Identification

Orthotrichum – Britain's bristle-mosses

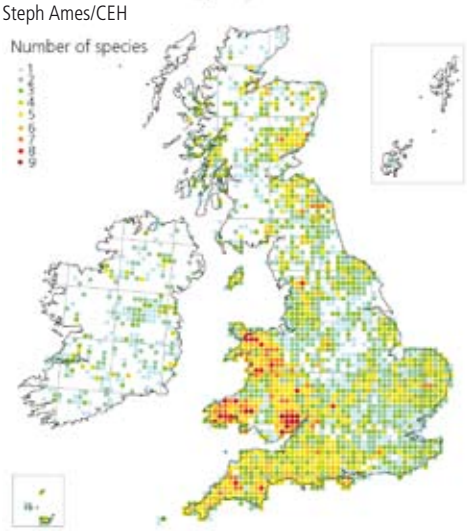
Sam Bosanquet

Orthotrichum affine. Sam Bosanquet

The moss genus *Orthotrichum* includes 19 British species, 16 of which are obligate epiphytes that grow on woody plants. They form a reasonably discrete group, with only a few confusion species in other genera. As such, *Orthotrichum* is a potential gateway into bryology, although the currently available identification guides (Smith 2004; Watson 1980) make the genus seem complicated and difficult to fathom. This was not helped by the scarcity of all but one or two *Orthotrichum* in most of England during the 20th century, when atmospheric pollution severely limited their distribution. This pollution, caused particularly by SO_2, led to the loss of *O. striatum*, *O. stramineum* and others from several counties, and the complete loss of *O. obtusifolium* from southern Britain. Cleaner air in the last few decades has allowed these losses to be reversed, and at the same time a few continental European *Orthotrichum* have started spreading into Britain. *British Wildlife* readers will have seen species such as *O. consimile*, *O. obtusifolium* and *O. speciosum* appearing regularly in the Wildlife reports section because of these range changes. These factors make this a particularly interesting genus to study, and one for which *British Wildlife* readers can contribute significant records.

The members of the genus are small to medium-sized acrocarpous mosses: they form tufts that are 0.5cm to 4cm tall, are often slightly branched, and have spore capsules borne terminally on shoots, or on short side branches. Most species are opaque mid-green, dirty green or dark green. Their leaves are almost parallel-sided, tapering very gradually from the base, and have tips that are anything from rounded to sharply pointed. Sporophytes (spore capsules) are produced annually from late spring to summer by most epiphytic *Orthotrichum*, but three British species fruit rarely and instead reproduce primarily by using gemmae (asexual buds on the leaf surfaces). The sporophytes are light brown and roughly egg-shaped, tapering below into the seta (their supporting stalk) and opening at the top to release spores. In most species they are smooth when moist, but become furrowed when dry. Around the open mouth of the spore capsule is a double row of delicate teeth, forming a peristome that helps with spore release. The inner row (endostome) usually has 8 or 16 narrow teeth; the outer row (exostome) has 8 or 16 wider teeth. In most species, very slightly differentiated leaves (termed perichaetial leaves) surround the sporophyte and partly hide it from view; a few *Orthotrichum* have relatively long setae that hold their spore capsules above the

Map of the British Isles showing the number of *Orthotrichum* species recorded in each 10km square.
Steph Ames/CEH



perichaetial leaves. Unripe sporophytes are covered by a thin, membranous hood called a calyptra, and the English name of 'bristle-mosses' refers to the erect hairs on the calyptrae of many species.

