On the occurrence of *Riccia warnstorfii* in Britain

Christian Berg, **Martina Pöltl** and **Des Callaghan** reinstate this taxonomically troublesome liverwort on the British list.

Riccia warnstorfii Limpr. ex Warnst. is widely distributed in Europe, listed by Hodgetts & Lockhart (2020) as occurring in Austria, the Azores, Belgium, Corsica, Croatia, Czech Republic, Estonia, France, Germany, Hungary, Italy, Luxembourg, Madeira, Montenegro, The Netherlands (extinct), Poland, Portugal, Romania, Sardinia (uncertain record), Sicily, Spain, Sweden and Switzerland.

The species was frequently and widely recorded in Britain, with records dating from 1910 (Paton, 1990), and it was listed as occurring in 57 vice-counties by Corley & Hill (1981). However, in a broad discussion of several collections which refers to many experts who dealt with *Riccia* in Europe at that time, Paton (1990) concluded that all records of *R. warnstorfii* from Britain and Ireland should be transferred to *R. subbifurca*. Since then, *R. warnstorfii* has been considered to be absent from Britain and has not been included in subsequent national checklists of bryophytes (Blockeel *et al.*, 2021; Blockeel and Long, 1998; Hill *et al.*, 2008). Nevertheless, Paton (1990) had formulated the matter carefully, stating 'It is possible that *R. warnstorfii* may yet be found to occur here …', and draws attention to the difficulties of identifying *Riccia* species in general, and in particular distinguishing *R. warnstorfii* from *R. subbifurca*.

In the course of the Austrian '*Riccia* Morphology and Sequencing Project' samples of European *Riccia* species from the subgenus *Euriccia* are being analysed in detail by studying fresh material. During the study, which has been ongoing since 2018, *R. warnstorfii* has been collected and cultivated from Austria, France, Germany and Sweden, comprising 38 samples so far.

Riccia plants found and collected in Britain in 2021 by Des Callaghan were contributed to the project and one could be confirmed as *R. warnstorfii*, with the following collection details:

> Tump Farm, Monmouthshire (vc 35), SO4602419390, 135 m a.s.l., on bare soil subject to weed control beneath fruit trees in orchard, associated with *Fossombronia caespitiformis sens. str.*, 16 March 2021, leg. et det. D.A. Callaghan, conf. C. Berg & M. Pöltl (herb. D.A.C., GJO).

Description

According to the current stage of the project, the sample shows characteristics we clearly refer to *R. warnstorfii* and matches very well several samples of *R. warnstorfii* from other European sites. The plants of *R. warnstorfii* (Fig. 1) are short-lived, light to darker grass or yellowish green, and older segments sometimes show a purple pigmentation on the sides and dorsally. The thalli grow in rosettes or in dense batches, the ultimate segments usually 0.6–1.0 mm wide, linear or narrow linear-lanceolate. The apex is rounded rectangular, not or slightly emarginated, and the groove is very shallow, soon vanishing proximally. The flanks are vertical or slightly bulging, the margins rounded, and the cross-section of ultimate segments are 1–3.5 times wider than tall. Ventral scales are inconspicuous and hyaline. Cilia are rare, being single or few. Sporophytes are frequent and numerous, often with several capsules developing in one segment. Spores (Fig. 2) are dark chestnut brown and measure (51–)70–95(–123) µm diameter (mean 84 µm; data from 1125 spores of 30 specimens). The wing of the spores is well developed and is smooth to (rarely) somewhat irregular. The distal side of the spores show (6–)7–9(–11) areolae. The proximal side is also ornamented with well-developed areolae, only slightly smaller than those on the distal side. The proximal ridges are well developed, at least in the centre.

Riccia subbifurca

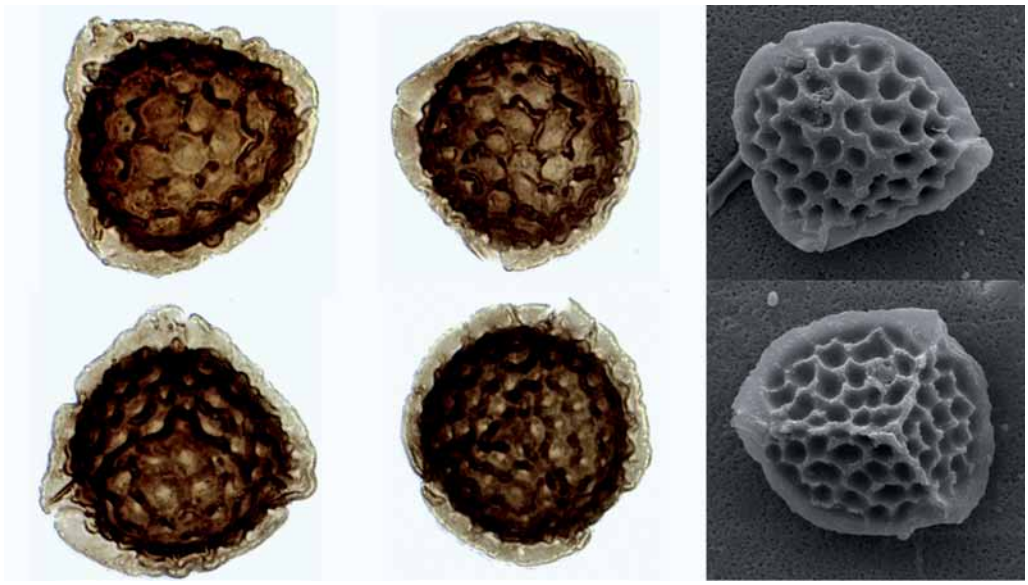
For *R. subbifurca* (Fig. 3), which is one of the most taxonomically troublesome species within the genus in Europe, we can present some preliminary results. We studied living material of *R. subbifurca* from three of its type locations, in France (*R. subbifurca*), Öland (*R. oelandica*) and Austria (*R. baumgartneri*), as well as material from Montenegro, Italy and Britain. The species is not as short-lived as *R. warnstorfii*, with less delicate, more cartilaginous thalli, which are light to dark olive or greyish green, often with dark purple marginal and ventral pigmentation. The thalli grow in intricate mats, the ultimate segments are 0.6–1.4 mm wide, lanceolate, and broadest in the upper third. The groove is well developed, and the apex is rounded or slightly emarginated. The flanks are bulging or ascending, and the margins are sharp or subacute, the cross-section of ultimate segments being up to two times wider than tall. Young ventral scales are hyaline, and older ones are purple or absent. Cilia are absent to numerous along the margin of ultimate segments, being short and of equal size (rarely longer than 240 µm). Sporophytes are often absent. Spores (Fig. 4) are blackish brown and measure (66–)78–108(–126) µm diameter (mean 92 µm; data from 275 spores of six specimens). The wing of the spores is well developed and is finely or coarsely irregular, rarely smooth. The distal side of the spores show (7–)8–11(–12) areolae. The proximal side is also ornamented with well-developed areolae, slightly smaller than those on the distal side. The proximal ridges are well developed, at least in the centre.

