On the occurrence of *Fredericella indica* Annandale, 1909 (Phylactolaemata) in Europe

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**ABSTRACT**

*Fredericella* colonies collected in summer 1994 in the Bavarian lake Königssee (Germany), and first regarded as 'ordinary' *Fredericella sultana*, yielded sessoblasts with a conspicuous pitted surface formed by a uniform network of reticulating ridges very apparent in SEM observation and quite different from typical European *Fredericella sultana* which has sessoblasts with a smooth surface. These features exactly match *Fredericella indica* such as recently described from American sites by T.S. Wood. Thus *F. indica*, hitherto only known from Asia, Africa, and North America, also occurs in Europe.

**Keywords:** Bryozoa, Phylactolaemata, *Fredericella indica*, Europe, Germany, Bavaria, Königssee, sessoblasts, taxonomy, zoogeography

**INTRODUCTION**

The genus *Fredericella* Gervais, 1838 is widely represented in Europe by *Fredericella sultana* (Blumenbach, 1779). A synopsis of the European distribution of this species is given by Geimer and Massard (1986). Lacourt (1968) considers all these occurrences as belonging to the subspecies *Fredericella sultana sultana* (Blumenbach, 1779) with a distribution area including the entire palaeartic region and probably Australia. Furthermore he distinguished the subspecies *F. sultana indica* Annandale, 1909, restricted to the Indian and Ethiopian regions, and *F. sultana crenulata* du Bois Reymond Marcus, 1946, known from North and South America. On the other hand, *F. australiensis* occurs in Asia, Africa, South America, and Australia and is also found in Belgium, Sweden, and Russia according to Lacourt (1968, 1982).

Karyotypic and morphological confirmation of species in *F. australiensis* was given by Backus and Wood (1981). Differentiation of North American and European forms of *F. sultana* was made by Wood and Backus (1992). By comparative analysis of North American forms and material stemming from the Moselle River (Luxembourg) they concluded that the North American specimens differ from the European forms and most resemble *F. indica* Annandale, 1909. North American *Fredericella* and *F. indica* share sessoblasts with a densely pitted capsule surface. Sessoblasts of European *F. sultana* are perfectly smooth. This was stressed by bryozoologists such as Marcus (1940) and Lacourt (1968) and has been confirmed by the SEM photographs published by Mundy (1980), Geimer and Massard (1986) and Wood and Backus (1992).

**MATERIALS & METHODS**

Three samples of *Fredericella* colonies were collected on 13 August 1994 in the Bavarian lake Königssee (northern point, west lakeside). The Königssee is situated near Berchtesgaden in Upper Bavaria (Germany) (Fig. 1). It is an oligotrophic lake with very clear water. Its main characteristics are as follows — altitude: 603 m above sea-level; maximum length: 7.7 km; maximum width: 1.2 km; surface: 521 ha; maximum depth: 190 m; mean depth: 98 m; ichthyofauna: *Salvelinus alpinus*, *S. fontinalis*, *Salmo trutta f. lacustris*, *S. trutta f. fario*, Perca fluviatilis, Phoxinus phoxinus, Esox lucius, Coregonus albula, C. lavaretus, Cottus gobio, Lota lota. Other bryozoans collected in the Königssee on the same day comprised three Plumatella fruticosa colonies.

All the *Fredericella* specimens were growing on the undersides of stones in shallow water near the lake margin. The material was scraped off, narcotised with menthol, and preserved in 70% ethanol. Three different samples (BAY1, BAY2, BAY7) were collected, mainly consisting of tube fragments containing statoblasts (sessoblasts) generally lightly attached to the tube walls.

Ultraslonically cleaned sessoblasts were observed under the light microscope then, after air drying, under a Jeol JXA-840 scanning electron microscope, courtesy of Du Pont de Nemours, Contern, Luxembourg.
RESULTS & DIAGNOSIS

Light microscopy revealed normally shaped, oval to reniform sessoblasts, somewhat darker than usual, with a suture line seemingly somewhat broader and more conspicuous than in ordinary *F. sultana*. At higher magnification, a distinct netlike pattern was discovered, especially on sessoblasts cleansed ultrasonically. Normally this feature could be seen on both sides of the sessoblast.

