
M1

Sphagnum auriculatum bog pool community

Synonymy

Sphagnetum Rankin 1911*b p.p.*; *Sphagnetum* regeneration complex Tansley 1939 *p.p.*; *Scheuchzeria palustris* vegetation Sledge 1949; *Drosera intermedia-Schoenus nigricans* Gesellschaft Braun-Blanquet & Tüxen 1952 *p.p.*; *Sphagnum* Hummock Complex, *Sphagnum cuspidatum* & *S. pulchrum* phases Rose 1953; Pool & furrow communities Pearsall 1956; Pool communities Ratcliffe & Walker 1958, Boatman & Armstrong 1968, Moore 1977, Boatman *et al.* 1981; *Rhynchospora-Sphagnum* vegetation Newbould 1960; *Trichophoreto-Eriophoretum* pool component McVean & Ratcliffe 1962; *Eriophorum angustifolium-Sphagnum cuspidatum* Association Birks 1973; *Rhynchosporium albae* Koch 1926 *sensu* Birse 1980 *p.p.*; *Caricetum limosae* Dierssen 1982 *p.p.*, Osvald 1923 *emend* Dierssen 1978 *sensu* Birse 1984 *p.p.*; Pool communities 2.ii & 2.iii Hulme & Blythe 1984; Peatland nodes 13–20 Lindsay *et al.* 1984; *Sphagnum* lawn bog hollows NCC New Forest Bogs Report 1984.

Constant species

Eriophorum angustifolium, *Menyanthes trifoliata*, *Sphagnum auriculatum*, *S. cuspidatum*.

Rare species

Hammarbya paludosa, *Rhynchospora fusca*, *Scheuchzeria palustris*, *Utricularia intermedia*, *Sphagnum pulchrum*.

Physiognomy

The *Sphagnum auriculatum* bog pool community typically consists of floating masses or soft wet carpets of Sphagna with scattered vascular plants growing on or through them or in areas of open water between. The dominant Sphagna are *S. auriculatum* (including var. *inundatum*, sometimes considered within *S. subsecundum*) and *S. cuspidatum*: the constancy and general abundance of the former, together with the rarity here of *S. recurvum*, provide a good contrast with the closely-related *Sphagnum cuspidatum/recurvum* bog pools.

Locally, throughout the range of the community, the bright orange-yellow *S. pulchrum* provides a conspicuous enrichment of this element of the vegetation, growing semi-submerged with the other species (as on Brishie bog, the only one of the Silver Flowe mires in Dumfries and Galloway where Ratcliffe & Walker (1958) found it) or as a somewhat firmer mat upon them (as on some of the lowland English valley mires described by Rose (1953) who distinguished a separate *S. pulchrum* phase). Then, where these species provide a more substantial base, there can be some *S. papillosum*, occasionally with *S. subnitens* or *S. tenellum*, and, in patches raised above the water level, even a little *S. magellanicum* or *S. capillifolium*. Generally, however, these species are of low frequency and cover and, on mires with a well-defined surface patterning, they represent a clear transition from the *Sphagnum auriculatum* community to the lawns and hummocks of the pool surrounds. Other bryophytes are generally scarce but *Cladopodiella fluitans* is characteristic of this kind of vegetation at low frequencies and there can also be some *Gymnocolea inflata*.

Among the vascular plants, the commonest throughout are *Menyanthes trifoliata* (another good preferential against the *Sphagnum cuspidatum* bog pools) and *Eriophorum angustifolium*. Together, these usually make up a cover of less than 30% over the more intact carpets of Sphagna, though they often extend out as a sparse but quite tall cover into areas of deeper open water where the semi-aquatic Sphagna are reduced to scattered, flaccid and submerged shoots. Such barer patches tend to be more common here than in the *Sphagnum cuspidatum/recurvum* community and they quite frequently have some *Utricularia* spp., usually *U. minor* or, more locally, *U. intermedia*, occasional specimens of Littorelletea species such as *Eleocharis multicaulis*, *Juncus bulbosus* and *Potamogeton polygonifolius* and a thick algal growth in which *Batrachospermum* spp. figure prominently. In some areas, *Carex limosa* is a frequent component of such stands (e.g. Sledge 1949, Hulme 1985, Birse 1984 who placed his samples in a *Caricetum limosae*),

though, being a somewhat shy flowerer, it can be easily overlooked. On many north-western mires on which the *Sphagnum auriculatum* community is represented, there is a continuous structural and floristic transition through these more open stands to what Sjörs (1948) called 'mud bottoms', deeper pools with little more than submerged accumulations of wind-blown *Molinia caerulea* litter over muddy peat (e.g. Ratcliffe & Walker 1958, Lindsay *et al.* 1984).

