# U10
# *Carex bigelowii-Racomitrium lanuginosum* moss-heath

**Synonymy**
*Rhacomitrium* heath Smith 1900*b*, Smith 1911*b*, Price-Evans 1932, Tansley 1939, Ratcliffe 1959*a*, Edgell 1969; Moss-lichen associes Smith 1911*b*, Watson 1925, Price-Evans 1932, Tansley 1939, *p.p.*; *Rhacomitrium-Carex bigelowii* nodum Poore 1955*c*, Poore & McVean 1957, Huntley 1979; *Dicranum fuscescens-Carex bigelowii* sociation Poore 1955*c*; *Caricetо-Rhacomitretum lanuginosi* McVean & Ratcliffe 1962, Birks 1973; *Polygoneto-Rhacomitretum lanuginosi* McVean & Ratcliffe 1962; *Juncus trifidus-Festuca ovina* nodum McVean & Ratcliffe 1962; *Festuca ovina-Luzula spicata* nodum Birks 1973; *Agrostis montana-Rhacomitrium lanuginosum* community Birse & Robertson 1976; *Rhacomitrium lanuginosum-Dicranum fuscescens* nodum Huntley 1979; *Festuco-Rhacomitretum lanuginosi* Birse 1980; *Carex bigelowii-Festuca vivipara* Association (Birse & Robertson 1976) Birse 1980 *p.p.*

**Constant species**
*Carex bigelowii*, *Deschampsia flexuosa*, *Festuca ovina/vivipara*, *Vaccinium myrtillus*, *Racomitrium lanuginosum*, *Cladonia uncialis*.

**Rare species**
*Artemisia norvegica*, *Diapensia lapponica*, *Koenigia islandica*, *Loiseleuria procumbens*, *Luzula arcuata*, *Minuartia sedoides*, *Sibbaldia procumbens*, *Aulacomnium turgidum*, *Hypnum hamulosum*, *Kiaeria starkei*, *Nephroma arctica*.

**Physiognomy**
The *Carex bigelowii-Racomitrium lanuginosum* community takes in both continuous carpets of mossy heath and much more open vegetation in which *Racomitrium lanuginosum* remains an important distinguishing feature. In the closed swards included here, this moss is often truly dominant, forming an extensive, sometimes total, cover of densely-packed shoots, frequently curled over all in one direction by relentless winds, but growing together as a vigorous mat up to 5 cm or so thick, which can be peeled off the rocky substrate beneath. From this kind of vegetation, which can stretch for many hectares over broad plateaus, there is a complete gradation through broken rocky ground with more patchy carpets, to almost barren stone-littered surfaces on which small clumps of *R. lanuginosum* are virtually the only cover.

Some other mosses play a more infrequent, but locally prominent, role in the community, though this variation is not of itself sufficient to characterise different kinds of *Carex-Racomitrium* heath (cf. Poore 1955*c*, Huntley 1979). Most obvious among these is *Dicranum fuscescens* which is only occasional throughout but sometimes patchily abundant within masses of *R. lanuginosum*, often where there are slight depressions, perhaps just a few centimetres deep, which catch and hold a little snow in the winter. Some of these spots are clearly transitional to late snow-beds, but often the effect is just to produce a mosaic within the moss carpet of what is otherwise fairly uniform vegetation. *Polytrichum alpinum* can behave in the same fashion, though it is rarely as extensive as *D. fuscescens*, and, more locally, *Rhytidiadelphus loreus* and other bulky pleurocarps, or the rare *Kiaeria starkei*, can pick out sheltered places. Then, scattered through the carpet, there can be occasional shoots of *Dicranum scoparium*, *Hypnum cupressiforme*, *Polytrichum piliferum*, *P. alpestre*, *Campylopus paradoxus* and *Andreaea alpina*. Some other *Racomitrium* spp. may occur infrequently too: *R. heterostichum*, *R. fasciculare* and *R. canescens* have all been recorded here, the last once noted in abundance by McVean & Ratcliffe (1962) over an area where fresh sand had been blown among rocks, but having a very restricted role in general here compared with, say, Icelandic moss-heaths (McVean 1955). One particular sub-community also provides a locus for the rare montane mosses *Aulacomnium turgidum* and *Hypnum hamulosum*. Frequent hepatics are much less numerous than mosses but *Diplophyllum albicans* and *Anastrepta orcadensis* occur occasionally and assiduous

searching, especially of damper places, sometimes turns up uncommon taxa such as *Anthelia juratzkana* and *Gymnomitrion corallioides* (Watson 1925, Birks 1973).

Lichens are not usually of high cover in the carpet, although a number are found frequently throughout and in some stands there is marked local enrichment of this element in the flora. Most common are *Cladonia uncialis* and *Cetraria islandica*, with *Cladonia arbuscula*, *C. gracilis*, *Cornicularia aculeata* and *Sphaerophorus globosus* more occasional and uneven in their representation. Among a variety of infrequent lichen associates is the very rare foliose species *Nephroma arcticum* (McVean & Ratcliffe 1962) and a large number of saxicolous taxa, particularly of the genera *Lecidea*, *Lecanora*, *Parmelia* and *Umbilicaria*, including some strict Arctic-Alpines, growing on exposed rock fragments (Watson 1925). From these, James *et al.* (1977) tentatively defined two rare montane associations of the Rhizocarpion alpicolae alliance.

Scattered through this ground, or dotted about in the shelter of rocks or moss clumps in the more open kind of vegetation, vascular plants are sometimes reduced to sparse wind-clipped individuals of a very few species. However, there is generally some *Carex bigelowii* and, though this is nothing like so luxuriant or floriferous as in flushed and less windswept situations, it can be quite abundant in the community, its rhizomes spreading protected in or beneath the moss mat. Then, there are frequent small tussocks of *Festuca ovina*, very often clearly *F. vivipara*, and, particularly towards lower altitudes, *Deschampsia flexuosa* with small sprigs of *Vaccinium myrtillus*. More occasional, or rather more unevenly distributed among the sub-communities, are *Galium saxatile*, *V. vitis-idaea*, *Agrostis canina*, *A. capillaris*, *Alchemilla alpina* and *Salix herbacea*, and, where these become a little more frequent, together with *Carex pilulifera* and *Potentilla erecta*, the community begins to look transitional to the sort of grassy or sub-shrub heath that occurs in windswept places at lower levels. In other stands, towards the more exposed extreme to which the community penetrates, there can be a very striking enrichment, in what is often an open and heterogenous cover, with *Luzula spicata*, *Polygonum viviparum*, *Thymus praecox* and various cushion herbs, notably *Silene acaulis*, *Armeria maritima* and the rare *Minuartia sedoides* and *Sibbaldia procumbens*. It is in this kind of *Carex-Racomitrium* heath, too, that another rarity, *Juncus trifidus*, is most often seen, usually on wind-blasted ablation surfaces, in vegetation which McVean & Ratcliffe (1962) described as a distinct *Juncus-Festuca ovina* nodum, but which can be readily accommodated here.

Three further extremely rare, and only fairly recently discovered, members of the British mountain flora are also found in more open, rocky stands of this moss-heath (Raven & Walters 1956). *Artemisia norvegica*, a plant that is otherwise known only from parts of Norway and the Urals (Hultén 1954), occurs in this vegetation in numerous small colonies spread over three localities in Ross (Blakelock 1953, Perring & Farrell 1977), while *Diapensia lapponica*, an altogether more spectacular plant when in flower and one with a widespread Arctic-Subarctic range, is restricted to a single rocky crest near Fort William, where it is fairly plentiful but damaged by collectors and deer (Perring & Farrell 1977). *Koenigia islandica*, which occurs on Skye and Mull, is not restricted to *Carex-Racomitrium* heath, being found also in wet, stony *Carex-Koenigia* flushes, but some of its drier stations north of The Storr on Skye belong here (Birks 1973).

