

Tortella fasciculata and *T. pseudofragilis* in Britain and Ireland

Tom Ottley and Tom Blockeel describe two mosses previously treated as one species

In a recent paper in the *Journal of Bryology*, Köckinger & Hedenäs (2017) showed that the moss hitherto known as *T. bambergerei* (Schimp.) Broth was in fact an aggregate of two distinct species, *T. fasciculata* (Culm.) Culm. and *T. pseudofragilis* (Thér.) Köckinger & Hedenäs, and that the name *T. bambergerei* was not available for either species, being a synonym of *T. tortuosa* (Hedw.) Limpr. The history of *T. bambergerei* in Britain and Ireland is quite recent, its occurrence here having been described just 13 years ago by Sam Bosanquet (2006). As described in that paper, the important diagnostic characters separating it from *T. tortuosa* include the presence of quadrate, papillose cells on the dorsal surface of the nerve in the upper part of the leaf, and the presence of a stem central strand. Based on the ecology and distribution of the two newly-recognised species, it was likely that most British and Irish material of the former *T. bambergerei* would belong to *T. fasciculata*, but there was a real possibility that some of the montane records, particularly from higher ground, could be ascribed to *T. pseudofragilis*. In view of the apparently clear-cut characters separating the two segregates, the first author (TO) undertook a revision of the entire holdings of *T. bambergerei* in the BBSUK and NMW herbaria and the results

are presented here.

During the study of herbarium material, the reliability of the published differences between the segregates was assessed, and the scope of the study was widened to include *T. fragilis* (Hook. & Wilson) Limpr. because of perceived similarities. There were nearly 60 packets named as *T. bambergerei* in the two herbaria. With the exception of a specimen from Wharfe, North Yorkshire, which was clearly placed in the wrong genus (*Trichostomum*), almost all samples were remarkably homogeneous in appearance, the tightly crisped cushions being of an ochraceous colour and with most leaves lacking their apices. Such cushions are distinctive and well known to many bryologists who work in upland, base-rich areas. However, a few specimens differed in showing the straight, rigid apices characteristic of *T. pseudofragilis* and, although all specimens were checked in detail, only these few were found to have any of the diagnostic features of that species. The remainder were clearly *T. fasciculata*, as expected.

Of the candidate specimens for *T. pseudofragilis*, one in particular, collected by Nick Hodgetts from high altitude in the Ben Lawers range, was found to match that species unambiguously, and the identification was subsequently kindly

confirmed by Heribert Köckinger. In addition, Sam Bosanquet forwarded a specimen that he had collected on Gleann Beag in 2003 and tentatively re-identified as *T. pseudofragilis*, and this identification was verified by TLB. In the event, this latter specimen has proved to be the earliest confirmed record of this species in Britain and Ireland. It is of course possible that further specimens await discovery in other herbaria and it is hoped that field work will now reveal additional populations.

