

Sphagnum divinum and *Sphagnum medium* in Britain and Ireland

Mark Hill finds out how frequent these segregates of *S. magellanicum* are in Britain and Ireland

In a recent paper, Hassel *et al.* (2018) distinguish two segregates of *Sphagnum magellanicum* in northern Europe. *S. medium* is found chiefly in ombrotrophic bogs, and is widespread in Britain and Ireland. In Europe, *S. divinum* has a wider range of habitats, occurring in mire forest and mire margins on a peat substrate. In oceanic parts of Norway, it occurs in sloping moist heath vegetation where *S. medium* is seemingly absent. It has been found in the Baltic region as well as in Germany and western Norway. Given this distribution, its presence in Britain and Ireland is very much to be expected. Indeed, Laine *et al.* (2018) assert that it is common in the British Isles, but give no detail.

In an attempt to find out how frequent *Sphagnum divinum* is in Britain, I borrowed 35 British specimens labelled *S. magellanicum* from the Royal Botanic Garden, Edinburgh (E) and examined 9 specimens of my own. I found that the distinction was unexpectedly difficult, and

asked the Norwegian *Sphagnum* expert Kjell Flatberg whether he could supply a reference specimen of *S. divinum* from Norway. He went into the field and collected specimens of both species from a mire site in the Trøndelag.

After I had examined the Edinburgh specimens, David Long sent me a photo of a plant which looked like *S. divinum*, taken in 2019 near where he had found *S. divinum* in 1999 (Fig. 1a). Another photo (Fig. 1b) from close by was clearly *S. medium*. He then sent two specimens for examination, one of which was clearly *S. medium*, but the other seemed intermediate. I therefore decided to examine further specimens of *S. magellanicum* agg., carefully checking all the main characters cited by Hassel *et al.* (2018) (Table 1). 26 extra specimens, including some from Ireland, were examined in detail.

Identification

By far the most useful character is the appearance of the divergent branches. *S. divinum* normally



△Fig. 1 (a) *Sphagnum divinum* (not examined microscopically) and (b) *S. medium* from Drone Moss, Berwickshire. David Long.

has somewhat pointed branches with branch leaves not 5-ranked and spreading at an angle less than 45° to the branch. *S. medium* has blunt branches, with branch leaves somewhat 5-ranked and spreading at an angle more than 45° to the branch. The next most useful character is the pore structure on the dorsal side of the branch leaves near their base. The pores are mostly less than half the width of the cell in *S. divinum* and greater than half in *S. medium*. I found this character rather difficult. There are often wider pores at the extreme leaf base in *S. divinum* and there may be some narrower pores in *S. medium* as illustrated in Figure 13K of Hassel *et al.* (2018). This is a useful but “soft” character and

several leaves should be examined if there is any doubt. Staining the leaves is advisable, but is not absolutely necessary as the pores are fairly easy to see in unstained material. Because of the frequent presence of broad pores in the extreme leaf base of *S. divinum*, a more quantitative criterion of the pore character was used in the analysis that follows. This was to note whether broad pores were present only in the basal cells (*S. divinum*) or also in the cells 2–3 rows up from the leaf base (*S. medium*).

The other characters are more straightforward. Chlorocyst cell walls can be observed by cutting sections of the branch leaves. The chlorocysts (green cells) are enclosed on both sides of the

▽Table 1. Diagnostic characters distinguishing *Sphagnum divinum* from *S. medium*; figure numbers refer to the paper by Hassel *et al.* (2018).

Character	<i>Sphagnum divinum</i>	<i>Sphagnum medium</i>	Figure
Branches	Somewhat pointed	Blunt	8, 12
Branch leaves	Appressed, angle to branch <45°	Spreading, angle to branch >45°	8, 12
Dorsal branch-leaf pores near leaf base	< 50% cell width	> 50% cell width	5E, 6E
Branch-leaf chlorocyst cell walls	thin	thick	5E, 6F
Stem leaf width	0.9–1.1 mm	0.75–0.9 mm	5A, 6A
Stem leaf pores in upper leaf	both pores and membrane gaps	mostly membrane gaps, rarely pores	9B, 11B

leaf and the thickness of their cell walls can be observed under the high power of an ordinary microscope. The distinction between pores and membrane gaps is that pores are rounded perforations in the cell wall, whereas membrane gaps are perforations that occupy most of the cell. Staining is advisable to observe whether pores or membrane gaps predominate; the pores or gaps are on the dorsal surface of the leaves.