### Sub-communities

***Galium saxatile* sub-community:** *Cariceto-Rhacomitretum typicum* Birks 1973; *Festuceto-Rhacomitretum*, Typical & *Nardia scalaris* subassociations Birse 1980 *p.p.*; *Carex bigelowii-Festuca vivipara* Association, *Rhacomitrium* degeneration phases Birse 1980. *R. lanuginosum* is still usually the most abundant plant in these more closed swards, but the cover and variety of the vascular associates are greater than in much Typical *Carex-Racomitrium* heath, and mixtures of *C. bigelowii*, *F. ovina/vivipara*, *D. flexuosa* and *V. myrtillus* quite often attain sub-dominance. Among the community occasionals, *V. vitis-idaea*, *Agrostis canina* and *A. capillaris* are all quite frequent, and each can show modest abundance, adding to the character of a grassy sub-shrub heath. Moreover, *Galium saxatile* is strongly preferential here, with *Carex pilulifera* and *Potentilla erecta* also good diagnostic plants but at lower frequencies. Some stands have *Alchemilla alpina* at moderately high cover, very occasionally in association with such herbs as *Campanula rotundifolia*, *Viola riviniana* and *Succisa pratensis*, while in others there is some *Salix herbacea*, which can give an altogether more chionophilous look.

Apart from the dominant *R. lanuginosum* and fairly frequent scattered tufts of *Dicranum scoparium* and *Polytrichum alpinum*, mosses are not very numerous, with just scarce records for *P. piliferum*, *P. alpestre*, *P. longisetum*, *Racomitrium heterostichum*, *Rhytidiadelphus loreus* and *Campylopus paradoxus*. And hepatics are generally limited to sparse individuals of *Diplophyllum albicans*. The commonest lichens are *Cladonia uncialis* and *Cetraria islandica*, with occasional *Cladonia arbuscula* and, preferential at low frequencies, *C. coccifera*, *C. impexa*, *C. cervicornis* and *C. crispata*, but even taken together these rarely have appreciable cover in the carpet.

**Typical sub-community:** *Rhacomitrium* heath Smith 1900*b*, Smith 1911*b*, Price-Evans 1932, Tansley 1939, Ratcliffe 1959*a*, Edgell 1969; *Rhacomitrium-Carex bigelowii* nodum Poore 1955*c*, Poore & McVean 1957, Huntley 1979; *Dicranum fuscescens-Carex bigelowii* sociation Poore 1955*c*; *Cariceto-Rhacomitretum*, typical facies McVean & Ratcliffe 1962; *Rhacomitrium lanuginosum-Dicranum fuscescens* nodum Huntley 1979; *Festuceto-Rhacomitretum*, *Cladonia arbuscula* sub-assocation Birse 1980. *R. lanuginosum* is often strongly dominant here, although the sub-community also includes many very open stands in which no species has more than sparse cover. The other constants of the heath all remain frequent, *C. bigelowii* in particular making some moderate contribution to the swards in some places, *F. ovina/vivipara* in others, but *D. flexuosa* is rather patchy in its occurrence and *V. myrtillus* is frequently very sparse and sometimes altogether absent. Other vascular associates are at most occasional, but there can be a little *V. vitis-idaea*, *Empetrum nigrum* ssp. *hermaphroditum*, *Huperzia selago* and *Galium saxatile*, and *J. trifidus* is found in some stands.

Along with *R. lanuginosum*, there are common records for *D. fuscescens* and, over undulating ground, the two can form a mosaic in the carpet. *Polytrichum alpinum* and *Dicranum scoparium* occur occasionally and there is sometimes locally abundant *Kiaeria starkei*. More striking, compared with the *Galium* sub-community, is the variety of the lichen flora, with *Cladonia uncialis* and *Cetraria islandica* both more frequent here, and often joined by *Cladonia arbuscula* and *C. gracilis*, less commonly by *C. squamosa* and *Cornicularia aculeata*.

***Silene acaulis* sub-community:** Moss-lichen associes Smith 1911*b*, Watson 1925, Price-Evans 1932, Tansley 1939, *p.p.*; *Rhacomitrium-Carex bigelowii* nodum, *Polygonum viviparum-Salix herbacea* facies Poore & McVean 1957; *Cariceto-Rhacomitretum*, cushion-herb facies McVean & Ratcliffe 1962, Birks 1973; *Cariceto-Rhacomitretum*, *Juncus* facies McVean & Ratcliffe 1962; *Polygoneto-Rhacomitretum lanuginosi* McVean & Ratcliffe 1962; *Juncus trifidus-Festuca ovina* nodum McVean & Ratcliffe 1962; *Festuca ovina-Luzula spicata* nodum Birks 1973. In this, the most distinctive and heterogenous kind of *Carex-Racomitrium* heath, the cover of *R. lanuginosum* can be extensive, but much vegetation included here is very open, when the moss carpet is fragmented, sometimes to virtual non-existence, and even in the more closed swards there can be local diversity in the mat. In particular, where there is intermittent irrigation, say from snow-melt, species such as *Rhytidiadelphus loreus*, *Pleurozium schreberi* and *Hylocomium splendens* increase in prominence, sometimes sharing dominance with *R. lanuginosum* over small patches. *Dicranum fuscescens*, *D. scoparium* and, more especially, *Polytrichum alpinum* are also common, though not generally with any appreciable cover. Then, the rare *Aulacomnium turgidum* and *Hypnum hamulosum* are preferential to this kind of vegetation and, more occasionally, there is some *H. callichroum* or *Drepanocladus uncinatus*. Among hepatics, *Ptilidium ciliare* is much more frequent than usual. Lichens are not usually so obvious a feature as in the Typical sub-community, but there is frequently a little *Cladonia uncialis* and *Cetraria islandica*, and *Sphaerophorus globosus* is strongly preferential.

More striking than these elements, though, are the vascular associates which can form anything from a dense scatter of plants through the moss carpet to a very sparse cover over what looks at first sight like a wilderness of rocks and gravel. Among the constants, *D. flexuosa* and *V. myrtillus* are both somewhat reduced in frequency and hardly ever of any abundance, and even *C. bigelowii* is usually limited to scattered, stunted tufts. *F. ovina/vivipara* remains very common, however, and is fairly often a co-dominant. Most of the other abundant herbs, though, belong to a group of preferentials, many of which grow as small mats or cushions, giving the vegetation a very distinctive appearance. Commonest among these are *Salix herbacea*, *Alchemilla alpina* and, more strictly confined to this kind of *Carex-Racomitrium* heath, *Silene acaulis*, *Thymus praecox*, *Armeria maritima*, *Polygonum viviparum*, *Luzula spicata*, *Minuartia sedoides*, *Sibbaldia procumbens* and *Omalotheca supina*. Rarely are all of these represented over a single small area, and indeed there tends to be a continuous transition between stands of the Typical sub-community in which a very few of these can occur, usually one or other of *S. acaulis*, *A. maritima* or *M. sedoides*, and richer swards, although for simplicity the cushion-herb facies of McVean & Ratcliffe's (1962) *Cariceto-Rhacomitretum* is entirely subsumed here. Other stands which can be accommodated within this kind of *Carex-Racomitrium* heath have small tussocks of *Deschampsia cespitosa* and occasional basiphilous plants such as *Thalictrum alpinum*, *Selaginella selaginoides* and *Pinguicula vulgaris*, species which give some floristic continuity with the *Festuca-Alchemilla-Silene* dwarf-herb community. Then, the very open vegetation with a sparse cover of cushion herbs and tussocks of *J. trifidus*, which McVean & Ratcliffe (1962) characterised as the *Juncus-Festuca* nodum, can also be taken into this sub-community. Apart from these features, there is usually nothing that is distinctive enough to suggest separating these stands from the *Carex-Racomitrium* heath, although the lack of competition from higher

plants, that is typical of the extremely exposed environment, sometimes encourages cryptogams that are otherwise most characteristic of late snow-beds: the foliose lichen *Solorina crocea* is one of these and there can also be occasional records for *Conostomum tetragonum* and *Gymnomitrion concinnatum*.

**Habitat**

The *Carex-Racomitrium* moss-heath is characteristic of windswept, cloud-ridden plateaus at moderate to very high altitudes through the cold, humid mountains of north-west Britain. It is strongly concentrated in the Scottish Highlands, where very large stands can be found over ridges and summits that are mostly blown clear of snow, but it also occurs more locally on moderately exposed cols and spurs, and can extend into situations where wind erosion and bitter temperatures maintain some of the most inhospitable upland scenery in the country. In general, harsh climatic conditions make this a climax community, although stands at lower altitudes have sometimes been affected by grazing.