Confirmed specimens of *T. pseudofragilis*

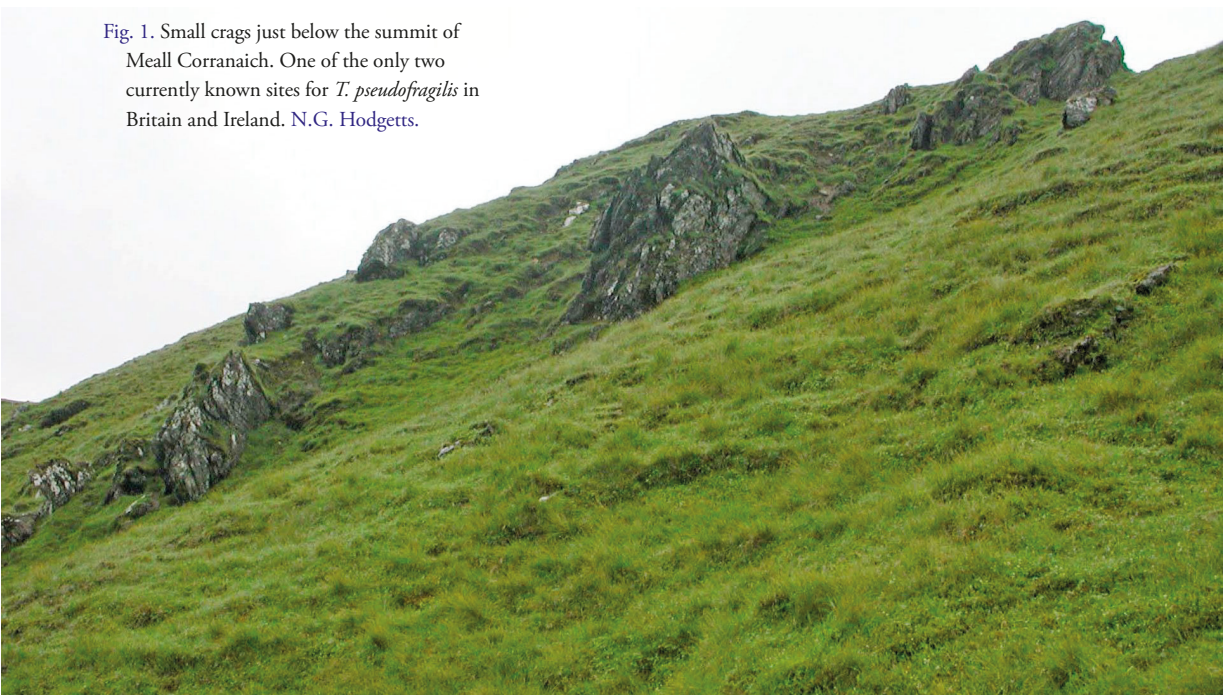
vc 88: east-facing mica-schist rocks in small crags at 990 m altitude (originally recorded as 940 m), Ben Lawers, Meall Corranaich, NN61564156, N.G. Hodgetts, 19 July 2005, conf. H. Köckinger, BBSUK accession number C.2006.003.178, duplicate in herb. Hodgetts, coll. no. 6191. Site shown in Fig. 1. **vc 89:** top of limestone block below crag on west side, Gleann Beag, NO130755, S.D.S. Bosanquet, 7 July 2003, BBSUK, awaiting accession.

Diagnostic characters

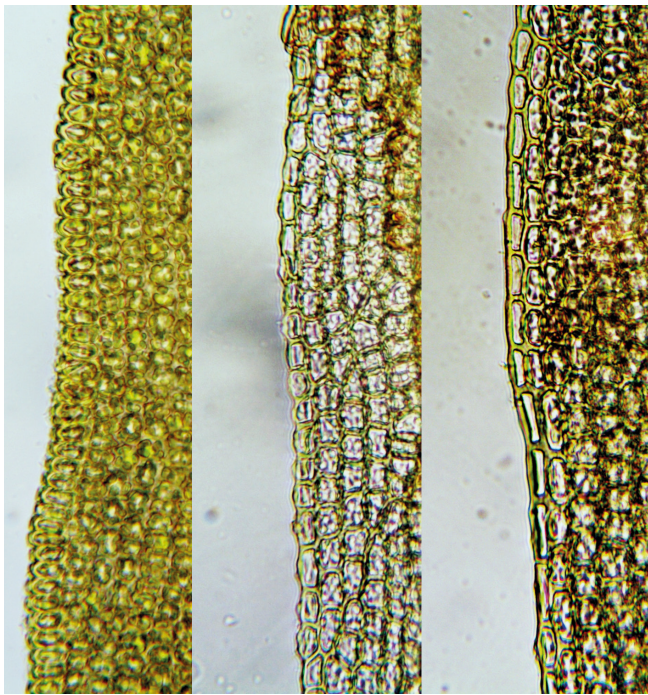
The leaves of *T. fasciculata* in the dry state are incurved or curled up to the apex, or very nearly so, giving the shoots a tightly-cripsed appearance. In *T. pseudofragilis* the leaves are less tightly curled, and their upper parts are straight or weakly flexuose, often lying flat across the tufts. This difference is well illustrated by Köckinger & Hedenäs (2017). Of the other diagnostic characters listed by them, the most useful were found to be the shape of the marginal leaf cells, the size of the median leaf cells, and the morphology of the stem central strand.

