

Puzzling hoary mosses: *Grimmia*, *Schistidium* and *Racomitrium*



Racomitrium aciculare bearing its distinctive, erect capsules

In September 2016 an excellent *Grimmia* identification workshop was delivered by Ron Porley on behalf of the BBS. Some participants noted how difficult it can be to distinguish some *Grimmia* species without capsules from members of the closely related genera of *Schistidium* and *Racomitrium*, producing the first kernels of an idea for this Beginner's Corner. **Sharon Pilkington**

Depending on where you do your bryologising, you're almost certainly familiar with some of the Grimmiaceae. In the British Isles this large family currently includes 28 species in *Grimmia*¹, 19 in *Schistidium*, 13 in *Racomitrium* and 1 in *Coscinodon*. Most of these are small, cushion- or tuft-forming mosses which grow in sunny places on hard rock.

Although the species of the Grimmiaceae are very variable, the combination of leaves with (i) usually some cells with slightly to strongly sinuose walls and (ii) a whitish hair-point (when present) arising directly from the leaf tissue, rather than extending from the nerve will serve to separate members of the Grimmiaceae from other acrocarps in different families.

¹ Following Ron Porley's conspectus of *Grimmia* which currently includes *G. ramondii* (*Dryptodon patens*) but not *Coscinodon cribrosus*

Common species like *Grimmia pulvinata*, *G. donniana*, *Schistidium crassipilum* and *Racomitrium aciculare* are usually so distinctive that it quickly becomes second nature to recognise these when they are growing well and in typical habitats. With others, when the plants bear capsules the differences between the genera are usually obvious.

However, vegetative differences are often much more subtle. Sooner or later you are likely to encounter puzzling plants without capsules and then it can be difficult to know if you have found a *Grimmia*, a *Schistidium* or a *Racomitrium* (or even a completely unrelated species such as *Dicranoweisia cirrata* or *Didymodon rigidulus*). In fact many of our *Grimmia* species rarely or never produce capsules.

The following tables provide you with some broad guidance in distinguishing *Grimmia*, *Schistidium* and *Racomitrium*. **Do bear in mind though that many species are highly**

Table 1. Growth form and substrate

	<i>Grimmia</i>	<i>Schistidium</i>	<i>Racomitrium</i>
Growth form	Various cushion-, tuft- and patch-formers	Mostly tuft-formers. Sometimes cushion-forming e.g. young <i>S. crassipilum</i>	Mostly patch-formers but some tuft- and cushion-formers Often have numerous short stubby-looking branches
Substrate	Hard rocks and masonry. Most species prefer acid rocks although some are calcicoles	Hard rocks and masonry	Hard, mainly acid rocks, also some ground-dwellers

variable and leaf cell characters in particular can be very complex, leading to difficulties in separating *Grimmia* and *Schistidium* in particular.

Growth form and substrate (Table 1)

At first, many of the Grimmiaceae can look superficially similar, forming dense cushions on rock, or looser tufts and patches. Most species are strongly associated with hard, igneous or metamorphic acid rock such as granite (often

in the uplands) but others are calcicoles and usually grow on natural limestone, concrete, wall mortar or other man-made calcareous substrates. A few such as *Racomitrium ericoides* typically grow directly on the ground whilst *Schistidium rivulare*, *R. aciculare* and others specialise in rock, tree roots and other substrates associated with running water.

Vegetative characters (Table 2)

In the field, a useful distinguishing character that with practice can be observed with a hand-lens is the nature of the leaf hair-point. Species of *Racomitrium* have hair-points that are flattened at the point of insertion on the leaf tip whereas those of *Grimmia* and *Schistidium* are terete (round). However not all species have hair-points and in others they may be very short and inconspicuous.