The combination of exposure to cold with high humidity is of great importance for the development of this kind of vegetation. It is largely a community of the low- to middle-alpine zones in our mountains, extending down to below 500 m along the western edge of its range, where it is represented on the Inner Isles from Skye down to Arran, but confined to progressively higher altitudes moving through the north-west Highlands into the Grampians: in Ross, for example, its base lies at around 750 m, whereas in the central Highlands it is not found much below 900 m but extends in fragmentary fashion to over 1200 m (McVean & Ratcliffe 1962, Birse 1980). Throughout these regions, at these levels, the summers are brief and cool, with mean annual maxima usually below 21 °C (Conolly & Dahl 1970). Outlying stations further south, where the community is of local importance over summits in the Southern Uplands, the Lake District, the north Pennines and, in more attenuated form, in north Wales, are just a little warmer, with maxima of 23–24 °C, but these still present some of the bleakest tracts of high ground outside the Highlands. Winter minima, on the other hand, and thus the annual range of temperatures, vary considerably across these parts of Britain, with the most bitter and more continental conditions being experienced over the higher summit plateaus of the east-central Highlands, the climate further west being noticeably more equable, particularly towards the lowest altitudinal limits of the community, over the spurs of mountains along the Atlantic seaboard of Scotland (*Climatological Atlas* 1952).

Towards the former extreme, the *Carex-Racomitrium* heath only survives where there is some degree of shelter from the very harshest exposure, its hold becoming increasingly tenuous the less oceanic the general climatic conditions: over the eastern slopes of the Cairngorms, for example, the lower limit of the community can be up to 250 m below that on the more exposed western spurs (McVean & Ratcliffe 1962). In general, however, this is a vegetation type of open, relatively unsheltered conditions, being most extensive over tracts of flat or gently-sloping ground, on what Smith (1900), in the first, classic account of the community, called 'alpine plateaus'. In such places, away from hollows and lee slopes, there is little relief from the strong, unrelenting winds that blow at these altitudes, so the ground is for the most part kept free of any but a patchy cover of snow through the winter. Over the range of the *Carex-Racomitrium* heath, the amount of snow can be substantial with over 100 days observed snow- or sleet-fall in some places (Manley 1940), but this is caught and held only very lightly and locally here, being mostly swept off into more sheltered situations. There can sometimes be a light covering of *verglas* over the moss carpet, with icy pennants frozen on to upstanding sedge and grass leaves (Poore 1955*c*), but generally speaking, the vegetation and soils are fully exposed to the influence of fluctuating temperatures and to the drying effect of the wind on ground already deprived of much of its winter moisture by the redistribution of precipitation in snow drifted elsewhere.

Potentially, then, the flora of such situations is likely to have a strong Arctic-Alpine character, consisting of plants adapted to the very short growing season and tolerant of bouts of bitter cold and desiccation alternating with drenching mist, and of the environmental instability resulting from freeze-thaw and solifluction. Such plants must also be able to survive in soils that are often of a very fragmentary character and highly impoverished, occurring locally in deep pockets, but often shallow and stony, usually sharply-draining and sometimes strongly podzolised and with at most a thin humic crust (Smith 1911*b*, Poore 1955*c*, Poore & McVean 1957, McVean & Ratcliffe 1962). What inhibits the expression of such a floristic aspect throughout the *Carex-Racomitrium* heath is the formidable competitive power of *R. lanuginosum* in all but the more exposed and disturbed situations here. Of all the many kinds of upland vegetation to which this moss contributes, it is in this community, characteristic of usually snow-free, but less continental, conditions, and with little or no grazing, that its growth is most vigorous and effective in ousting montane species susceptible to being crowded out.

Some plants tolerant of the generally montane climate, able to extend their rhizomes beneath the moss carpet, as do *C. bigelowii* and *V. myrtillus*, or growing as small tussocks which push aside the densely-growing moss shoots, as with *D. flexuosa* and *F. ovina/vivipara*, can withstand the competition to some extent and may actually benefit from the shelter that the mat provides

against extreme exposure: it is mixtures of these species that give much of the character to Typical *Carex-Racomitrium* heath. But most of the more diminutive species, among which are numbered many of the Arctic-Alpine herbs typical of these altitudes, are unable to compete in the more continuous swards, and it is only where the moss carpet becomes dissected by wind erosion or disturbed by upheaval of the substrate that such plants as *Silene acaulis*, *Minuartia sedoides* or *Juncus trifidus* are able to find an occasional place in this sub-community.

The other striking feature of Typical *Carex-Racomitrium* vegetation, as compared with the dwarfed heaths found in similarly open and windswept spurs and summits in the more continental mountains of eastern Scotland, is the limited role which lichens have in the carpet. The commonest species overall is the more oceanic *Cladonia uncialis* and, even where other lichens such as *Cetraria islandica* and *Cladonia arbuscula* occur with great frequency, neither these nor any of the more occasional associates in the Typical sub-community have the kind of abundance seen in the lichen-dominated sub-shrub heaths so extensive through the east-central Highlands or in much of the fell-field vegetation over the Cairngorm summits. This, then, is the moss-heath *par excellence* of the generally oceanic high-montane zone in the British uplands, yielding to the *Juncus-Racomitrium* vegetation on much of the highest ground on Cairngorm, Ben Macdui and Lochnagar, but becoming very extensive over the broader summits of the central Highlands, particularly over the flat-topped Drumochter Hills, on Ben Alder and around the Carn Liath end of Creag Meagaidh and, to the north-west, on parts of the Affric–Cannich Hills, Ben Hope and Ben Klibreck but, best of all, on Ben Wyvis, where an unbroken carpet of Typical *Carex-Racomitrium* heath stretches along the summit ridge for more than 8 km (McVean & Ratcliffe 1962, Ratcliffe 1977).

Increasingly to the north and west, however, this kind of moss-heath gives way in generally similar exposed situations to the *Silene* sub-community. A few stands of this vegetation can be found through the heartland of Typical *Carex-Racomitrium* heath in the central Highlands, on the summit of Creag Mhor, for example, and even more strikingly on Ben Heasgarnich; and mosaics of the two vegetation types, or more ill-defined transitions from one to the other, occur on Ben Alder, on the Affric-Cannich Hills and from there south to Beinn Fhada and north to Foinaven. Over many of the spurs and ridges of the north-west Highlands, however, it is the more strikingly Arctic-Alpine form of the *Carex-Racomitrium* heath that is the more common and widespread. Here, the climate is more humid and cloudy than further south and east in the Highlands, with over 2000 mm precipitation annually in many areas (*Climatological Atlas* 1952), more than 220 wet days $yr^{-1}$ (Ratcliffe 1968) and a percentage daytime cloudiness often over 80% (Page 1982). Such features, together with the somewhat more equable temperature regime in these western mountains, might generally be expected to favour the vigorous growth of the moss carpet in this vegetation but, as McVean & Ratcliffe (1962) pointed out, this is the most gale-ridden part of the British mainland: almost all the stands of the *Silene* sub-community lie beyond a line marking 20 gale-days $yr^{-1}$ at recording stations, considerably more of course at these higher altitudes (*Climatological Atlas* 1952). This in itself exerts some limitation on the spread of *R. lanuginosum* but the *Silene* sub-community also tends to favour somewhat steeper and stonier ground than does Typical *Carex-Racomitrium* heath, where the effects of the harsh and frequent winds are maximised, where drainage is that much sharper and where the effects of freeze-thaw and solifluction are concentrated. This kind of heath is also quite often found over more lime-rich substrates, marking out bands of calcareous schists and serpulite grits, as opposed to the poorer rocks like granite, gneiss and acidic schists usually sustaining the Typical sub-community. This association is not so strong as Poore & McVean (1957) suggested, but it does mean that the pH of the soils here can be higher than usual, sometimes up to 6. Churning of the substrates may also help release nutrients from the decaying detritus (McVean & Ratcliffe 1962).