Epiphytic *Orthotrichum* grow on a wide range of host trees, but favour those with base-rich bark, such as Ash *Fraxinus excelsior*, Hazel *Corylus avellana*, poplars *Populus*, Sycamore *Acer pseudoplatanus* and willows *Salix*. The moisture-retentive bark of Elder *Sambucus nigra* is particularly favoured in eastern England, whilst Aspen *Populus tremula* has been found to be a very productive host tree in eastern Scotland. There is great variation from tree to tree, and adjacent trunks can have completely different epiphyte floras. One tree in a woodland, perhaps with slightly rougher bark, can support hundreds of tufts of four or five *Orthotrichum* species, whilst the next may hold nothing. Both trunks and branches are used, and the commoner *Orthotrichum* seem to show little preference for one or the other. In drier areas, sloping trunks or areas below forks may be more productive because they receive marginally more rainwater run-off. A good *Orthotrichum* tree on a woodland edge in Wales, western England or southern Scotland can hold seven or eight species alongside a rich array of other epiphytes, such as *Cryphaea heteromalla*, *Neckera pumila*, *Frullania dilatata*, *Metzgeria* spp. and *Radula complanata*. The most exposed parts of Britain are generally poor for *Orthotrichum*, and there are zones in Pembrokeshire, Anglesey and especially Cornwall where the genus is rare (see map)

Box 1 Key to common British epiphytic *Orthotrichum*

The following field key is adapted from the forthcoming *British Mosses and Liverworts – a Field Guide* (Atherton *et al.* in prep.) and covers the nine common epiphytic *Orthotrichum*. Not all specimens can be named with it, and those without ripe capsules are very unlikely to be identifiable.

1 Leaves ending in a white 'hair-point' . . . . . *O. diaphanum*
'Hair-point' absent 2

2 Gemmae clearly visible with x10 lens all over leaf surface . . . . . *O. lyellii*
Gemmae absent or clearly visible only under a microscope 3

3 Mosses on trees by silty rivers 4
Mosses on trees away from silty rivers 5

4 Leaf tips bluntly rounded; plants dark green . . . . . *O. rivulare/sprucei*
Leaf tips pointed; plants mid-green or dirty green 5

5 Plants vivid green; leaves very short (<2mm long), with acute tips; leaves appressed to stem when dry, rapidly spreading when wetted . . . . . *Zygodon* spp.
Plants dull green or with longer, blunter leaves; if vivid green, leaves curled when dry 6

6 Capsule on seta long enough to hold it well above leaves; leaves curled when dry 7
Capsule either hidden among leaves or only just visible projecting from among them; leaves straight when dry 8

7 Calyptra covered with abundant, orange-brown hairs; calyptra >3x as long as wide, with hairs obscuring dark tip . . . . . *Ulota bruchii/U. crispa*
Calyptra with sparse, pale green hairs; <3x as long as wide, with dark tip and with dark spots around its lower edge . . . . . *O. pulchellum*

8 Calyptra hairless, with dark tip contrasting strongly with papery, pale lower parts; plants forming compact, rounded cushions . . . . . *O. stramineum*
Calyptra hairy (sometimes sparsely so); plants loosely branched, or tiny and narrow 9

9 Calyptra very narrow, pale green, >3x as long as wide; plants <1cm tall, with very narrow individual shoots . . . . . *O. tenellum*
Calyptra <3x as long as wide; plants >1 cm tall 10

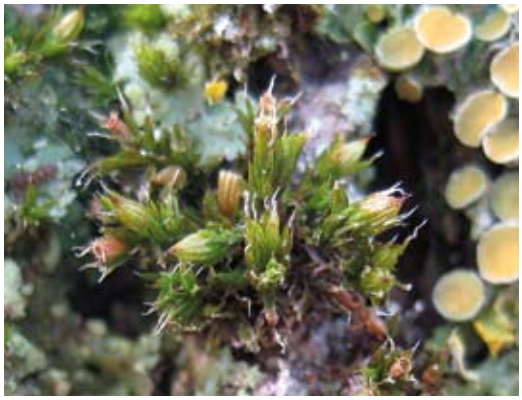
10 Dry capsules furrowed; leaves with shortly acute tips. . . . . *O. affine*
Dry capsules smooth; leaves with very narrow, sharply pointed tips . . . . . *O. striatum*

Box 2 Stomata for microscope confirmation

One useful character for separating similar species lies in the stomata, which can be found easily on halved, flattened sporophytes under a x100 microscope. Eleven species have immersed stomata, where cells partially cover the two stoma cells, whereas the other eight have superficial stomata that have the entirety of both stoma cells uncovered.

