other chionophilous communities, fell-field vegetation and dwarfed sub-shrub heath in zonation and mosaics that depend largely on the degree of exposure over the slopes and summit plateaus. Moving further west, there is an increasing tendency for the vegetation of all but the latest snow-beds to be replaced by their more oceanic equivalents, and the *Carex*-*Polytrichum* sedge-heath persists only very locally among these sequences in the western Highlands. In shifting down into the sub-alpine zone throughout the range of the community, there are transitions to heaths and grasslands that are increasingly anthropogenic in their origin.

The most complete range of chionophilous vegetation through the heartland of the *Carex*-*Polytrichum* sedge-heath in the central Highlands is to be seen over the north-facing slopes of the Cairngorms, where the community occurs among a suite of snow-field vegetation disposed according to variation in length of snow-

lie, ease of drainage and the amount of instability due to freeze-thaw and creep. Where the snow cover persists fairly long, the *Carex*-*Polytrichum* sedge-heath may represent the most chionophilous vegetation type of the sequence, occupying the centre of small snow-beds or filling larger concavities which accumulate drifts, or covering more extensive tracts in patchy fashion over generally sheltered gentle slopes. Around it as an enclosing zone, or forming mosaics with it on ground that has fine patchworks of less and more exposed areas, there is often to be found the *Nardus*-*Carex* grass-heath, zonation between the two vegetation types being sometimes very gradual. *C. bigelowii*, *Polytrichum alpinum*, *Cetraria islandica*, *Cladonia arbuscula* and *C. uncialis* give a strong measure of continuity, particularly where the *Polytrichum-Ptilidium* sub-community of the sedge-heath occurs with the *Empetrum-Cetraria* sub-community of the grass-heath, but the increasing prominence of *Nardus* and reduction of moss cover are usually sufficient to define the boundary. Where the snow cover is a little less persistent or the drainage of the melt-water more free, the *Dicranum-Racomitrium* sub-community of the sedge-heath and the Typical or *Alchemilla-Festuca* forms of the grass-heath can occur together in similar patterns, with *V. myrtillus* as well as *Nardus*, and often too pleurocarpous mosses, becoming more prominent with the shift on to less snow-bound slopes. This kind of sequence frequently continues into some sort of *Vaccinium-Deschampsia* heath, a vegetation type of moderately sheltered and often rather steeper, better-drained ground, where dominance generally lies with the sub-shrubs. Running down into the sub-alpine, this community often forms a patchy zone of fairly chionophilous vegetation below the altitudes at which the *Carex*-*Polytrichum* sedge-heath is best represented (Figure 34).

Where the snow cover persists longer than is usual over the community, as in the very latest snow-beds that are such a distinctive feature on the sunless northern slopes of the Cairngorms, the *Carex*-*Polytrichum* vegetation typically gives way to a patch of either the *Polytrichum-Kiaeria* or, on more unstable ground, the *Salix-Racomitrium* community. There, *C. bigelowii* and *Polytrichum alpinum* can both remain fairly frequent, but they are rarely abundant and dominance usually lies with such snow-tolerant bryophytes as *P. sexangulare*, *K. starkei*, *R. heterostichum*, *Conostomum tetragonum*, *Oligotrichum hercynicum* and *Gymnomitrium concinnum*, with common records for *Salix herbacea*, *Saxifraga stellaris* and *Omalotheca supina*.

Common variations on this basic theme can be seen where melt-waters emerge from late snow-beds in distinct springs where the *Pohlietum glacialis*, with its striking apple-green carpets of *P. wahlenbergii* var. *glacialis*, is characteristic, or, where the snow-lie is not

quite so long, the *Sphagno-Anthelietum*, with its swelling masses of *Anthelia julacea*. High-altitude stands of the *Philonoto-Saxifragetum*, dominated by *Philonotis fontana*, *Dicranella palustris* and *Scapania undulata*, can also be found where swift-running rills carry away melt from the *Carex-Polytrichum* sedge-heath. Then, where the gentle slopes carrying the community give way to rocky or boulder-strewn ground with long-persistent

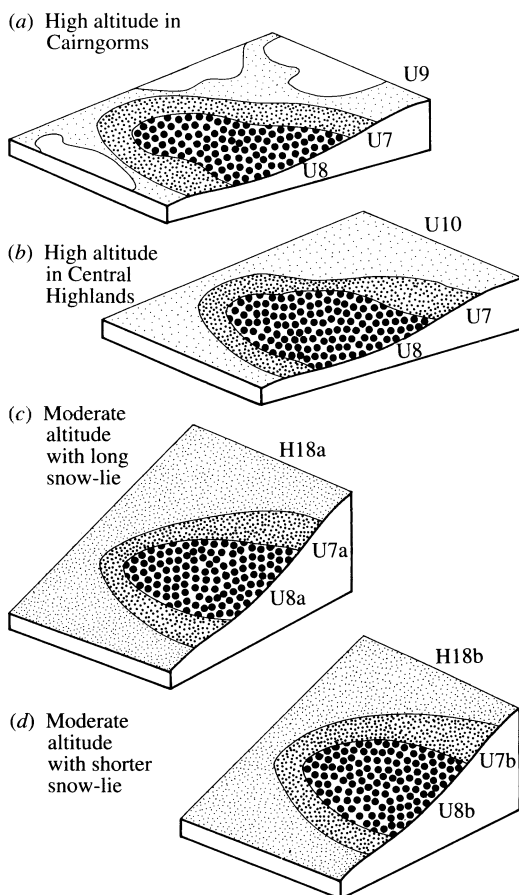
snow, it can pass abruptly to fern-dominated *Cryptogramma-Athyrium* vegetation.