The combination of increased openness of the ground with some amelioration of the poor soil conditions encourages the distinctive suite of more competition-sensitive and demanding plants, mat formers such as *Alchemilla alpina*, *Salix herbacea* and *Thymus praecox*, rhizomatous species like *Luzula spicata*, *Juncus trifidus* and *Polygonum viviparum* and the cushion herbs *Silene acaulis*, *Armeria maritima*, *Sibbaldia procumbens* and *Minuartia sedoides*. Sometimes, the occurrence of plants such as *Omalotheca supina* with *Racomitrium heterostichum* and *Gymnomotrion concinnatum* in patches of *S. herbacea* can give the impression of a late snow-bed and, indeed, hollows within this kind of *Carex-Racomitrium* heath sometimes shelter such vegetation. But here, it is the extreme exposure that maintains the open conditions which such plants favour: snow-lie is generally still very slight and sporadic over the *Silene* sub-community and, in its more extreme manifestations, it is markedly chionophobous. Irrigation by melt-water is sometimes a feature, though, and it is usually this which encourages the patchy replacement of *R. lanuginosum* in the moss carpet by such hypnaceous species as *Rhytidiadelphus loreus*, *Pleurozium schreberi* and *Hylocomium splendens*, and the occasional occurrence of *Aulacomnium turgidum*. Where such flushing brings a little more base-enrichment by seepage from calcareous rocks, a

more obviously basiphile element can be seen in the flora, and the vegetation approaches the dwarf herb communities of intermittently irrigated schists: good transitions of this kind are seen on Creag Mhor and Ben Heasgarnich (Ratcliffe 1977).

Particularly striking are those stands of the *Silene* sub-community developed in association with solifluction features. These can be seen, too, beneath other kinds of *Carex-Racomitrium* heath: hummocks and ridges are well developed beneath the Typical sub-community on parts of Ben Wyvis, for example, and there is fossil patterned ground on some Lake District and Pennine sites with the community. But, it is over the more exposed ridges and summits of the north-west Highlands that the most extensive and active features are to be seen, the processes and resulting patterns having a marked effect on the composition and structure of the *Silene* sub-community. More amorphous phenomena resulting from the slumping and flow of detritus saturated with melt-water are sometimes found where the *Carex-Racomitrium* heath occurs on less competent substrates like mudstones, and here the exposure of fresh bare ground offers an opportunity for colonisation by the more competition-sensitive herbs. In other cases, such flow is more structured, with the formation of terraces running along the contours, providing a series of less and more exposed and disturbed ground for the *Silene* sub-community: this kind of patterning is well seen on Ben Klibreck, through the Affric–Cannich and Fannich hills and over the summit and spurs of Am Faochagach, where the terracing is still obviously active. Over the flatter ground behind such terraces and running up on to summits, sorting can produce stone polygons and nets, which themselves can extend down gently-inclined ground into elongated shapes and stripes, and over the finer material within and between these features, the *Silene* sub-community can thicken up into a more continuous turf. Beinn Dearg has some good mosaics of this kind.

Quite often, however, it is on the flat surfaces found between solifluction terraces and over the high plateaus that the most extreme conditions of exposure occur, with the *Carex-Racomitrium* heath becoming most severely attenuated. Here, on these ablation surfaces, the ground is often littered with rubble, some pieces tilted up like gravestones by the churning of the substrate, others part-submerged, as if pressed down, into a matrix of finer material, sand and gravel being picked up by the fierce winds and blasted against the exposed rocks and vegetation. In such circumstances, the moss carpet of the *Silene* sub-community becomes ever more fragmented and the cover of *C. bigelowii* increasingly sparse but, among the small tussocks of *F. ovina/vivipara* and scattered cushion herbs, *J. trifidus* is often able to make its most obvious contribution to this vegetation, in what McVean & Ratcliffe (1962) termed the *Juncus-Festuca* nodum. Ablation surfaces with gradations to this kind of *Carex-Racomitrium* heath, and beyond to a virtual wilderness of stones with next to no vegetation, can be seen on Beinn Dearg, in the Affrich–Cannich and Fannich hills, on Ben Hope and in the Letterewe Forest (Ratcliffe 1977).

Outlying stands of the *Silene* sub-community, sometimes disposed in fragmentary fashion over these kinds of solifluction and ablation features, can be found up to around 1000 m on the more exposed spurs and summits on Skye, most notably over the basalt lavas of the Trotternish Ridge (Birks 1973) but, for the most part, the *Carex-Racomitrium* heath that occurs over windswept plateaus around the Atlantic seaboard of Scotland, and down through the Southern Uplands into northern England and north Wales, is of the *Galium* type. This kind of vegetation can be seen locally in more sheltered situations through the north-west and central Highlands, but it is mostly confined to moderate altitudes, generally between 400 and 800 m, in regions of somewhat more equable climate than is usual for the community, where summer maxima and, more particularly, winter minima, are higher than for much of the Typical and certainly the *Silene* sub-communities. It is thus the usual form of the community on Hoy, over the less exposed plateaus on Skye, on Rhum, Mull and Arran, over some of the summits in the Moffat and Tweedsmuir hills, on the Cairnsmore of Fleet and The Merrick, on Cross Fell, where it is particularly extensive, on Skiddaw and the Buttermore Fells and on the Carneddau and Cader Idris. These areas have a very wet and generally bleak climate but, though some stands of the *Galium* sub-community can provide more far-flung localities for such Arctic-Alpines as *S. herbacea* and *S. acaulis* towards the southern limits of their ranges (e.g. Ratcliffe 1960), the vegetation has nothing like the extreme montane character seen in the *Silene* sub-community.

Indeed, with its generally grassy character, and frequent records for *Potentilla erecta* and the broadly oceanic *Carex pilulifera*, this kind of *Carex-Racomitrium* heath comes quite close in appearance to the subalpine grass-heaths that are a common feature of these parts of Britain. An additional reason for this may be that stands of this sub-community are often within easier reach of grazing stock than usual, quite frequently running into the rough pastures on the slopes below. Grazing would tend to reduce the distinctive features of this vegetation, favouring an increased contribution from monocotyledons and resistant herbs like *G. saxatile* at the expense of *R. lanuginosum*: such more generalised swards are well seen over the summits of Helvellyn, which once evidently had much greater stretches of moss-heath (Ratcliffe 1977) (Figure 35).

Figure 35. Floristic contrasts between summit vegetation at higher (U10b) and lower (U10a) altitudes and with grazing (U4e) in the latter situations.