Immersed	**Superficial**
O. anomalum	*O. affine*
O. consimile	*O. gymnostomum*
O. cupulatum	*O. lyellii*
O. diaphanum	*O. obtusifolium*
O. pallens	*O. rupestre*
O. pulchellum	*O. shawii*
O. pumilum	*O. speciosum*
O. rivulare	*O. striatum*
O. sprucei	
O. stramineum	
O. tenellum	

***Orthotrichum affine*.** Sam Bosanquet



***Orthotrichum diaphanum*.** Sam Bosanquet

and *Ulota phyllantha* is the dominant epiphytic moss. Inland from these zones, most areas of woodland or scrub are likely to hold some *Orthotrichum*, although they are perhaps most diverse in humid willow carr and upland-edge Hazel woodland. Even in eastern England there are good epiphyte assemblages in some places, including city-centre parks and gardens.

The peak fruiting period for *Orthotrichum* runs from late winter to early summer, with ripe sporophytes present in most species by late spring (March to May in Pembrokeshire). Many tufts will retain a few old capsules through the rest of the year, but these gradually become more damaged as it progresses. Identification is based primarily on characters of the capsule and the calyptra that covers it, so that spring is the best time for recording the genus. Some species, such as *O. striatum*, are almost impossible to identify conclusively when their capsules are unripe, and it is always best to search for brown, ripe capsules if specimens are being collected for checking. Recording in dry weather is also much easier than when it is raining, because the curled dry leaves of *O. pulchellum* and very similar *Ulota* species are then apparent.

Widespread epiphytic *Orthotrichum*

Seven epiphytic *Orthotrichum* are sufficiently widespread to allow bryologists to encounter them regularly. One can hope to find these in many scrub patches or woodlands throughout all but the driest parts of the southern half of Britain. Two others, *O. rivulare* and *O. sprucei*, are widespread specialists of trees by silty rivers. A key to these nine species is given in Box 1. Familiarity with the field appearance of these widespread epiphytes is the only way of having a realistic chance of finding our rarer species, although the Spanish approach of collecting little bits of many *Orthotrichum* tufts and examining each one microscopically appears to be very successful in southern Europe and may reap rewards here.

Wood Bristle-moss *Orthotrichum affine*

The most abundant epiphytic member of the genus by far. It is also the most variable in appearance, and more often than not a specimen collected as a slightly odd *Orthotrichum* which does not quite match any other species will prove to be just *O. affine* when examined microscopically. It tends to form rather loose, messy tufts, but can grow as small, dense cushions. The sporophytes are more or less hidden among perichaetial leaves, and their calyptrae are pale green and usually have a few hairs, but may be hairless. There are eight light brown exostome teeth, which are bent back when dry. Dry spore capsules are strongly furrowed. A useful microscope feature is the superficial stomata (see Box 2). Forms of *O. affine* can resemble most of our other species, especially *O. lyellii*, *O. pallens*, *O. rivulare*, *O. speciosum*, *O. sprucei*, *O. stramineum*, *O. striatum* and *O. tenellum*.

White-tipped Bristle-moss *Orthotrichum diaphanum*

This differs from all of our other *Orthotrichum* in having each leaf ending in a white 'hair-point'. Its pale brown sporophytes are clearly similar in shape to those of other members of the genus, and differ from most other epiphytes with hair-points in having such short setae that the capsules are partly hidden among perichaetial leaves. Only *Schistidium* and *Grimmia*, which are found mostly on rock but are occasional epiphytes, have such short setae. The seta is strongly curved in *Grimmia pulvinata*, whilst the peristome of *Schistidium crassipilum* is bright red, unlike the pale brown teeth of *O. diaphanum*. *O. diaphanum* is also very common on concrete and tarmac, and is the most abundant *Orthotrichum* in urban areas.