Under the microscope, species of *Racomitrium* are usually relatively straightforward to separate from *Grimmia* and *Schistidium*. Examination of the cells at the base of the leaf will show that in *Racomitrium* they are clearly elongate and **strongly sinuose** down to the extreme leaf base. In *Grimmia* and *Schistidium* they usually have straight-sided or slightly sinuose walls in the leaf



- ◁ **Top.** *Grimmia laevigata* is an uncommon cushion-former that rarely has capsules.
- ◁ **Bottom.** *Schistidium elegantulum*: a strikingly hoary cushion-former. This plant has very few capsules

Table 2. Vegetative characters

	<i>Grimmia</i>	<i>Schistidium</i>	<i>Racomitrium</i>
Colour	Various shades of green (beware <i>G. elongata</i>)	Some species have reddish/yellowish pigments	Various shades of green
Nerve in TS	Cells differentiated. At the base of the leaf a row of at least 4 guide cells is present on the ventral side, with a row of stereids and sometimes hydroids below	Cells little differentiated (except in <i>S. maritimum</i>)	Cells little differentiated
Hair-point	Present or not Terete at the point of insertion on the leaf tip	Present or not. If present often short and may be toothed Terete at the point of insertion on the leaf tip	Present or not. If present often toothed Flattened at the point of insertion on the leaf tip
Upper leaf margins	Entire	Toothed (<i>S. apocarpum</i> and <i>S. crassipilum</i>) or entire	Usually entire (toothed in <i>R. aciculare</i>)
Cell walls at base of leaf	Usually straight-sided to slightly sinuose or nodulose	Usually slightly sinuose, sometimes straight-sided	Strongly sinuose

base (depending on the species), although they may be more strongly sinuose elsewhere in the leaf.

You'll need a high-power microscope and a steady hand to examine the leaves. When selecting leaves to place on your slide, make sure you choose mature ones from the upper part of a well-grown shoot. If you are examining a cushion-former, select leaves from young shoots within the cushion.

Separating vegetative *Grimmia* from *Schistidium* can be tricky and here it is often helpful to examine a nerve in transverse section (TS). *Grimmia* has a ventral row of guide cells, usually 4 in the leaf base, a row of stereids and sometimes hydroids. *Schistidium* lacks this specialisation of cells so in TS the nerve looks rather homogenous and lacks stereids. Beware of poorly developed plants!

▷ **Top.** *Grimmia dissimulata* nerve section showing cell differentiation.

▷ **Bottom.** *Racomitrium aciculare* has elongate basal leaf cells with strongly sinuose walls.

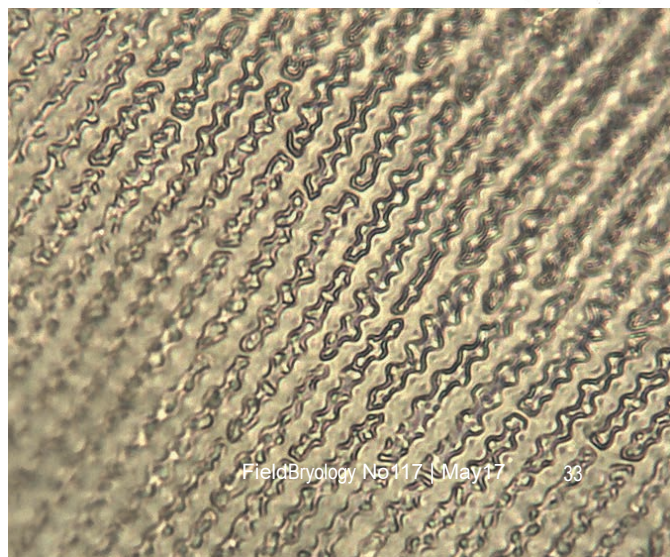
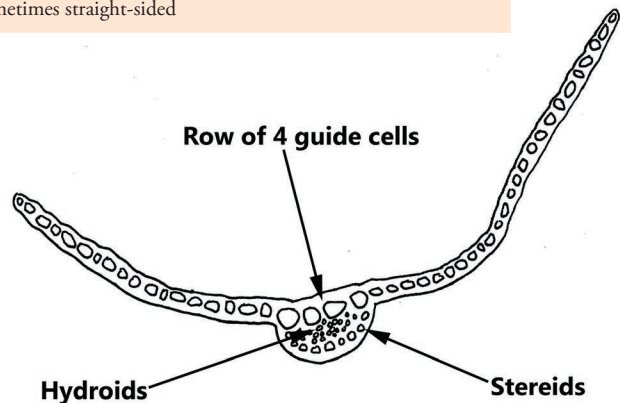