| | U10b | | U10a | | U4e | |
|---|---|---|---|---|---|---|
| *Festuca ovina* | IV | (1–6) | V | (1–6) | IV | (1–10) |
| *Deschampsia flexuosa* | IV | (1–6) | V | (1–6) | IV | (1–9) |
| *Vaccinium myrtillus* | IV | (1–4) | IV | (1–6) | V | (1–6) |
| *Racomitrium lanuginosum* | V | (1–10) | V | (1–10) | II | (1–4) |
| *Carex bigelowii* | V | (1–9) | IV | (1–6) | I | (1–4) |
| *Cladonia uncialis* | V | (1–6) | IV | (1–4) | | |
| *Polytrichum alpinum* | II | (1–4) | III | (1–6) | I | (1–3) |
| *Salix herbacea* | I | (1–4) | III | (1–8) | | |
| *Vaccinium vitis-idaea* | II | (1–6) | II | (1–6) | | |
| *Dicranum fuscescens* | II | (1–6) | II | (1–6) | | |
| *Cornicularia aculeata* | II | (1–6) | II | (1–3) | | |
| *Cetraria islandica* | V | (1–4) | III | (1–4) | | |
| *Cladonia arbuscula* | III | (1–4) | II | (1–6) | | |
| *Cladonia gracilis* | II | (1–3) | I | (1) | | |
| *Alectoria nigricans* | II | (1–3) | I | (1) | | |
| *Empetrum nigrum hermaphroditum* | II | (1–4) | I | (1) | | |
| *Kiaeria starkei* | II | (1–4) | | | | |
| *Galium saxatile* | II | (1–4) | V | (1–5) | V | (1–8) |
| *Potentilla erecta* | | | III | (1–5) | V | (1–6) |
| *Dicranum scoparium* | II | (1–3) | III | (1–4) | III | (1–6) |
| *Hypnum cupressiforme* | I | (1) | III | (1–4) | III | (1–4) |
| *Carex pilulifera* | I | (1–3) | III | (1–6) | II | (1–2) |
| *Agrostis capillaris* | I | (1) | II | (1–6) | V | (1–8) |
| *Pleurozium schreberi* | I | (1) | I | (1–3) | IV | (1–6) |
| *Nardus stricta* | I | (1–4) | I | (1–4) | IV | (1–8) |
| *Anthoxanthum odoratum* | | | I | (1–3) | III | (1–6) |
| *Luzula campestris* | | | I | (1–3) | III | (1–4) |
| *Rhytidiadelphus squarrosus* | | | | | III | (1–6) |
| *Juncus squarrosus* | I | (1–3) | I | (1–4) | II | (1–4) |
| *Hylocomium splendens* | I | (1–4) | I | (1) | II | (1–6) |
| *Festuca rubra* | I | (1–4) | | | II | (1–8) |
| *Danthonia decumbens* | | | I | (1–4) | II | (1–6) |
| *Calluna vulgaris* | | | I | (1) | II | (1–6) |
| *Carex binervis* | | | I | (1–3) | II | (1–4) |
| *Pseudoscleropodium purum* | | | | | II | (1–4) |
| Number of samples | 52 | | 65 | | 66 | |
| Number of species | 13 | (6–25) | 18 | (7–26) | 17 | (8–30) |

U10b *Carex-Racomitrium* moss-heath, Typical sub-community
U10a *Carex-Racomitrium* moss-heath, *Galium saxatile* sub-community
U4e *Festuca-Agrostis-Galium* grassland, *Vaccinium-Deschampsia* sub-community

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**Zonation and succession**

The *Carex-Racomitrium* community often terminates altitudinal sequences of sub-shrub heaths and various kinds of chionophilous vegetation disposed over slopes and summits in relation to exposure to wind and cold. Flushing with snow-melt or spring waters can result in transitions to dwarf-herb communities or soligenous mires, and on some high-level plateaus the moss-heath grades to blanket bog over thickening ombrogenous peat. Increasingly, towards the less oceanic parts of eastern Scotland, the various elements in these patterns are replaced by their continental equivalents, and towards lower altitudes there is a strong tendency for the vegetation types to be influenced by grazing.

In the typical oceanic sequence of low- and middle-alpine heaths, well seen over the long quartzite ridge of Foinaven in the north-west Highlands, where each of the communities descends to particularly low levels, the striking feature is the abundance of *R. lanuginosum* throughout the zonation. Over the summit, the *Carex-Racomitrium* heath can be found in its most fragmentary form on the stony ablation surfaces, but this thickens up to more extensive tracts of the *Silene* sub-community with a little shelter, and this in turn gives way below to a zone of the *Vaccinium-Racomitrium* heath. There is frequently strong floristic continuity between the vegetation types, particularly in those places where the *Carex-Racomitrium* heath loses some of its contingent of cushion herbs and becomes more like the Typical form, and where, as is usual over more windswept slopes, the *Vaccinium-Racomitrium* heath is represented by the more lichen-rich *Cetraria* sub-community. Then, species such as *C. bigelowii*, *F. ovina/vivipara*, *D. flexuosa*, *Cladonia uncialis*, *C. arbuscula* and *Cetraria islandica* occur often throughout and, although *V. myrtillus* and, more distinctly, *Empetrum nigrum* ssp. *hermaphroditum* increase in frequency and abundance eventually becoming co-dominant with *R. lanuginosum*, this development may be at first very ill-defined. Among the lower reaches of the *Carex-Racomitrium* heath, for example, the *Vaccinium-Racomitrium* heath can occur in small patches over stretches of block scree or in shallow hollows, looking very much like a sub-shrub facies of the moss-heath (Poore & McVean 1957). In other places, a more sudden shift on to steeper, bouldery ground can be matched by a clearer boundary between the vegetation types.

On Foinaven and some other mountains in the north-west Highlands, as over the Affric–Cannich Hills, the broad altitudinal zonation continues downwards with the replacement of the *Vaccinium-Racomitrium* heath by its heather-dominated equivalent, the *Calluna-Racomitrium* heath. In other places, as on the western half of the Creag Liath ridge on Ben More Assynt, this latter community passes more directly to the *Carex-Racomitrium* heath: again, the transition can be fairly gradual, but *Calluna* is typically unable to survive at the higher altitudes of the moss-heath and such species as *C. bigelowii* and *Diphasium alpinum* become increasingly frequent above. A further complication of this pattern is seen where the *Calluna-Arctostaphylos alpinus* heath occupies some of the more windswept slopes below the *Carex-Racomitrium* heath, as on high spurs in the Fannich Hills, but with its wind-clipped mat of *A. alpinus* and *Loiseleuria procumbens*, among *Calluna*, *V. myrtillus* and *E. nigrum* ssp. *hermaphroditum* such vegetation is usually very distinct.

With the geographical shift eastwards, the competitive ability of *R. lanuginosum* in these zonations becomes increasingly curtailed, especially over more severely exposed slopes through the low- and middle-alpine zones, where less oceanic heaths, usually with an abundance of lichens, replace their western equivalents. And, away from the eroded and intermittently irrigated ablation surfaces of the north-west Highlands, the *Carex-Racomitrium* heath is more often of the Typical form. Good zonations, juxtaposing oceanic and continental communities, can be observed on Ben Wyvis and, in the west-central Highlands, over the Drumochter Hills, both sites with very extensive moss-heaths over their summit plateaus. Here, Typical *Carex-Racomitrium* heath passes below to *Calluna-Cladonia* heath, often through a mosaic in which fragments of each vegetation type are included within a ground of the other (McVean & Ratcliffe 1962), though with a general shift in dominance among the cryptogams from *R. lanuginosum* to a variety of lichens, and the appearance of wind-clipped *Calluna* with a little *V. myrtillus* and *E. nigrum* ssp. *hermaphroditum*. On other mountains, as over parts of the Monadhliath plateau, these latter sub-shrubs figure more prominently in the zone below the *Carex-Racomitrium* heath, forming stands of the *Vaccinium-Cladonia* heath, in which lichens are often even more overwhelmingly abundant than in the heather-dominated counterpart. Zonations of both these types can be seen in and around the Cairngorms, too: above Glen Feshie, for example, there are some especially fine sequences of the former sort, and on the outlying spurs of White Mounth and Cairn Bannoch in Lochnagar some of the latter. Over much of the high plateaus here, though, and particularly in the eastern Cairngorms, the *Carex-Racomitrium* heath is replaced by the *Juncus-Racomitrium* heath, where the more continental character of the flora extends on to the fell-fields. The two vegetation types occur together in some places, most extensively on the summits of Lochnagar, where gentle transitions between them can be widely seen: usually a move from the *Carex-Racomitrium* heath to the other community involves a reduction in the abundance of *R. lanugino-*

*sum*, an increase in the cover of lichens and much more frequent tussocks of *Juncus trifidus*. Here, the *Juncus-Racomitrium* heath represents the equivalent of the most open stands of the *Silene* sub-community of the *Carex-Racomitrium* heath on the western Highland ablation surfaces.