Results

Of the first batch of 43 specimens examined, mostly from the Royal Botanic Garden Edinburgh (E), one was too scrappy to be identified. Four were *S. divinum* and 39 were *S. medium*. These specimens were identified mainly on the first three characters in Table 1, plus stem-leaf width. However, the more formal definition of what defines wide or narrow cells (wide in 2–3 cells above the base or wide in at most 1 row the base) was not used, and the pore width was merely judged by eye.

The next 26 specimens were examined in greater detail - a time-consuming process because each examination took about 40 minutes.

Specimens were assigned to *S. divinum* only if they had appressed leaves and pointed branches together with narrow pores in the second and third rows above the base of the branch leaves. There were 7 such specimens. The 19 others were assigned to *S. medium*.

The chlorocyst cell wall character had no value. All but one specimen (which was *S. divinum*) had narrow cell walls. There was wide variation in the width of the stem leaves, but there was indeed a significant tendency for the leaves of *S. divinum* to be wider than those of *S. medium* (Table 2). Likewise there was a tendency, nearly significant, for *S. divinum* to have stem leaves with pores rather than membrane gaps.

All the specimens assigned to *S. divinum* had narrow pores except in the lowest row of cells. However three specimens assigned to *S. medium* also lacked broad pores except in the lowest row of cells. These had spreading branch leaves. There is some doubt about the naming of these specimens, but *S. medium* was thought the more likely as it is the commoner taxon in Britain and Ireland.

The confirmed distributions of the two

▽Table 2. Diagnostic value of the last three characters in Table 1.

Character	<i>Sphagnum divinum</i> (7 specimens)	<i>Sphagnum medium</i> (19 specimens)
Branch-leaf chlorocyst cell walls	6 thin, 1 thick	19 thin
Some stem leaves > 0.95 mm wide	5 (70%)	4 (20%)
Some stem leaves < 0.75 mm wide	0	10 (50%)
Stem leaves with pores	3 (40%)	2 (10%)

species are mapped (Fig. 2). Their vice-county distributions are listed below, using the conventions of the current *Census Catalogue* (Hill *et al.*, 2008). Brackets signify that there is no confirmed specimen later than 1959.

M1.5 *Sphagnum divinum* (49), 51, 57, 67, 81. H19, 20, 22, 27.

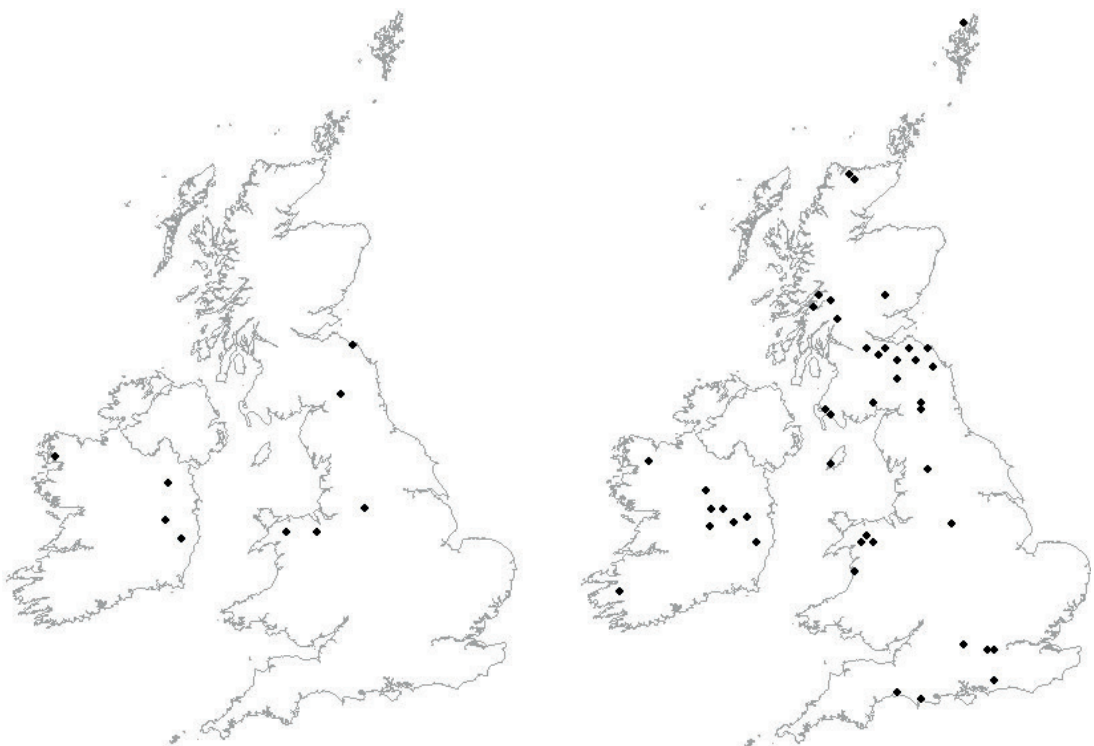
M1.5A *Sphagnum medium* 9, (13, 17), 22, 46, 49, 50, 57, 64, 67, 68, 71, 73, 74, 79, 81, 83, 84, 89, 98, 99, 108, 112. H1, 18-20, 24, 27.