Leaf margin. In *T. pseudofragilis*, elongate, smooth-walled cells are present along the upper leaf margins and, since these have rather thick walls, this may account for the tendency for the upper parts of the leaves to remain straight upon drying. Further down the margins the cells become nearly square to slightly longer than wide, sometimes with more elongate cells mixed in, and only weakly papillose. This contrasts with the marginal cells of *T. fasciculata*, which

Fig. 1. Small crags just below the summit of Meall Corranaich. One of the only two currently known sites for *T. pseudofragilis* in Britain and Ireland. N.G. Hodgetts.



▷ Fig. 2. Leaf edge at about mid-leaf of *T. fasciculata* (left) with its characteristic marginal cells which are normally oblate (wider than long), and *T. pseudofragilis* (centre and right) showing the square to elongate marginal cells but illustrating the wide variation that was found in the samples studied. The magnification is the same in all three pictures, demonstrating the wider laminal cells of *T. pseudofragilis*.



are normally wider than long (oblate), relatively thin-walled and often very papillose. In addition, they are usually laterally bulging, giving a crenulate appearance to the margin. The leaf margins of both species are illustrated in Fig. 2.

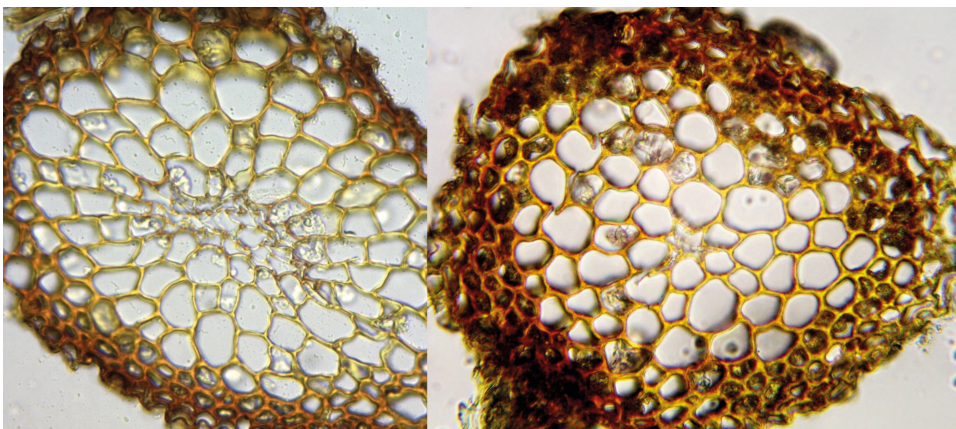
Size of laminal leaf cells. The upper leaf cells of *T. pseudofragilis* are, on average, a little larger than in *T. fasciculata*. Köckinger & Hedenäs (2017) give measurements of (6) 8–14 µm and (5) 6–10 µm respectively. In the Ben Lawers specimen the laminal cells (away from the margin) measure about 11 µm across. In the Gleann Beag specimen they were a little wider at 12–13 µm. The laminal cells in *T. fasciculata* measured in this study did not exceed 10 µm.

Stem central strand. The central strand (Fig. 3) is well-developed and readily observed in *T. fasciculata*, covering a region of up to about 1/5 of the width of the stem. In *T. pseudofragilis*, it is small and few-celled. In the two confirmed Scottish specimens of the latter species, only a tiny area of cells in the middle of the stem formed the central strand; the characteristic thin-walled but fragile cells were observed under the microscope but are hardly discernible in the photograph. When assessing this character, it is important to take sections from the lower parts

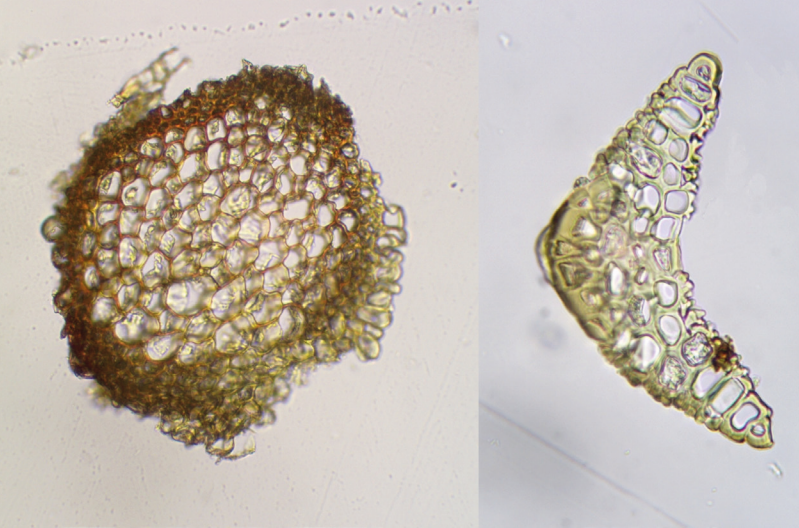
of the shoots as the central strand may be smaller or absent in the upper parts.