SEM observation showed a very striking reticulation on the dorsal valve of the studied sessoblasts. This reticulation extends to the ventral side where it may be slightly less striking, though always clearly visible. The reticulation is formed by protruding ridges enclosing mostly hexagonal, rarely pentagonal cells. The diameter of the cells ranges from about 3 to 7 μm. As already suggested by light microscopy, the suture line is clearly apparent. In light microscopy it seems broader, up to 12 or even 13–15 μm; on SEM photographs it seems narrower: about 4–5 μm.

Nine statoblasts were retrieved from the tubes, then mounted in water and observed under the light microscope. They had the following measurements (length/width ratio in brackets): 471 x 285 μm (1.65), 471 x 322 μm (1.46), 514 x 285 μm (1.80), 521 x 310 μm (1.68), 521 x 335 μm (1.55), 533 x 335 μm (1.59), 533 x 341 μm (1.56), 558 x 279 μm (2.00), 570 x 291 μm (1.95). Mean length: 521 μm (min.: 471, max.: 570), mean width: 309 μm (min.: 279, max.: 341). The mean length/width ratio is 1.7 (max.: 2.0, min.: 1.46).

The zoarium tubes may be emarginate and keeled.

The dimensions of the sessoblasts are within the normal range of variation for *F. sultana* statoblasts, but the reticulated surface of the valves and the broader suture line do not match *F. sultana sultana* as described by Lacourt (1968) but rather *F. sultana indica*. This impression is corroborated by comparison of our observations with the description given by Wood and Backus (1992) and the SEM photographs they published. So there is no doubt that the Bavarian material belongs to the same taxon as that 'tentatively' designated as *Fredericella indica* by Wood and Backus (1992).
Figs 2-6: Sessoblast of *Fredericella indica* (BAY7; Königssee, 13.8.1994). Fig. 2. Dorsal side: well-developed pitted reticulation. Fig. 3. Ventral side: pitted reticulation locally less conspicuous. Fig. 4. Dorsal side: pitted reticulation, high magnification. Fig. 5. Peripheral region of the capsule with suture line, high magnification. Fig. 6. Suture line of the statoblast at high magnification, ventral side in front. Fig. 7. Sessoblast of European *F. sultana* (x 200), dorsal side: smooth surface (Nennig, Germany, 01.08.1984).
DISCUSSION

Annandale (1909) characterised *F. indica* as having a stout chitinous ring, a smooth lower valve, and an upper valve covered with minute prominences, the bases of which are somewhat star-shaped and the apaxes rounded. Lacourt (1968) considered *F. indica* as a simple subspecies of *F. sultana* which in his opinion included *F. sultana sultana* (Blumenbach, 1779), *F. sultana indica* Annandale, 1909, and *F. sultana crenulata* du Bois Reymond Marcus, 1946.

Annandale (1910, 1911) emphasised that *F. indica* has a statoblast with minute prominences on the upper surface, whereas the statoblasts of *F. sultana* and *F. australiensis* are smooth on both surfaces. Lacourt (1968) noted that *F. australiensis* sessoblasts are round, their surface smooth and without any reticulation, and the capsule surrounded by a substantial chitinous ring from which it is separated by a deep peripheral groove. Wood (1981, 1989) confirmed that *F. australiensis* sessoblasts have smooth surfaces and thick rims, that they are round to oval, seldom elongate, and have a length/width ratio of 1.19 to 1.52. Thus the Bavarian Fredericella with its deeply pitted sessoblasts and its length/width ratio of 1.7 cannot belong to *F. australiensis*, a species signalled in Europe from Sweden and possibly from Russia (Lacourt 1968, 1982). Concerning the taxonomic interpretation of the Swedish and Russian as well as some other records, Abrikosov (1961) concluded differently from Lacourt (1968), but this is of no consequence to the present discussion.