Very typically, over the high summits of the Cairngorms, the zone of low- and middle-alpine communities developed on the more snow-bound slopes gives way to *Juncus-Racomitrium* fell-field. This is itself a somewhat chionophilous vegetation type in many situations, extending often on to moderately sheltered ground where there can be an intermittent powdering of snow up to 50 cm or so deep throughout the winter (McVean & Ratcliffe 1962) and it can form a fringe over the convex upper margins of snow-beds, surrounding the *Carex-Polytrichum* sedge-heath itself, or grading to it through an intervening zone of *Nardus-Carex* grass-heath. Frequently, though, it occurs in a network of loose erosion surfaces over more exposed plateaus, with the more chionophilous vegetation picking out distinct shallow basins. *C. bigelowii*, *R. lanuginosum* and many of the lichens continue as frequent components of the fell-field, but mosses are generally sparse, and *J. trifidus*, an uncommon plant in *Carex-Polytrichum* sedge-heath, is a constant and often abundant feature.

The geographical range of the *Juncus-Racomitrium* heath is very strongly confined to a small part of the east-central Highlands: it occurs patchily on some other summits around the Cairngorms but over the plateaus of Lochnagar and in parts of the Clova-Caenlochan area, for example, it is extensive tracts of the *Carex-Polytrichum* sedge-heath itself that are the most obvious feature of gentle high-altitude slopes. And, with the shift westwards to Ben Alder and on its northern outliers in the Affric-Cannich Hills and on Ben Wyvis, the *Carex-Polytrichum* community gives way to the more oceanic *Carex-Racomitrium* heath where later snow-beds occur in stretches of level or gently-sloping ground that are more exposed. *J. trifidus* continues as a locally prominent plant in such vegetation but the most striking feature is the great abundance of *R. lanuginosum* which generally serves to distinguish the community from the *Carex-Polytrichum* sedge-heath. However, there is much floristic continuity between the two vegetation types and the *Dicranum-Racomitrium* sub-community, in particular, with its frequent records for *R. lanuginosum*, *V. myrtillus* and grasses, can grade gently into the moss-heath. Increasingly over these western hills, too, the *Deschampsia-Galium* grassland occurs among sequences of chionophilous vegetation, forming extensive tracts over moderately snow-bound slopes and those well irrigated by melt-water. In its *Rhytidiadelphus* sub-community, of gentler and more snow-bound hill-sides, it comes quite close to the *Dicranum-Racomitrium* type of *Carex-Polytrichum* sedge-heath, although the abundance of *R. loreus* and *Hylocomium splendens* will usually mark the boundary between the vegetation types.

Figure 34. Patterns in and around snow-beds.

- U7a *Nardus-Carex* grass-heath, *Empetrum-Cetraria* sub-community
- U7b *Nardus-Carex* grass-heath, Typical sub-community
- U8a *Carex-Polytrichum* sedge-heath, *Polytrichum-Ptilidium* sub-community
- U8b *Carex-Polytrichum* sedge-heath, *Dicranum-Racomitrium* sub-community
- U9 *Juncus-Racomitrium* rush-heath
- H18a *Vaccinium-Deschampsia* heath, *Hylocomium-Rhytidiadelphus* sub-community
- H18b *Vaccinium-Deschampsia* heath, *Alchemilla-Carex* sub-community



**Distribution**

The community occurs in the central Highlands, concentrated to the east, with outlying stands to the north-west on Ben Wyvis and on the Affrich–Cannich Hills.

**Affinities**

The *Carex*-*Polytrichum* sedge-heath takes in most of the late snow-bed vegetation described by McVean & Ratcliffe (1962) in the two associations *Dicraneto-Caricetum* and *Polytricheto-Caricetum*, themselves subsuming samples of Poore (1955c and unpublished). With additional data, the two subside well as a single community, although the distinct *rhytidadelphetosum* of the *Polytricheto-Caricetum* is in this scheme transferred to the *Deschampsia-Galium* grassland.