Habitat differences

There appears to be a difference in the habitat typically occupied by *R. warnstorfii* and *R. subbifurca* across Europe. While *R. warnstorfii* is adapted to disturbed habitats like arable fields, gardens, footpaths and waterbody margins, *R. subbifurca* grows in more semi-natural sites like rocky grasslands or dwarf-shrub heathland on thin soil, often rich in humus.

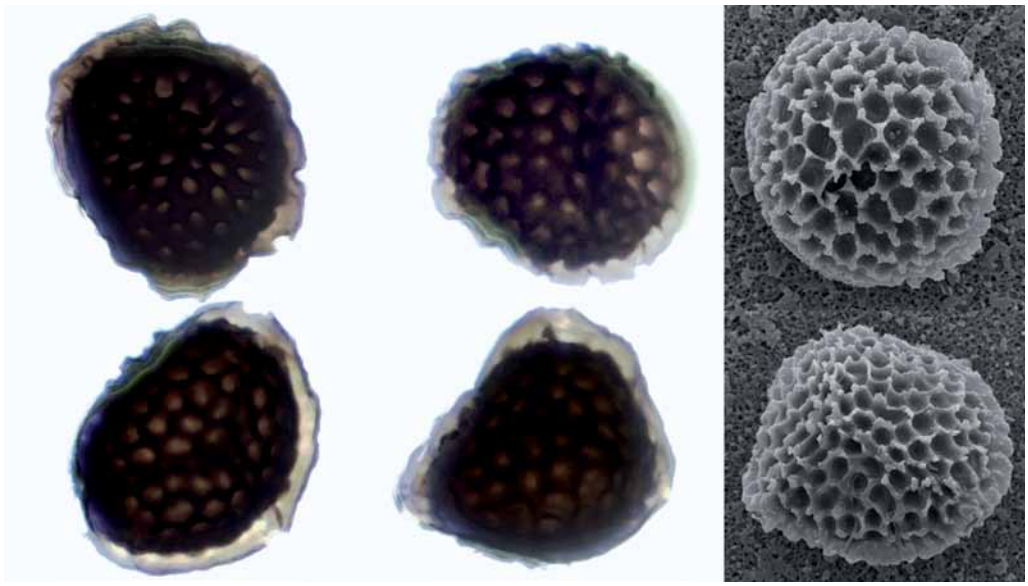
Asymmetry of thallus cross-sections has been used as a key character when determining *R. subbifurca* (e.g. Paton, 1990, 1999). Results of the present study suggest asymmetry of thallus

△ Figure 1. Thalli and cross sections of *R. warnstorfii* (Tump Farm, vc 35, 16th March 2021, *D.A. Callaghan*). *D.A. Callaghan & M. Pöltl*



△ Figure 2. Spores of *R. warnstorfii* (top line distal, bottom line proximal), material as Figure 1. *M. Pöltl*

△ Figure 3. Thalli and cross sections of *R. subbifurca* (top left: St David's Head, vc 45, shallow peaty soil on coastal promontory, 17th December 2019, *M.D. Sutton*; top right: Great Ensworthy, vc 3, poached damp soil at edge of mire, 25th July 2019, *D.A. Callaghan*). *M. Pöltl*



△ Figure 4. Spores of *R. subbifurca* (top line distal, bottom line proximal), material from vc 3 as Fig. 3. *M. Pöltl*

cross-sections, which we have observed in many *Riccia* species, is not a good feature to characterise a species. According to the approximately 2000 photos of cross-sections we have collected so far for the project, asymmetry appears to occur often as a result of environment growth conditions, for example, when thallus segments are closely packed together during their growth, or when a thallus has grown across a rough surface. Notably, when grown on a smooth surface or when grown in culture, all thalli appear to grow symmetrically. Lastly, our provisional results suggest that whilst there are overlaps there are also significant differences between *R. subbifurca* and *R. warnstorfii* in the spore characteristics, something we will analyse further.

We hope this article will raise attention amongst bryologists in Britain of *R. warnstorfii*, a species that has been somewhat forgotten and is a name that will not be known generally to younger bryologists. We welcome any contributions of *Riccia* material to our project, ideally comprising plants with mature spores present. Please send air-dried specimens, together with collection details, to Martina Pöltl at the address below.

Acknowledgements

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