Discussion

As befits a difficult genus like *Tortella*, separating *T. pseudofragilis* and *T. fasciculata* is not entirely straightforward, even with the seemingly simple difference in the marginal cells. Elongate cells do appear occasionally in *T. fasciculata*. They can be an extension of the ascending basal cells but that is not problematic. Sometimes, however, they can descend a short way from the apex and even occur in short sections of the margin around mid-leaf. Such forms may have straight, projecting leaf apices, and indeed this was the case in two of the herbarium specimens that initially appeared to be candidates for *T. pseudofragilis*.



◁ Fig. 3. Central strand in the stems of *T. fasciculata* (left) and *T. pseudofragilis* (right). Although sections of *T. fasciculata* stems normally show a rounder central strand, it is always composed of many cells and covers a sizeable part of the middle of the stem as shown here. In contrast, the central strand in *T. pseudofragilis* is small and, as in the photo, often consists of little more than an irregularly-shaped patch in the centre of the stem.



◁Fig. 4. Section of stem of *Tortella fragilis* showing the complete lack of a central strand, and section of leaf apex demonstrating the more or less triangular cross-section with multistratose laminal cells.

However, in true *T. pseudofragilis* the entire margin is composed of square to elongate cells. If segments of the leaf margin are composed of oblate cells and are crenulate, then the specimen will not be *T. pseudofragilis*. Very young leaves should be avoided, however tempting they may be with their intact apices, as the areolation can be misleading.

In assessing the morphology of the leaf apex, it is relevant to consider *T. fragilis*, which also has a straight, rigid leaf apex and can occur in similar habitats. The leaf apices of *T. fragilis* are, however, usually erect, while those of *T. pseudofragilis* lie flat on the cushions. The structure of the leaf apex is different too, having a more or less triangular cross-section with multistratose laminal cells, and the stem lacks a central strand (Fig. 4).

T. fragilis is usually a more robust moss with weakly curved leaves in the dry state that give it a quite different appearance from the segregates of the former *T. bambergeri*. Quadrate, papillose cells are not normally present on the dorsal surface of the nerve in the upper part of the leaf in *T. fragilis*, where these cells are usually elongate and smooth. However, this latter character should not be used in isolation, since forms of *T. fragilis* with quadrate upper dorsal cells occur occasionally, although not observed in this study. Also, some forms of *T. tortuosa* have rigid (and often fragile) leaf apices, and indeed such forms are frequent on Ben Lawers. They might be confused with *T. pseudofragilis* but, like *T. fragilis*, they lack a stem central strand, and

usually have smooth elongate cells throughout the dorsal surface of the nerve.

Conclusions

Köckinger & Hedenäs (2017) noted that *T. fasciculata* was more thermophilous in its ecology than *T. pseudofragilis*, having a Suboceanic-Submediterranean distribution. They characterised *T. pseudofragilis* as Boreo-montane so it was unlikely that it would be widespread in Britain or Ireland. The two Scottish sites, both in areas well-known for their rich calcicole floras with Alpine affinities, are consistent with a Boreo-montane distribution, and *T. pseudofragilis* must surely be rare here. The recorded distribution of *T. fasciculata* at vice-county level in Britain and Ireland can be considered accurate, there being additional voucher specimens of *T. fasciculata* in BBSUK and NMW to replace the two that have now been renamed as *T. pseudofragilis*.

Acknowledgements

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References

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- Köckinger, H. & Hedenäs, L. (2017).** A farewell to *Tortella bambergeri* (Pottiaceae) as understood over the last decades. *Journal of Bryology* 39: 213–225.