Discussion and conclusions

Even with the help of the Norwegian specimen of *Sphagnum divinum* I found some specimens of British and Irish *S. magellanicum* agg. hard to

determine. The characters are variable and “soft”. It is to be hoped that British and Irish bryologists will acquire a knowledge of *S. divinum* in the field. It is a somewhat cryptic species, which was based on a limited molecular analysis. The existence of further genetic segregates cannot be ruled out.

Given that *Sphagnum divinum* has a circumpolar distribution, I had expected its distribution in Britain and Ireland to have a northern bias. Clearly this is not the case, as there are no records from north of Edinburgh. *S. medium* is signified by Hassel *et al.* (2018) as a plant of ombrotrophic bogs. In southern Britain it is also found in valley bogs, which share many of the attributes and species of more northern ombrotrophic bogs. According



△Fig. 2. Distribution of (a) *Sphagnum divinum* and (b) *S. medium* in Britain and Ireland; these distributions are very incomplete because only 68 specimens of *S. magellanicum* agg. were examined. The maps were prepared by the Biological Records Centre.



△Fig. 3 (a) *Sphagnum divinum* and (b) its habitat, an artificially dug pool on Rathduffmore Bog, Co. Wicklow. Jo Denyer.

to Hassel *et al.* (2018), *S. divinum* has a much broader niche than *S. medium*, and is typically a mire margin and mire forest species on peat substrate. In Ireland *S. divinum* has been found on three raised (ombrotrophic) bogs. In October 2019, a BBS party saw it on Rathduffmore Bog in County Wicklow (Fig. 3), where the bog had been disturbed by digging, so it may be favoured by disturbance. There is some evidence that *S. divinum* is relatively more frequent in Ireland than in Britain, but this is not statistically significant.

Acknowledgements

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Appendix

Records to support the vice-county distribution of *Sphagnum medium* and *S. divinum* are given here. Each is the most recent record for its vice-county. Records other than those in E and TCD are in the private herbaria of their collectors. Accession numbers in E are included with the records. The specimen of *S. divinum* from vice-county 49 came to Edinburgh from the University of Lancaster (LANC) and lacked details of the collector. Albert Wilson had moved from Lancashire to the Conway Valley and reported *Sphagnum magellanicum* from Llyn y Parc in 1947 (Wilson 1946-47, p. 194), so he is taken to be the collector in 1944.

Collectors of specimens

BioForest team, H.J.B. Birks, T.L. Blockeel, D.A. Callaghan, B.J. Coppins, M.F.V. Corley, A.C. Crundwell, J. Denyer, B. Hammong, S. Hickey,

M.O. Hill, D.L. Kelly, A.G. Kenneth, N. Lockhart, D.G. Long, P. Martin, C. O'Connell, J. O'Reilly, S.L. Pilkington, R. Saville, A.McG. Stirling, C.C. Townsend, E.V. Watson, A. Wilson.