Throughout its range, a frequent complication of these zonations involves the occurrence of various kinds of chionophilous vegetation wherever there is an increased tendency for snow to accumulate and persist in hollows or over slopes that have a little more shelter than is usual for the moss-heath. The widest range of snow-bed communities in our mountains is, in fact, found where the *Carex-Racomitrium* heath is least common and extensive, through the east-central Highlands, although stands can be found there which contain patches of the *Salix-Racomitrium* and *Carex-Polytrichum* communities, and quite a variety of more chionophilous vegetation of this sort occurs among *Carex-Racomitrium* heath on the summit of Aonach Mor. Such snow-beds are generally very distinct from their surrounds, with their characteristic abundance of snow-tolerant mosses like *Racomitrium heterostichum*, *Dicranum fuscescens*, *Polytrichum alpinum* and *Kiaeria starkei*, species which are never more than local in the *Carex-Racomitrium* heath, but much more widespread and often less well defined are transitions to stands of the *Nardus-Carex* grass-heath. In that vegetation, *Nardus stricta* and sometimes also *Scirpus cespitosus* and *Juncus squarrosus* can be abundant on ground that is left moist as the snow melts, but there is strong floristic continuity between the communities with frequent records for *C. bigelowii*, *D. flexuosa*, *G. saxatile*, *V. myrtillus* and *Cladonia uncialis*, as well as *R. lanuginosum* which can remain quite extensive provided snow-lie is not too lengthy or irrigation very heavy. Such zonations can be seen in hollows within stretches of the moss-heath or where there is a shift to more sheltered slopes in sites like the Drumochter Hills, Beinn Dearg and Ben Wyvis, and, at lower levels, where snow-lie is not so prolonged, the *Vaccinium-Deschampsia* heath can also figure in transitions to less exposed ground, particularly where the drainage is free and the ground more bouldery or craggy.

In the north-west Highlands, the more chionophilous elements in these kinds of sequences are somewhat different. There, stretches of ground which hold snow for long periods within or adjacent to stands of the *Silene* sub-community often have moss-rich *Deschampsia-Galium* vegetation, where mixtures of *Rhytidiadelphus loreus*, *Hylocomium splendens* and *Pleurozium schreberi* dominate the ground carpet and where *D. cespitosa* becomes common, and small patches of these species on intermittently irrigated ground within the *Carex-Racomitrium* heath can represent the beginnings of a transition to such late snow-beds. Alternatively, over slopes flushed with melt from such fields, the more grass-rich kind of *Deschampsia-Galium* vegetation may replace the *Silene* sub-community.

Over somewhat more calcareous substrates, modest flushing may bring some base-enrichment to the *Silene* sub-community which can presage a switch to the *Alchemilla-Sibbaldia* dwarf-herb vegetation. *A. alpina*, *T. praecox*, *S. procumbens* and *C. bigelowii* all remain common there, but *R. lanuginosum* is usually replaced by *R. fasciculare* or *R. canescens* which, with *Polytrichum alpinum* and *Oligotrichum hercynicum*, make up the bulk of the moss carpet. Mosaics of the two communities can be seen over windswept ground on the Moine schists or limestone of the Monar Forest hills and on Ben Alder, and over Dalradian schists on Creag Mhor. Then, on Ben Lawers, a mountain which has little gentler exposed ground at high levels but where some patchy *Carex-Racomitrium* heath can be found, there are transitions to both the *Alchemilla-Sibbaldia* vegetation and, in somewhat drier situations, the *Festuca-Alchemilla-Silene* dwarf-herb community.

On other sites, flushing of stands of *Carex-Racomitrium* heath may be with more base-poor waters, when there are springs of the *Philonoto-Saxifragetum* or *Pohlietum glacialis* or soligenous vegetation like the *Carex-Sphagnum russowii* mire. These are usually clearly enough marked off from the surrounding moss-heath, although they are sometimes found as part of complexes of high-level bog vegetation within which boundaries are much less well defined. Over the summits of the Drumochter Hills, for example, and on some of the Affric–Cannich Hills, the *Carex-Racomitrium* heath can pass fairly gradually into the *Vaccinium-Hylocomium* sub-community of the *Calluna-Eriophorum* blanket mire with a thickening cover of ombrogenous peat. Although such plants as *Eriophorum vaginatum*, *Rubus chamaemorus*, *Sphagnum capillifolium* and *S. papillosum*, as well as *Vaccinium myrtillus*, *V. vitis-idaea*, *V. uliginosum* and *Empetrum nigrum* ssp. *hermaphroditum*, characterise such vegetation, over mire margins there is sometimes strong continuity through *R. lanuginosum*, various lichens, *C. bigelowii* and *D. flexuosa*.

Where the *Carex-Racomitrium* heath extends into regions of less extreme climate, as towards lower altitudes around the western seaboard of Scotland, through the Southern Uplands and northern England, it generally occurs as the *Galium* sub-community in zonations which have a much less sharply alpine character than those described above. In the Moffat Hills, for example, on the Cairnsmore of Fleet and over Cross Fell, this kind of *Carex-Racomitrium* heath can pass below to subshrub vegetation which approaches montane heath in its composition but which is usually some sort of *Calluna-Vaccinium* or *Vaccinium-Deschampsia* heath, lichen-rich

in more exposed situations, or with an abundance of hypnaceous mosses in the more sheltered. Colder, damper aspects can have stands of the latter community which come close to chionophilous bilberry heath and locally there may be patchy *Nardus-Carex* heath where snow is held a little longer than usual.

A further complication in these regions is that, increasingly with the shift to lower altitudes, there is a tendency for these sequences of vegetation types to be affected by grazing: this reduces the peculiar features of the different communities, encouraging a spread of grasses and grazing-tolerant dicotyledons throughout, tramples out more sensitive mosses and lichens and sometimes favours the appearance of mesophytes in response to manuring. Such a trend is already visible in the *Galium* sub-community and, where more ill-defined stands of this occur above zones of *Nardus-Galium* and *Festuca-Agrostis-Galium* grasslands, there seems little doubt that the whole vegetation pattern has been long affected by its use as rough pasture over unenclosed mountain slopes. Generally speaking, the *Carex-Racomitrium* heath is a climax community but it is probably quite vulnerable to cropping, trampling and manuring, being fairly readily converted to some kind of *Vaccinium-Deschampsia* grass-heath and then perhaps to Nardo-Galion grassland at more moderate altitudes. Over higher ground, ptarmigan may sometimes find palatable herbage in stretches of *Carex-Racomitrium* heath, but the community is otherwise little affected by biotic factors. Erosion by wind and the effects of solifluction may help create new ground for colonisation by this kind of vegetation and it is possible that cycles of degeneration and regrowth occur in some places (Smith 1911*b*, Tansley 1939, Pearsall 1950), but there is little actual evidence for this, and such processes may be very fragmentary and readily set back.

**Distribution**

The *Carex-Racomitrium* moss-heath is largely a community of the Scottish Highlands, with the *Galium* sub-community extending its range into the Southern Uplands, northern England and locally into Wales. The Typical sub-community is the most common form but it is concentrated in the central Highlands, giving way over higher ground in the north-west Highlands to the *Silene* sub-community.

**Affinities**

In this scheme, the treatments of moss-heath dominated by *R. lanuginosum* reverse to some extent the revision proposed by McVean & Ratcliffe (1962). They assigned most of the facies of this vegetation recognised by Poore & McVean (1957) to separate noda, returning to the species-poor heath of Poore (1955*c*) as the basis of their *Cariceto-Rhacomitretum*. Here, moss-heath with a prominent sub-shrub element is separated off into distinct communities, but otherwise the *Carex-Racomitrium* heath is a fairly compendious vegetation type, subsuming both the *Cariceto-Rhacomitretum* and its equivalents (Tansley 1939, Birks 1973, Huntley 1979) and the more distinct richer vegetation which McVean & Ratcliffe (1962) called *Polygoneto-Rhacomitretum*, open stands of which correspond to the Moss-lichen associes recognised by various early authors (Tansley 1939). The *Silene* sub-community can also readily accommodate the fell-field vegetation of McVean & Ratcliffe's (1962) *Juncus-Festuca* nodum which is here seen as an attenuated variant of their *Polygoneto-Rhacomitretum* (see also Birks 1973). The *Galium* sub-community then includes less montane *Racomitrium* heath which has often been referred to only incidentally (Tansley 1939, McVean & Ratcliffe 1962, Ratcliffe 1977), but which found a more prominent place in the scheme of Birse (1980; see also Birse & Robertson 1976).