Also very characteristic of this community, though more strictly confined to shallower water around pool margins or extending across smaller mire pools, is *Rhynchospora alba*. Unlike *E. angustifolium* which is conspicuous throughout the year with its often red-tipped leaves with long triquetrous tips, *R. alba* dies back in winter to slender, green, spindle-shaped perennating structures hidden by the old leaf-bases and is then easily missed. In Hampshire and east Dorset, and at a few scattered localities through the range of the community, *Sphagnum auriculatum* bog pools also provide a major locus for the much rarer *R. fusca* (Newbould 1960, Moore 1977, British Ecological Society Mires Group unpub.). Then, among the *Sphagnum* carpet, there can be occasional plants of *Narthecium ossifragum*, *Drosera rotundifolia* and, more locally, *D. anglica* (and sometimes the hybrid between these two sundews, *D. × obovata*) or *D. intermedia*. *Pinguicula lusitanica* has been recorded from some stands and also the rare *Hammarbya paludosa*, an inconspicuous orchid typically found in the transition zone to surrounding hummocks. Finally among these species of more restricted national distribution, the only surviving plants of *Scheuchzeria palustris* in Britain, on Rannoch Moor on the Argyll/Perth border, occur in this community, in stands with frequent *Carex limosa* and *Drosera anglica* (Sledge 1949), an association characteristic of both its extinct English stations and its Eurasian localities (Katz 1926, Hegi 1965, Tallis & Birks 1965).

Also around the pool margins, *Molinia caerulea* can extend down from the mire surface, though its cover is generally low and it is typically not tussock-forming. Occasionally there may also be a little *Myrica gale*, *Scirpus cespitosus* or *Erica tetralix*.

Habitat

The *Sphagnum auriculatum* community is confined to pools and wetter hollows on ombrogenous and topogenous mires with base-poor and oligotrophic raw peat soils in the more oceanic parts of Britain. Where mires are grazed or burned, the wetness of the ground affords some protection to this vegetation but it has been reduced on many sites by draining and cutting of the peat.

Of our two major *Sphagnum*-dominated Rhynchosporion pool communities of bog peats, this is the more oceanic in its distribution. By and large, it is restricted to

the far west of Britain, where annual precipitation exceeds 1200 mm (*Climatological Atlas* 1952) with more than 180 wet days yr^{-1} (Ratcliffe 1968), and to south-western valley mires, where local topography maintains a consistently high water-table in an area with an Atlantic climate. Within the former region its range coincides closely with that of the *Scirpus-Eriophorum* mire, in the latter with the distribution of the floristically similar *Narthecio-Sphagnetum* mire, and it typically comprises the pool and wet hollow component in these two communities.

A major part of the difference between the community and its analogue in the eastern lowlands of Britain, the *Sphagnum cuspidatum/recurvum* community, is the increased prominence here of *S. auriculatum*, a feature seen not only in Rhynchosporion vegetation and in the wetter flats of the mires in which these pools occur, but also in sedge- and rush-dominated *Sphagnum* carpets of oligotrophic soligenous areas in mires, heaths and grasslands in moving into the western parts of Britain. But other positive floristic features of the *Sphagnum auriculatum* community may be a coincidental reflection of the fact that the bog pool habitat has become very scarce outside the more oceanic parts of Britain because of the extensive draining of lowland mires. *Menyanthes*, for example, though much commoner here than in the *Sphagnum cuspidatum/recurvum* community, is widely recorded in other kinds of open water transition in the eastern lowlands and, of the other preferentials, only *Pinguicula lusitanica* has an oceanic distribution through Europe as a whole. Thus, *Rhynchospora fusca*, *Drosera anglica*, *D. intermedia* and *Carex limosa*, though more frequent here, are occasionally found in *Sphagnum cuspidatum* bog pools and have a Continental Northern range in Europe. *Sphagnum pulchrum*, likewise, is only western in Britain (Ratcliffe 1968). *Hammarbya*, though not recorded in *Sphagnum cuspidatum/recurvum* pools, has a number of old stations within their range and *Scheuchzeria palustris* a few (Sledge 1949). These species, then, are probably best regarded as plants which maintain their general affinities with Rhynchosporion vegetation in Britain but which have become increasingly confined to one particular kind of bog pool because of regional differences in the intensity of mire drainage.