Lyell's Bristle-moss *Orthotrichum lyellii*

This is among our largest *Orthotrichum*, and its loose tufts characteristically hang down from tree trunks, curving out at their tips. Its most distinctive feature is the dusting of brown gemmae over both surfaces of the leaves – through a lens, the entire plant looks to be covered with short, dark brown filaments. Sporophytes are rare, and are most similar to those of *O. striatum*, with shallow furrows when dry and 16 strongly recurved exostome teeth. *Ulota phyllantha* is sometimes confused with *O. lyellii*, but its gemmae are restricted to the leaf tips, where they look like brown pom-poms, and its leaves curl up strongly when dry. The strongest colonies

Photographs throughout are not to scale.

***Orthotrichum lyellii*.** Graham Motley

***Orthotrichum pulchellum*.** David Holyoak

***Orthotrichum rivulare*.** David Holyoak

***Orthotrichum sprucei*.** Sam Bosanquet

***Orthotrichum stramineum*.** Sam Bosanquet

***Orthotrichum striatum*.** Sam Bosanquet

of *O. lyellii* are on the trunks of old parkland Ash or oaks *Quercus*, but it occurs as scattered tufts on many hosts.

Elegant Bristle-moss *Orthotrichum pulchellum*

An aptly named, beautiful plant. Its loose tufts have leaves that are wavy when dry, unlike those of almost all other *Orthotrichum* except *O. consimile*, which have straight dry leaves. The other distinctive feature, again shared with *O. consimile*, is the relatively long seta, which holds the spore capsules high enough above the leaves that the base of each capsule can be seen. Unripe sporophytes have pale green calyptrae that are tipped with black and edged by a row of black dots. Ripe capsules have distinctive bright red exostome teeth. Willow trees in wet woodland are a favourite host of

O. pulchellum, and it can be locally abundant, for example in parts of the Norfolk Broads.

River Bristle-moss *Orthotrichum rivulare*
This is the more widespread of the two riparian specialists. Both it and *O. sprucei* differ from the non-specialists in having rounded leaf tips; these are pointed in all the others. The loose tufts are dark green, but are often heavily encrusted with silt. The light brown sporophytes and eight recurved exostome teeth are similar to those of *O. affine*, so it is useful to check the stomata microscopically. All of the other widespread species grow on riverside trees, but generally not so low down in the flood zone.

Spruce's Bristle-moss *Orthotrichum sprucei*
Similar to *O. rivulare* in its dark green colour and rounded leaf tips. It is a shorter plant, just 6-7mm tall, and often forms low turfs on silty Alder *Alnus glutinosa* or willow branches. The other main difference between the two species lies in the larger leaf cells of *O. sprucei*, but this is hard to appreciate without a microscope unless both species are present for comparison. Generally, *O. sprucei* is restricted to more mature, siltier rivers than those where *O. rivulare* is found, but there is much overlap.

Straw Bristle-moss *Orthotrichum stramineum*
Named because of its straw-coloured calyptrae, which are hairless and have dark, red-brown tips. The capsules tend to sit proud of the typically dense, rounded cushions, making the calyptrae very prominent on plants with young capsules. Mature capsules are generally a darker orange than those of *O. affine*, and when dry are pinched in more below the mouth. However, it is always best to take *O. stramineum* back to check its stomata, as the variable *O. affine* regularly mimics it and there is a slim chance that colonies with paler calyptra tips may be *O. pallens*. *O. stramineum* favours moderate altitudes, and is particularly frequent on the upland edge, as in the Black Mountains in south Wales, where Hazel and Ash are its main hosts.