Birse (1980) grouped this grassier and sometimes biotically-influenced moss-heath among the calcifugous swards of the Nardetalia. However, although a number of Nardo-Galion grasslands and related grass-heaths in this scheme do have sub-communities rich in *R. lanuginosum*, the balance of the different floristic elements in the stands of the *Galium* sub-community argue for retaining them here as a transitional type, perhaps partway along a grazing-mediated succession in many cases. But the overall affinities of the *Carex-Racomitrium* heath are quite difficult to decide. McVean & Ratcliffe (1962) favoured a position in the Salicion herbaceae with what are here called the *Polytrichum-Kiaeria* and *Salix-Racomitrium* late snow-beds. However, although there is some floristic overlap with these communities, with shared occurrences for certain species favouring open conditions, the generally chionophobous character of the *Carex-Racomitrium* heath suggests that a place among heaths of exposed situations might be more appropriate. One possibility would be to locate it in the Nardeto-Caricion, to which McVean & Ratcliffe (1962) assigned their Cairngorm *Juncus-Racomitrium* heath and which in this scheme would also take in the *Nardus-Carex* and *Carex-Polytrichum* communities, vegetation types which are moderately chionophilous. Alternatively, it could be placed among the grassy and dwarf-shrub heaths of the Arctostaphyleto-Cetrarion Dahl 1956 (= Loiseleurio-Arctostaphylion Nordhagen 1943), a location preferred by Birks (1973) and Birse (1980, 1984). Here, it would then consort with the *Calluna-Racomitrium* and *Vaccinium-Racomitrium* heaths and perhaps also their lichen-rich analogues.

In general, however, it is the moss-dominated heaths that obviously belong together as oceanic vegetation types (McVean & Ratcliffe 1962) and similar communities to the *Carex-Racomitrium* heath have been des-

cribed from Ireland (Pethybridge & Praeger 1905), the Faroes (Ostenfeld 1908, Böcher 1937), Iceland (Hansen 1930), Greenland (Trapnell 1933), and western Norway (Nordhagen 1928, Dahl 1956, Engelskjön 1970). Many of the Faroese, Icelandic and Scandinavian heaths are closer to the *Silene* sub-community of this scheme than the other kinds of British *Carex-Racomitrium* heaths, although the *Rhacomitreto-Caricetum* of Dahl (1956) has much in common with the Typical sub-community.

## Floristic table U10

| | a | b | c | 10 |
|---|---|---|---|---|
| *Racomitrium lanuginosum* | V (1–10) | V (1–10) | V (1–10) | V (1–10) |
| *Carex bigelowii* | IV (1–6) | V (1–9) | V (1–6) | V (1–9) |
| *Festuca ovina/vivipara* | V (1–6) | IV (1–6) | V (1–6) | V (1–6) |
| *Cladonia uncialis* | IV (1–4) | V (1–6) | IV (1–3) | IV (1–6) |
| *Deschampsia flexuosa* | V (1–6) | IV (1–6) | III (1–4) | IV (1–6) |
| *Vaccinium myrtillus* | IV (1–6) | IV (1–4) | III (1–4) | IV (1–6) |
| *Galium saxatile* | V (1–5) | II (1–4) | III (1–6) | III (1–6) |
| *Carex pilulifera* | III (1–6) | I (1–3) | I (1–3) | II (1–6) |
| *Hypnum cupressiforme* | III (1–4) | I (1) | II (1–4) | II (1–4) |
| *Potentilla erecta* | III (1–5) | | I (1–4) | II (1–5) |
| *Cladonia coccifera* | II (1–4) | I (1) | I (1–3) | I (1–4) |
| *Campanula rotundifolia* | I (1–4) | | I (1) | I (1–4) |
| *Cladonia impexa* | I (1–4) | I (1) | | I (1–4) |
| *Polytrichum longisetum* | I (1–4) | I (1) | | I (1–4) |
| *Cladonia cervicornis* | I (1–4) | I (1) | | I (1–4) |
| *Cladonia crispata* | I (1–4) | | | I (1–4) |
| *Cetraria islandica* | III (1–4) | V (1–4) | III (1–6) | III (1–6) |
| *Cladonia arbuscula* | II (1–6) | III (1–4) | I (1–3) | II (1–6) |
| *Cladonia gracilis* | I (1) | II (1–3) | I (1–3) | I (1–3) |
| *Alectoria nigricans* | I (1) | II (1–3) | I (1) | I (1–3) |
| *Empetrum nigrum hermaphroditum* | I (1–3) | II (1–4) | I (1) | I (1–4) |
| *Cladonia squamosa* | I (1) | II (1–3) | | I (1–3) |
| *Kiaeria starkei* | | II (1–4) | | I (1–4) |
| *Polytrichum alpinum* | III (1–6) | II (1–4) | IV (1–4) | III (1–6) |
| *Salix herbacea* | III (1–8) | I (1–4) | IV (1–6) | III (1–8) |
| *Alchemilla alpina* | II (1–8) | I (1–6) | V (1–8) | III (1–4) |
| *Silene acaulis* | | I (1) | V (1–7) | II (1–7) |
| *Thymus praecox* | I (1–4) | | IV (1–4) | II (1–4) |
| *Luzula spicata* | I (1–3) | I (1) | IV (1–3) | II (1–3) |
| *Armeria maritima* | I (1) | I (1–3) | IV (1–6) | II (1–6) |
| *Polygonum viviparum* | | | V (1–4) | II (1–4) |
| *Rhytidiadelphus loreus* | II (1–4) | I (1–3) | III (1–4) | II (1–4) |
| *Juncus trifidus* | I (1) | II (1–6) | III (1–4) | II (1–6) |
| *Hylocomium splendens* | I (1) | I (1–4) | III (1–4) | II (1–4) |
| *Pleurozium schreberi* | I (1–3) | I (1) | III (1–4) | I (1–4) |
| *Sphaerophorus globosus* | I (1–3) | I (1) | III (1–3) | I (1–3) |
| *Ptilidium ciliare* | I (1) | I (1) | III (1–3) | I (1–3) |
| *Deschampsia cespitosa* | I (1) | I (1–4) | III (1–6) | I (1–6) |
| *Sibbaldia procumbens* | I (1) | | III (1–4) | I (1–4) |

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**Floristic table U10** (*cont.*)

| | a | b | c | 10 |
|---|---|---|---|---|
| *Minuartia sedoides* | | I (1–4) | III (1–6) | I (1–6) |
| *Aulacomnium turgidum* | | | III (1–4) | I (1–4) |
| *Ochrolechia frigida* | I (1–4) | I (1) | II (1–4) | I (1–4) |
| *Omalotheca supina* | I (1) | I (1) | II (1–3) | I (1–3) |
| *Selaginella selaginoides* | I (1) | | II (1–3) | I (1–3) |
| *Antennaria dioica* | I (1–3) | | II (1–4) | I (1–4) |
| *Achillea millefolium* | | | II (1–4) | I (1–4) |
| *Racomitrium heterostichum* | I (1–4) | I (1) | II (1–4) | I (1–4) |
| *Hypnum hamulosum* | | | II (1–4) | I (1–4) |
| *Hypnum callichroum* | | | I (1–3) | I (1–3) |
| *Rumex acetosa* | | | I (1–3) | I (1–3) |
| *Drepanocladus uncinatus* | | | I (1–3) | I (1–3) |
| *Peltigera canina* | | | I (1–3) | I (1–3) |
| *Vaccinium vitis-idaea* | II (1–6) | II (1–6) | II (1–6) | II (1–6) |
| *Dicranum fuscescens* | II (1–6) | II (1–6) | II (1–4) | II (1–6) |
| *Cornicularia aculeata* | II (1–3) | II (1–6) | II (1–3) | II (1–6) |
| *Dicranum scoparium* | III (1–4) | II (1–3) | II (1–4) | II (1–4) |
| *Agrostis canina* | III (1–4) | I (1–3) | III (1–4) | II (1–4) |
| *Agrostis capillaris* | II (1–6) | I (1–4) | II (1–4) | II (1–6) |
| *Huperzia selago* | I (1–3) | II (1–3) | II (1–3) | II (1–3) |
| *Diplophyllum albicans* | II (1–4) | I (1–3) | II (1–3) | II (1–4) |
| *Polytrichum piliferum* | II (1–4) | I (1–3) | II (1–3) | II (1–4) |
| *Nardus stricta* | I (1–4) | I (1–4) | I (1) | I (1–4) |
| *Diphasium alpinum* | I (1–6) | I (1–3) | I (1–3) | I (1–6) |
| *Nardia scalaris* | I (1–4) | I (1–4) | I (1–3) | I (1–4) |
| *Cladonia furcata* | I (1–3) | I (1–3) | I (1–3) | I (1–3) |
| *Pohlia nutans* | I (1–3) | I (1–3) | I (1–3) | I (1–3) |
| *Polytrichum alpestre* | I (1–4) | I (1–3) | I (1–3) | I (1–4) |
| *Solidago virgaurea* | I (1–3) | I (1–3) | I (1–3) | I (1–3) |
| *Thamnolia vermicularis* | I (1–3) | I (1–3) | I (1–3) | I (1–3) |
| *Viola palustris* | I (1–4) | I (1) | I (1–4) | I (1–4) |
| *Campylopus paradoxus* | I (1–3) | I (1) | I (1–3) | I (1–3) |
| *Loiseleuria procumbens* | I (1) | I (1–4) | I (1–3) | I (1–4) |
| *Cladonia rangiferina* | I (1–3) | I (1–4) | I (1) | I (1–4) |
| *Andreaea alpina* | I (1) | I (1) | I (1–3) | I (1–3) |
| *Juncus squarrosus* | I (1–4) | I (1–3) | I (1–3) | I (1–4) |
| *Anastrepta orcadensis* | I (1–3) | I (1–3) | I (1–3) | I (1–3) |
| *Cladonia pyxidata* | I (1–3) | I (1–3) | I (1–3) | I (1–3) |
| *Polytrichum juniperinum* | I (1) | I (1–4) | | I (1–4) |
| *Viola riviniana* | I (1–4) | | I (1–3) | I (1–4) |
| *Succisa pratensis* | I (1–3) | | I (1) | I (1–3) |
| *Carex panicea* | I (1–4) | | I (1–3) | I (1–4) |
| *Racomitrium fasciculare* | I (1–3) | | I (1–4) | I (1–4) |