In the European context, some of the vegetation included here compares well with certain Scandinavian

noda. The *Polytrichum-Ptilidium* sub-community in particular is very like the *Polytricheto-Caricetum* which Dahl (1956) described from Rondane and occupies similar habitats, although it is ice as well as snow which there provides the winter cover and the source of melt which seasonally waterlogs the ground. Several stands of Gjaerevøll's (1956) *Caricetum bigelowii-lachenalii* from Torne Lappmark and Beiarn also have co-dominant mixtures of *C. bigelowii* and *Polytrichum alpinum*, although in other generally similar communities characterised from Norway by Nordhagen (1928, 1943), *Salix herbacea* is a constant feature. The *Dicranum-Racomitrium* sub-community is not so well matched, but both Gjaerevøll (1949) and Dahl (1956) have syntaxa with *C. bigelowii* and *D. fuscescens* prominent. Otherwise the nearest equivalents are to be found among a variety of chionophilous Scandinavian noda.

**Floristic table U8**

	a	b	8
<i>Carex bigelowii</i>	V (1–10)	V (1–10)	V (1–10)
<i>Polytrichum alpinum</i>	V (1–6)	V (1–4)	V (1–6)
<i>Cladonia arbuscula</i>	V (1–4)	V (1–4)	V (1–4)
<i>Dicranum fuscescens</i>	V (1–4)	V (6–10)	V (1–10)
<i>Cetraria islandica</i>	IV (1–3)	IV (1–3)	IV (1–3)
<i>Cladonia bellidiflora</i>	IV (1–3)	IV (1–3)	IV (1–3)
<i>Ptilidium ciliare</i>	IV (1–4)	II (1–4)	III (1–4)
<i>Cladonia pyxidata</i>	IV (1–3)	II (1–3)	III (1–3)
<i>Dicranum scoparium</i>	III (1–3)	I (1–3)	II (1–3)
<i>Deschampsia cespitosa</i>	III (1–4)	I (1)	II (1–4)
<i>Cetraria delisei</i>	III (1–3)		II (1–3)
<i>Cladonia coccifera</i>	II (1–3)	I (1)	II (1–3)
<i>Salix herbacea</i>	II (1–6)		I (1–6)
<i>Lophozia alpestre</i>	II (1–3)		I (1–3)
<i>Luzula spicata</i>	II (1–3)		I (1–3)
<i>Drepanocladus uncinatus</i>	II (1–3)		I (1–3)
<i>Hylocomium splendens</i>	I (1–3)		I (1–3)
<i>Racomitrium canescens</i>	I (1–3)		I (1–3)
<i>Juncus trifidus</i>	I (1–3)		I (1–3)
<i>Racomitrium lanuginosum</i>	II (1–3)	V (1–5)	III (1–5)
<i>Festuca ovina/vivipara</i>	I (1–3)	III (1–6)	II (1–6)
<i>Vaccinium myrtillus</i>	I (1–3)	III (1–4)	II (1–4)
<i>Agrostis capillaris</i>	II (1–3)	III (1–6)	II (1–6)
<i>Galium saxatile</i>	I (1)	II (1–4)	II (1–4)
<i>Cladonia rangiferina</i>	I (1)	II (1–3)	I (1–3)
<i>Cornicularia aculeata</i>		II (1–3)	I (1–3)
<i>Cladonia macrophylla</i>		I (1–3)	I (1–3)



**Floristic table U8 (cont.)**

	a	b	8
<i>Cladonia uncialis</i>	III (1–3)	III (1–3)	III (1–3)
<i>Deschampsia flexuosa</i>	II (1–6)	II (1–4)	II (1–6)
<i>Cladonia gracilis</i>	II (1–3)	II (1–3)	II (1–3)
<i>Pohlia nutans</i>	I (1–3)	I (1–3)	I (1–3)
<i>Pleurozium schreberi</i>	I (1–2)	I (1–4)	I (1–4)
<i>Huperzia selago</i>	I (1–3)	I (1–3)	I (1–3)
<i>Nardus stricta</i>	I (1–3)	I (1–3)	I (1–3)
<i>Racomitrium fasciculare</i>	I (1–3)	I (1–3)	I (1–3)
<i>Cladonia squamosa</i>	I (1–3)	I (1)	I (1–3)
<i>Cladonia floerkeana</i>	I (1–3)	I (1)	I (1–3)
<i>Saxifraga stellaris</i>	I (1)	I (1)	I (1)
<i>Ochrolechia frigida</i>	I (1–3)	I (1–3)	I (1–3)
<i>Sphagnum compactum</i>	I (1)	I (1)	I (1)
Number of samples	11	16	27
Number of species/sample	17 (11–26)	13 (8–18)	15 (8–26)
Vegetation height (cm)	4 (2–5)	5 (2–12)	5 (2–12)
Vegetation cover (%)	99 (95–100)	98 (90–100)	99 (90–100)
Altitude (m)	1050 (853–1235)	1066 (823–1250)	1059 (823–1250)
Slope (°)	5 (0–15)	5 (0–10)	5 (0–15)

a *Polytrichum alpinum*-*Ptilidium ciliare* sub-community

b *Dicranum fuscescens*-*Racomitrium lanuginosum* sub-community

8 *Carex bigelowii*-*Polytrichum alpinum* heath (total)