Smooth Bristle-moss *Orthotrichum striatum*
Looks superficially like *O. affine*, but its sporophytes are unfurrowed when dry and have 16 off-white exostome teeth that curl back when dry. Other suggestive features include very acutely pointed leaves, and a dark, dingy green colour, but identifying this species without ripe sporophytes is unwise. It is widespread but unpredictable, and often grows as just one or two tufts on a willow, Hazel or Ash on the edge of a wood. Two near-identical species may be set to spread into southern England, so it is a very good idea to check that specimens of *O. striatum* have both an exostome and an endostome (see Box 3).

Box 3 *Orthotrichum striatum* and its relatives

Two allies of *O. striatum* were overlooked in Europe until recently. As there is a chance that both may occur in Britain, it is a good idea to check the peristome of all epiphytic *Orthotrichum* with smooth capsules. The exostome and endostome teeth are easily visible with a x10 lens.

Species	Exostome	Endostome
O. striatum	16 orange-brown teeth	16 yellowish teeth
O. shawii	16 pale brown teeth	absent or rudimentary
O. acuminatum	absent or rudimentary	8 yellowish teeth

***Orthotrichum tenellum*.** Sam Bosanquet

***Orthotrichum consimile*.** Tom Blockeel

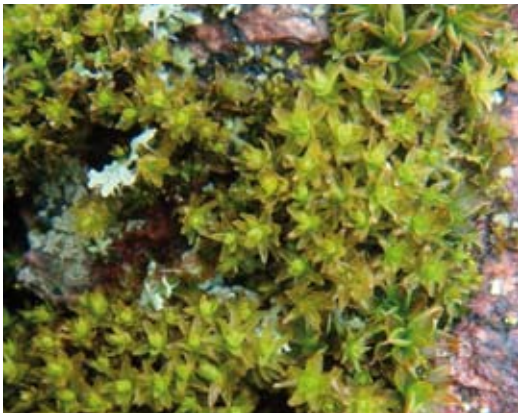
Slender Bristle-moss *Orthotrichum tenellum*
This species has characteristically slender shoots, which grow together in small, narrow tufts. The slenderness is emphasised by much longer, narrower calyptrae than in our other *Orthotrichum* species (>3x as long as wide): these hide the entire spore capsule, whereas its base is visible below the calyptra in other members of the genus, notably in the similarly small *O. pumilum*. The calyptra is light green and sparsely hairy or hairless, whilst the ripe capsule is light orange-brown. *O. tenellum* is locally abundant, especially on elms *Ulmus* and Ash, in parts of south-west Britain with a Mediterranean climate; elsewhere it is widespread but seldom grows in quantity.

Scarce and rare epiphytic *Orthotrichum*

Seven species of *Orthotrichum* are scarce or rare in Britain, with fewer than 20 extant sites and in some cases just a handful of populations. Some, including *O. obtusifolium*, *O. pallens* and *O. speciosum*, have been mentioned recently in *British Wildlife* as possible invaders from the Continent, and it is possible that these or others will become more familiar to British bryologists before too long.

Mitten's Bristle-moss *Orthotrichum consimile*
(RDB Data Deficient)
This has been found only twice in Britain – in Sussex in the 19th century and in Derbyshire in 2006 – but may

Orthotrichum gymnostomum. Andy Amphlett

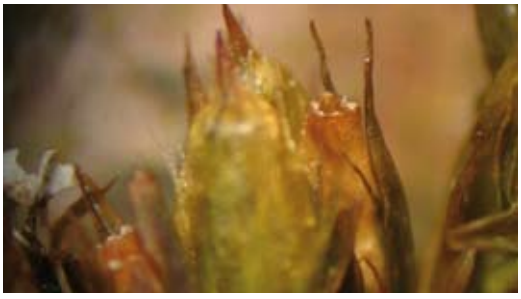


Orthotrichum obtusifolium. Arthur Chater

Orthotrichum pallens. Nick Hodgetts/Plantlife

Orthotrichum pumilum. Sam Bosanquet

Orthotrichum shawii. Sam Bosanquet



Orthotrichum acuminatum. Sam Bosanquet

be spreading northwards from continental Europe. It looks very much like *O. pulchellum*, but has eight pale brown exostome teeth rather than 16 bright red ones.