Whether such real floristic differences as there are between the two communities are based directly on climate is unknown. Certainly, there seems little in the character of the peats and waters to separate the two types of bog pool: the pH range here, varying from 3 to 5, is only a little broader than in the *Sphagnum cuspidatum/recurvum* community and both are generally typical of acidic and impoverished substrates.

Throughout its range, the *Sphagnum auriculatum* community occupies wetter situations on the vegetated mire surface, comprising the shallow pool and wet

hollow element in patterned systems. The distinctness of such patterning and the relative contribution of this component are very varied, but there is a clear tendency for pools and hollows to become proportionately more important in moving to the far north-west of Britain (e.g. Lindsay *et al.* 1984). In the lowland valley mires in which the community is represented, the hollows are generally small with a fairly smooth transition to the hummocks, whereas around the western sea board of Scotland, the blanket and raised mires can have complex and extensive systems of well-defined pools, locally so numerous as to give the surfaces a shining appearance (hence the name Silver Flowe: Ratcliffe & Walker 1958; see also photographs in Moore 1977, Ratcliffe 1977, Boatman *et al.* 1981). Even on the same stretch of mire, pools can vary considerably in size and shape. They may be but a few metres long to over 50 m in their longer dimension and, though deeper pools tend to be of the 'mud-bottom' type, the community can extend down in fragmentary form to depths of about 25 cm (Ratcliffe & Walker 1958, Lindsay *et al.* 1984). Pools can be straight, curved, simple, branched or irregular in shape though, at many sites, there is a strong tendency for them to be elongated and oriented along the contours of gently-sloping mire surfaces with more rounded, island-dotted pools on flatter areas. The overall effect is thus often of arcs or eccentric rings of pools with hummocks between.

Just how such pools form is a matter of considerable debate, though most authorities now discount Pearsall's (1956) suggestion that mire corrugations arise by wrinkling and tearing of the peat as it moves under gravitational flow (Ratcliffe & Walker 1958, Boatman & Armstrong 1968, Boatman & Tomlinson 1973, Boatman *et al.* 1981). Neither do surface freeze-thaw effects (Moore & Bellamy 1973) nor wind erosion (Osvald 1949) nor a combination of the two seem adequate to account for the origin of pools, though Ratcliffe & Walker (1958) considered that deeper pools could only have developed from shallower ones by wind and water erosion. More likely seem to be proposals that pools form in areas where mire waters collect, either over depressions in the underlying mineral basins (Osvald 1923, Goode 1970, Birks 1973, Boatman & Tomlinson 1977, Boatman *et al.* 1981) or where waters are channelled within mires or from their surrounds (Ratcliffe & Walker 1958, Boatman & Tomlinson 1973), differentiating from initials of more aquatic Sphagna on the very wet and more or less level mire surface. Boatman (1977) has suggested that, in the climatic conditions characteristic of such mires as those of the Silver Flowe, such nuclei might be inherently unstable, tending to degenerate into self-maintaining pools, because of the sub-optimal growth of *S. cuspidatum*, an abundant species even in this community (see also Boatman & Tomlinson 1977, Boatman *et al.* 1981). It was also thought possible that colonisation of

pool surrounds by the more robust *S. papillosum* might be set back where the free-floating and flaccid shoots of *S. cuspidatum* were blown across the water and deposited as a smothering mass (Boatman & Tomlinson 1977). Such observations as these cast some doubt on the traditional view of regenerative alternations between pools and hollows on the one hand and flats and hummocks on the other (Osvald 1923, Tansley 1939) and stratigraphic evidence seems to support the view that, in sites like the Silver Flowe and the Claish/Kentra mosses in Argyll, the pools are quasi-permanent structures. The same is probably true of the larger pool systems in the New Forest and Dorset valley mires.