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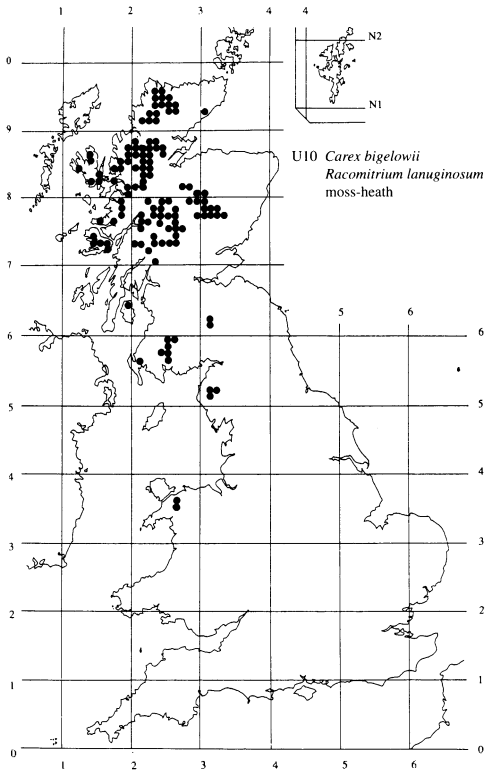
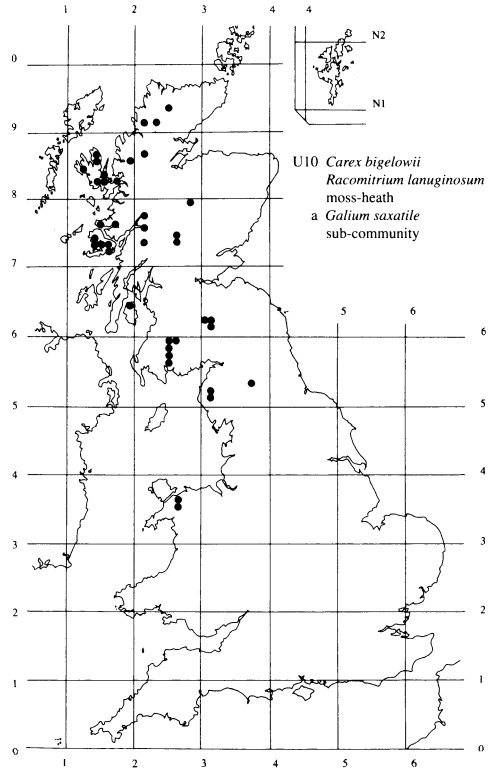
| | | | | |
|---|---|---|---|---|
| Number of samples | 65 | 52 | 45 | 162 |
| Number of species/sample | 18 (7–26) | 13 (6–25) | 30 (16–60) | 20 (6–60) |
| Herb height (cm) | 5 (2–15) | 5 (2–13) | 5 (2–8) | 5 (2–15) |
| Herb cover (%) | 62 (1–100) | 77 (20–100) | 85 (25–100) | 72 (1–100) |
| Ground layer height (mm) | 29 (4–60) | 32 (20–80) | 25 (10–40) | 31 (4–80) |
| Ground layer cover (%) | 62 (5–100) | 73 (4–100) | 98 (95–100) | 65 (4–100) |
| Altitude (m) | 666 (206–976) | 909 (160–1166) | 850 (569–1089) | 787 (160–1166) |
| Slope (°) | 9 (0–65) | 8 (0–75) | 11 (0–40) | 10 (0–75) |

a *Galium saxatile* sub-community
b Typical sub-community
c *Silene acaulis* sub-community
10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath (total)

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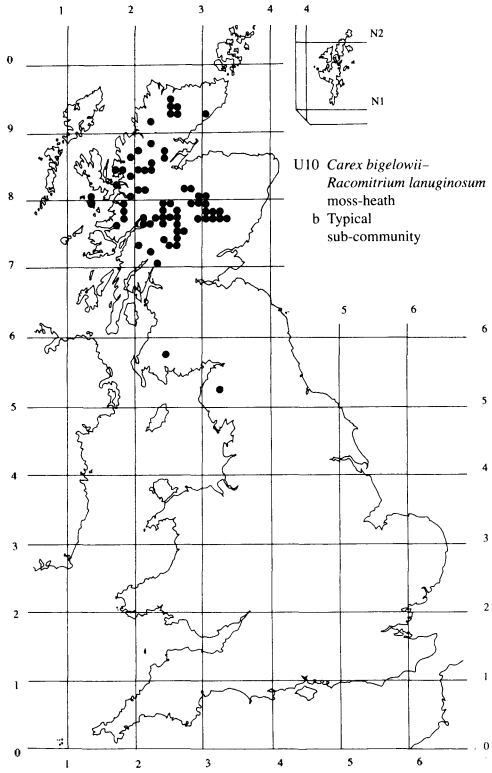


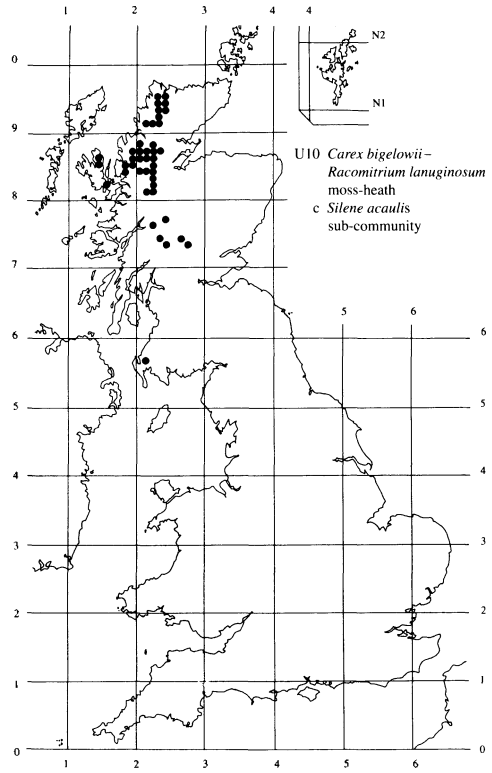


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