Table 3. Reproductive characters

	<i>Grimmia</i>	<i>Schistidium</i>	<i>Racomitrium</i>
Capsule	Lacking in many species. If present always erect and exerted on a long straight or arcuate seta (except <i>G. crinita</i> , <i>G. anodon</i> and <i>G. tergestina</i>) Not systylious	Usually immersed in leaves or emergent on a very short, erect seta Systylious	Present or absent. If present erect and borne on a long seta Not systylious
Gemmae	Usually absent but leaf gemmae are sometimes present in e.g. <i>G. trichophylla</i> , <i>G. hartmanii</i> and <i>G. anomala</i>	Absent	Absent

Reproductive characters (Table 3)

Although it is usually vegetative forms that cause confusion, it may be helpful to point out some of the differences between the plants when capsules are present (remember, some species rarely or never have them). Those of *Grimmia* and *Racomitrium* are usually obvious but old or immature *Schistidium* capsules are easily missed as they may be hidden among the leaves.

Further information

There is plenty of modern literature available to help in the study and identification of the Grimmiaceae. Tony Smith’s perennially popular *Moss Flora of Britain and Ireland* (2004) includes

keys and species accounts for all three genera but is unfortunately now rather out of date and not recommended. However, good alternative sources of information are available including:

- *The Genus Grimmia Hedw.: A morphological-anatomical study.* Eva Maier (2010). A relatively recent and very detailed account of *Grimmia* written in English with meticulous illustrations.
- *Grimmia Hedw.* (Grimmiaceae, Musci) *in Europe.* Henk Greven (1995). In English, good accounts and useful colour plates but the taxonomy is a little outdated and/or controversial.
- *Keys to Grimmia species in Europe* (2011). A very accessible key by Peter Erzberger in *Field Bryology* vol. 105.

▽Left. The characteristic immersed capsules of *Schistidium crassipilum*. ▽Right. *Grimmia trichophylla* often lacks capsules.



Making nerve sections

When making transverse sections of leaves to examine the nerve it is essential that you cut your sections with a very sharp razorblade very close to the base of the leaf i.e. in the lowest 1/8 - 1/4.

- *Flora Briofitica Iberica* Volume 2 (2015) also has very good accounts of *Grimmia* written in Spanish.
- Elsa Nyholm's *Illustrated Flora of Nordic Mosses* (Fascicle 4, 1998) provides excellent keys and descriptions in English for *Schistidium* (by Hans Blom) and *Racomitrium*. Most of the species described are also present in the British Isles.
- The sumptuously-produced *Encyclopaedia of the Swedish Flora and Fauna (Nationalnyckeln till Sveriges flora och fauna)* includes a 2006 volume

(*Buxbaumia – Leucobryum*) providing beautifully illustrated accounts of Nordic Grimmiaceae (many of which are also found here). Although the text is written in Swedish, keys and key facts about species are translated into English.

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Sharon Pilkington

e sharon.pilkington1@btinternet.com

Sharon Pilkington works as a professional bryologist and botanist and is the BBS's regional recorder for N. Somerset and N. Wiltshire.

Definitions

Arcuate: curved or bent like the arc of a circle

Calcicole: a plant that's mainly restricted to calcium-rich substrates

Columella: central column of sterile tissue in the capsule

Emergent: capsules that only partly protrude beyond the perichaetial leaves

Entire: a smooth leaf margin, lacking teeth, cilia, indentations or erosions

Exserted: carried well above the perichaetial leaves

Guide cells: a layer of large, empty cells across the costa, often with hydroids and stereids

Hyaline: lacking chlorophyll or other pigments so often colourless

Hydroids: thin-walled nerve cells forming a small group in the middle of the nerve immediately below the guide cells, when seen in section

Immersed: capsules that are overtopped by their perichaetial leaves

Nodulose: cell wall has local thickening so it appears under the microscope to have knobs

Paracostal: cells next to the nerve

Perichaetial leaves: specialised leaves surrounding the base of the seta

Sinuose: wavy or corrugated (cell walls that are not unevenly thickened)

Stereids: groups/bands of small, thick-walled cells in the nerve

Systylious: where the capsule lid is attached to and falls with the columella

Terete: cylindrical in form so circular in cross-section

Ventral: upper leaf surface