Once pools are established, it is relatively easy to see how they might take on the distinctive shapes and alignments seen in more extensive systems. Thus, larger pools could form by the flooding of low intervening strips of vegetation between smaller ones. Only where such initials lie on the same contour can water level be maintained evenly throughout the new, enlarged pool, so pools on flatter mire surfaces can enlarge in all directions, whereas those on gently-sloping areas tend to become elongated along the contours (Boatman & Armstrong 1968, Boatman & Tomlinson 1973, Boatman *et al.* 1981). In some situations, differential peat growth above and below long pools on slopes could pond back mire waters and allow fusion at right angles to the slope (Boatman *et al.* 1981).

Zonation and succession

On more featureless mires, the *Sphagnum auriculatum* community can contribute to ill-defined areas of wetter vegetation (e.g. Newbould 1960, Goode & Lindsay 1979, Boatman *et al.* 1981), but it is best developed as the pool and wet hollow component in certain patterned Erico-Sphagnion mires where it grades, with increasing height above the water-table, to flat and hummock vegetation. There is only limited evidence that such mosaics represent a full regenerative sequence of alternating pools and hummocks.

Throughout western Britain, the community is found most consistently within the *Scirpus-Eriophorum* mire, on domed or slightly sloping areas within blanket mire or in areas which bear a more obvious resemblance to raised mire. Where surface patterning is pronounced, it passes, round the margins of pools and wetter hollows to the *Drosera-Sphagnum* sub-community of the mire proper, with a switch in the *Sphagnum* carpet from *S. auriculatum* and *S. cuspidatum* to *S. papillosum*, *S. subnitens* and *S. tenellum* (and, locally, *S. magellanicum*) and thence to *S. capillifolium*. *Drosera rotundifolia* and, more locally, *D. anglica* run some way into this transitional vegetation, *Narthecium* and *Eriophorum angustifolium* much further; and there is a substantial increase in *Molinia* and *Erica tetralix* and an appearance of *Erio-*

phorum vaginatum and *Scirpus cespitosus*. Mixtures of these species continue on as vascular dominants of the *Cladonia* sub-community of the *Scirpus-Eriophorum* mire which typically makes up the vegetation cover of the hummock sides and tops in such systems. The vertical stratification of the major species in relation to water-table is well seen in profiles from the Silver Flow mosses (Ratcliffe & Walker 1958) and Kentra Moss (British Ecological Society Mires Group unpub.). On degraded blanket mires in western Britain, fragmentary *Sphagnum auriculatum* pools may persist in the *Juncus-Rhytidiadelphus* sub-community of the *Scirpus-Eriophorum* mire. On moving further east in Scotland, where the *Erica-Sphagnum* mire replaces the *Scirpus-Eriophorum* mire on lowland raised bogs, the *Sphagnum auriculatum* bog pool is replaced by the *Sphagnum cuspidatum/recurvum* type, and intermediate stands may be encountered in the transitional zone.

In southern lowland valley bogs, the *Sphagnum auriculatum* community occupies an analogous position in patterned *Narthecio-Sphagnetum* mire, though here hummock-hollow systems tend to be less well defined and there is the complication of soligenous influence along the axes and around the margins of the bogs. Also, *Sphagnum capillifolium* and *Eriophorum angustifolium* play a less prominent role in the drier elements of the vegetation than to the north-west. But, these things apart, the general pattern is the same: typically, the community gives way to the *Sphagnum-Rhynchospora* sub-community of *Narthecio-Sphagnetum* mire, *S. papillosum*, *S. tenellum* and *S. subnitens* increasing their cover and *Molinia*, *Erica tetralix* and *Calluna* becoming important. Such transitions are well described in the various phases of Rose's (1953) *Sphagnum* Hummock Complex and were included in the 'general bog communities' characterised by Newbould (1960) from Cranemoor in the New Forest.

It has sometimes been assumed that such zonation as these are a spatial expression of a cyclic alternation of hollows and hummocks in regenerative bog growth (e.g. Tansley 1939) but, as noted above, the evidence for this is limited. The *Sphagnum auriculatum* community may thus often be a fairly permanent self-maintaining feature of mire surfaces with rather limited switches from more to less aquatic *Sphagna* but no guaranteed progression to the vegetation of drier flats and hummocks.