Sphagnum divinum. **49:** wood, west of Llyn y Parc, SH75, 1944, Wilson E00905592, specimen ex Lancaster (E); **51:** boggy moorland, nr Rhydtalog, SJ249547, 1972, Hill; **57:** on blanket bog, Torside Naze, Bleaklow, SK0788097791, 2015, Blockeel 45/703; **67:** wet moorland, 420 m alt., below Gill Pike, Kielder Forest, NY615838, 1995, Townsend 95/128 E00905589 (E); **81:** peaty holes at edge of conifer plantation, 220 m alt., Penmanshiel Moss, NT828683, 1999, Long 28548 E00049865 (E); **H19:** hummocks on bog, Mouds Bog, N790188, 1983, Lockhart; **H20:** disturbed peaty ground on raised bog, Rathduffmore Bog, nr Knockanna, T00548262, 2019, Hill; **H22:** raised bog, Girley Bog, N7031470014, 2019, Denyer; **H27:** peat soil, blanket bog, 25 m alt., Ballyveeney, near Mallaranny, F839050, 2004, BIOFOREST team (TCD).

Sphagnum medium. **9:** boggy ground, Moreton Heath, SY790873, 1971, Hill; **13:** Heyshott Common, SU91, 1951, Crundwell E00905596 (E); **17:** West End Common, nr Bisley, SU96, 1953, Crundwell E00905595 (E); **22:** valley bog, Snelsmore Common, SU47, 1966, Corley E00905594 (E); **46:** raised bog, Borth Bog, SN69, 1968, Coppins E00905591 (E); **49:** moorland, Migneint, SH7745, 2008, Pilkington; **50:** raised bog on watershed, by A5 near Cerrigydrudion, SH9449, 1986, Hill; **57:** wet heath, with *Calluna*, *Eriophorum* and *Vaccinium oxycoccos*, Leash Fen, SK2977074150, 2016, Blockeel 45/278; **64:** raised bog, Malham Tarn Moss, SD8866, 1993, Blockeel 22/243; **67:** in bog/poor fen transition, with *S. fallax*

and *S. papillosum*, 295 m alt., Rushy Rigg, NY71037601, 2019, O'Reilly; **68:** bog pools on floating raft of peat, Ford Moss, NT9737, 1964, Birks E00422694 (E); **71:** grazed acidic mire on hill slope, 234 m alt., Glen Rushen, SC2352675759, 2019, Callaghan 88045; **73:** raised bog, under thin *Pinus sylvestris*, Kirkconnell Flow, NX9770, 1976, Hill; **74:** raised bog, Mark of Luce Moss, NX268598, 1975, Hill; **79:** hummocky bog in hollow, 280 m alt., west end of Alemoor Reservoir, NT38551476, 2010, Long 39537 E00905604 (E); **81:** peaty hollow at margin of raised bog, among *Trichoporum* and *Empetrum*, 210 m alt., Drone Moss, Coldingham Moor, NT84656684, 2019, Long; **83:** Red Moss, Pentlands, NT16, 1992, Saville E00452909 (E); **84:** blanket bog, Blawhorn Moss nr Backridge, NS8868, 1975, Long 4698 E00905613 (E); **89:** raised bog, Alyth Forest, NO15, 2006, Denyer; **98:** bog, nr Benderloch, NM93, 1968, Corley E00391669 (E); **99:** moorland, 530 m alt., S side of Ben Glas Burn, head of Loch Lomond, NN31, 1963, Crundwell E00905601 (E); **108:** bog, lower slopes of Ben Loyal, NC64, 1971, Watson E00905598 (E); **112:** flat area of bog on moorland, Yell, Rigga Dale SW of Gloup, HP497027, 1972, Hill; **H1:** bog, near Gallavally Wood, V8916881298, 2019, Martin; **H18:** raised bog, Cadamstown, N2109, 1982, O'Connell; **H19:** Ballynafagh Bog, N814278, 1982, O'Connell; **H20:** raised bog, Rathduffmore Bog, nr Knockanna, T00488266, 2019, Hill; **H24:** raised bog, Mount Jessop Bog SAC, N130698, 1982, Hammong; **H27:** quaking bog by lochan, Massbrook, nr Pontoon, G10, 1970, Kelly (TCD).