Sessoblasts with a very thick capsule and a regular pattern of pits on both valves were described as *F. sultana crenulata* by du Bois Reymond Marcus (1946). The border of these sessoblasts is slightly extended and forms a flat transparent rim which is crenulate with denticles. This characteristic crenulation is missing in *F. sultana indica* and also in our material which thus cannot belong to *F. sultana crenulata*. Fredericella australiensis and *F. sultana sultana* being excluded by their smooth surface, and *F. sultana crenulata* by the absence of crenulation, the Bavarian material consequently must be compared to *F. indica*.

Toriumi (1951) noted that North American statoblasts of Fredericella sultana are strongly reticulated, and that, in some Japanese material, this reticulation is present but not so distinct as in the American material, whereas in other Japanese material the statoblasts are smooth. He interpreted the reticulation of the sessoblast as a racial character, thus considering *F. indica* as a race of *F. sultana*. Whereas in his diagnosis Toriumi (1951) stated that the sessoblast is smooth or reticulated, Wiebach (1960) did not make this distinction, describing the surface of the statoblasts of *F. sultana* as mostly smooth and with a reticulate structure. This reticulation, however, is not represented on his figure of the statoblast. It is not clear if Wiebach’s (1960) description was a personal observation or, following the example of Prenant and Bobin (1956), if he simply cited Toriumi (1951).

Annandale’s (1909, 1911) figures of the *F. indica* statoblast match the present sessoblasts if they are observed at medium magnification under the light microscope. The ‘minute prominences’ and their ‘star-shaped’ base seen by Annandale correspond in fact to the reticulated pattern revealed by SEM. Annandale did not see any reticulation on the ventral valve. This is quite possible as the reticulation of the ventral valve may be concealed by attached material.

The light-micrographs of North American *F. sultana* (i.e., *F. indica*) published by Wood (1979), Backus and Wood (1981), Wood (1989), and Wood and Backus (1992) exactly match our material, as does the SEM photograph in Wood and Backus (1992). Thus there is no doubt that the Bavarian *Fredericella* corresponds to their *F. indica* which, in regard to its reticulate sessoblasts must be considered, in our opinion, as a valid species distinct from *F. sultana*.

Bushnell and Rao (1979) published SEM photographs of *Fredericella sultana* sessoblasts from North America, India, and Japan. One of these sessoblasts is clearly smooth, the other one is reticulated. They were believed to represent earlier and later stages of development. In fact it must be assumed that they belong to two different species. Unfortunately the captions do not give any hint as to the geographical origin of the examined samples.

CONCLUSION

Formerly, European Fredericella specimens could be routinely identified by simple low-power binocular microscopic observation of their typical non-buoyant statoblasts without an annulus. Nowadays, no diagnosis should be made without high-resolution microscopy of these statoblasts (light microscope or SEM, if necessary). ‘Classical’ European *F. sultana* is characterised by smooth statoblasts whereas those of macroscopically identical *F. indica* are distinctly reticulated.
RÉSUMÉ

En été 1994, des colonies de Fredericella ne se distinguent en rien, extérieurement, de la classique Fredericella sultana ont été récoltées dans le Koenigsee, un lac de Bavière (Allemagne). Mais, l’observation au MEB a révélé que la surface des sessoblastes de ces colonies est très nettement alvéolée, alors que celle des sessoblastes des formes européennes typiques de F. sultana est lisse. Les caractéristiques observées correspondent exactement à celles de F. indica telle qu’elle a été récemment décrite par T.S. Wood à partir de matériel américain. Il faut en conclure que F. indica, connue jusqu’ici exclusivement par des stations situées en Asie, en Afrique, et en Amérique du Nord, est également présente en Europe.

Mots-clés: Bryozoaires, Phylactolaemates, Fredericella indica, Europe, Allemagne, Bavière, Koenigsee, sessoblastes, taxonomie, zoogéographie

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