Orthotrichum speciosum. Sam Bosanquet

It is therefore well worth checking ripe *O. pulchellum* routinely in case it may be this rarer relative. The calyptrae on unripe sporophytes lack the black dots of *O. pulchellum*.

Aspen Bristle-moss *Orthotrichum gymnostomum*
(RDB Extinct)

One of only two British *Orthotrichum* that do not have obviously downcurved leaf margins; instead they are uniquely inrolled. Its relatively short leaves have rounded tips and resemble those only of *O. obtusifolium*, which also shares a dusting of gemmae on the leaf surface.

Orthotrichum anomalum. Sam Bosanquet

Orthotrichum cupulatum. Robert Goodison

Until recently, there was only a single British record, but *O. gymnostomum* is now known from several Aspen woods in the eastern Scottish Highlands.

Blunt-leaved Bristle-moss *Orthotrichum obtusifolium*
(RDB Endangered; Schedule 8)
A bright, light green plant with flat leaf margins and rounded leaf tips. Except for the very similar *O. gymnostomum* – and the dark green, riparian *O. rivulare* and *O. sprucei* – these rounded tips are unique among British epiphytes, and any plants with this feature should therefore be collected (only one or two stems, as both species are extremely rare) for checking with a microscope. Dry shoots are parallel-sided and look similar to *Zygodon*, but all members of that genus have acute leaf tips. Most of the few recent records come from eastern Scotland, where parkland trees are favoured. *O. obtusifolium* was lost from England in the very early 20th century, but recent records from Norfolk, Cambridgeshire, Essex and Cardiganshire suggest that it may be recolonising.

Pale Bristle-moss *Orthotrichum pallens*
(RDB Endangered)
One of the most anonymous members of the genus, with similarities to *O. affine*, *O. stramineum* and *O. tenellum*. The calyptrae are straw-yellow with orange tips, are hairless, and are much shorter than those of *O. tenellum*. There are records from 20 sites in northern England and eastern Scotland, but it is extant only in two areas and is almost entirely restricted to Weardale. However, a recent record from near Watford gives hope that it may be overlooked further south or be spreading in from the Continent.

Dwarf Bristle-moss *Orthotrichum pumilum*
(RDB Critically Endangered)
Grows in tiny, dense rounded cushions dotted with small capsules sporting short, hairless calyptrae. The slightly larger *O. tenellum* differs mostly in its long calyptrae, which hide the entire sporophyte. *O. pumilum* is a reasonably distinctive species, so that its rarity in Britain seems to be genuine. There are records from just five sites, only one of which is at all recent.

Shaw's Bristle-moss *Orthotrichum shawii*
(RDB Data Deficient)
This was recorded from the trunk of a Manna Ash *Fraxinus ornus* at Dailly, in Ayrshire, in 1860 and is now extinct. The main difference between *O. shawii* and the commoner *O. striatum* is the absence of an endostome. Routine checking of the peristome teeth of all *O. striatum* should ensure that *O. shawii* and the equally similar *O. acuminatum* are not being overlooked in Britain. As European records come mostly from submontane areas of countries such as France, Italy and Spain, perhaps this is an unlikely species to reappear in Britain.

Showy Bristle-moss *Orthotrichum speciosum*
(Nationally Scarce)
Has long setae that hold the capsules slightly above the branched shoots. Its calyptrae are hairier than is typical of the otherwise similar *O. affine*, whilst the dry capsule is only slightly striate when dry. Like *O. obtusifolium*, this species was lost from England in the early 20th century, although it remained very locally frequent in eastern Scotland. A record from Cambridgeshire in 2008 gives hope that this large, showy *Orthotrichum* will recolonise southern Britain.