Where mire drainage lowers the water-table, the community is readily damaged or destroyed and it has been widely lost where *Erico-Sphagnion* communities have been converted to *Ericion* heaths or their degraded derivatives. Shallow peat-digging can create flooded hollows which become suitable for recolonisation by *Sphagna*, *Rhynchospora alba* and *Drosera* ssp. but such locally reconstituted stands often lie in much modified mire contexts (Rose 1953).

Distribution

The community is a widespread component of the *Scirpus-Eriophorum* mire in western Scotland and parts of the Lake District, Wales and the South-West Peninsula (and it continues into Ireland in essentially the same form, though with abundant *Schoenus nigricans*: Braun-Blanquet & Tüxen 1952). In the range of the *Narthecio-Sphagnetum* mire, it is best developed in the valley bogs of the New Forest with local occurrences elsewhere.

Floristic table M1

<i>Sphagnum auriculatum</i>	IV (1–10)
<i>Eriophorum angustifolium</i>	IV (1–7)
<i>Menyanthes trifoliata</i>	IV (1–9)
<i>Sphagnum cuspidatum</i>	IV (1–10)
<i>Utricularia minor</i>	II (1–5)
<i>Rhynchospora alba</i>	II (1–6)
<i>Potamogeton polygonifolius</i>	II (1–8)
<i>Drosera rotundifolia</i>	II (1–4)
<i>Narthecium ossifragum</i>	II (1–4)
<i>Carex limosa</i>	II (1–8)
<i>Sphagnum papillosum</i>	II (1–5)
<i>Drosera anglica</i>	II (1–4)
<i>Molinia caerulea</i>	I (1–7)
<i>Erica tetralix</i>	I (1–3)
<i>Sphagnum subnitens</i>	I (1–4)
<i>Eleocharis multicaulis</i>	I (2–6)
<i>Sphagnum palustre</i>	I (1–4)
<i>Sphagnum magellanicum</i>	I (1–8)
<i>Juncus bulbosus/kochii</i>	I (1–6)
<i>Sphagnum pulchrum</i>	I (2–9)
<i>Myrica gale</i>	I (1–4)
<i>Gymnocolea inflata</i>	I (1–2)
<i>Drosera intermedia</i>	I (1–3)
<i>Utricularia intermedia</i>	I (2–3)
<i>Scirpus cespitosus</i>	I (1–3)
<i>Cladopodiella fluitans</i>	I (1–3)
<i>Sphagnum recurvum</i>	I (8–9)
<i>Odontoschisma sphagni</i>	I (1)
<i>Rhynchospora fusca</i>	I (1–3)
<i>Scheuchzeria palustris</i>	I (1–3)
Number of samples	63
Number of species/sample	7 (2–15)
Vegetation height (cm)	20 (10–45)
Vegetation cover (%)	88 (30–100)
Altitude (m)	64 (6–280)
Soil pH	4.3 (3.2–5.1)

Affinities

Bog pool vegetation of this kind has sometimes been described as an integral part of more broadly-defined mire communities (e.g. Rankin 1911*b*, Tansley 1939, Rose 1953) but, though it is characteristically found within *Erico-Sphagnion* bogs, it is floristically distinct enough to be considered separately. Phytosociologically, it belongs to the *Rhynchosporion albae* alliance, which comprises the most calcifuge and oligotrophic of the communities dominated by *Sphagna* and cyperaceous plants within the *Scheuchzerio-Caricetea nigrae* (*sensu* Ellenberg 1978). Some stands show clear affinities with the *Littorelletea* vegetation of shallow acid bog pools and runnels, where such species as *Eleocharis multicaulis*, *Juncus bulbosus* and *Potamogeton polygonifolius* provide a link, or with the submerged aquatic vegetation with *Utricularia minor* and *U. intermedia* placed by some authorities in the *Utricularietea* (Oberdorfer 1977, Birse 1984) or a class *Utricularietalia* in the *Lemnetea* (Ellenberg 1978). Similar bog pool vegetation has been described from Ireland in the *Drosera intermedia-Schoenus nigricans* Gesellschaft (Braun-Blanquet & Tüxen 1952; see also Morrison 1959) and from Scandinavia (e.g. Nordhagen 1928, 1943, Sjörs 1948). It falls within the rather more broadly defined *Caricetum limosae* of Dierssen (1982).