Non-epiphytes

The remaining three British *Orthotrichum* grow primarily on base-rich rock, but all three are occasionally found growing epiphytically.

Anomalous Bristle-moss *Orthotrichum anomalum*
Has such long setae that its capsules are held well above the leaves. A hairy red-brown calyptra hides an orange sporophyte, which has 16 exostome teeth and no endostome when ripe. This is a common plant on wall tops, gravestones and other worked rock. It rarely grows epiphytically, except in the vicinity of limestone quarries.

Hooded Bristle-moss *Orthotrichum cupulatum*
This is inconspicuous without sporophytes and can easily be passed over as *O. anomalum*. However, when fruiting, its pale capsules and calyptrae are obvious, despite being partly hidden among the leaves because

Orthotrichum rupestre. David Holyoak

Ulota bruchii. Sam Bosanquet

of the short setae. Like *O. anomalum*, it has 16 upright exostome teeth and no endostome. It is widespread on worked rock and natural limestone, and is often found by rivers.

Rock Bristle-moss *Orthotrichum rupestre*
Forms loose, red-brown patches on rocks in upland Britain. Its very hairy calyptra is a distinctive feature on unripe capsules, whilst the smooth ripe capsules and eight exostome teeth separate it from *O. cupulatum*. *O. rupestre* is a relatively regular epiphyte in southern Europe, where the smooth capsules and rudimentary endostome can cause confusion with *O. shawii*, but for some reason it seems to be almost exclusively saxicolous in Britain. It has been recorded recently in an orchard in East Anglia.

Species recorded in error

O. patens was reported from four sites in Britain, but the three specimens examined by A J E Smith (including one from Dailly, where *O. shawii* once grew) turned out to be *O. affine*. It is usually considered to be more similar to *O. stramineum*, but is said to be taller, with larger leaf cells and broader capsules suddenly narrowed into the seta (Nyholm 1998). It is a scattered epiphyte in Scandinavia and could conceivably be discovered in north-eastern Britain.

O. urnigerum is a large, branched species found primarily on rocks in Scandinavia, like the similar *O. anomalum* and *O. cupulatum*. The only British record, from a limedust-enriched pine in Scotland, was later reidentified as *O. anomalum*. Britain is much further west than the core of its range.

Similar epiphytic genera

Two closely related genera are similar in size and general appearance to *Orthotrichum*. Most other epiphytic mosses are either pleurocarpous (with creeping, branched stems and laterally borne spore capsules) or differ in having translucent leaves or white hair-like leaf tips (a feature shared with *O. diaphanum*).

Ulota has six epiphytic members in Britain, three of which are common and widespread. All have longer setae than typical *Orthotrichum*, which means that their spore capsules are held well above the leaves. *U. phyllantha* very rarely fruits, but is identified by the unique (among epiphytes) pom-poms of brown gemmae on its leaf tips. The three common species have leaves that curl up much more when dry than those of *Orthotrichum*.

Zygodon conoideus. Sam Bosanquet

Zygodon has five epiphytic members in Britain, three of which are common. The leaves of this genus are shorter than those of *Orthotrichum* (<2mm), sharply pointed, and held densely on the shoot. They tend to be a very bright, vivid green, which differs from the usually dingy coloration of *Orthotrichum*.

References

Atherton, I, Bosanquet, S D S, & Lawley, M (eds) in prep. *British Mosses and Liverworts – a Field Guide*. British Bryological Society

Nyholm, E 1998 *Illustrated Flora of Nordic Mosses, Fasc. 4.* Nordic Bryological Society, Copenhagen and Lund

Smith, A J E, 2004 *The moss flora of Britain and Ireland, edition 2*. Cambridge University Press, Cambridge

Watson, E V 1980 *British Mosses and Liverworts, second edition*. Cambridge University Press, Cambridge

Sam Bosanquet is the British Bryological Society recorder for Monmouthshire and Pembrokeshire and co-editor of the forthcoming *British Mosses and Liverworts – a Field Guide.*