ON THE IDENTITY OF *RICCIA FLUITANS* (RICCIACEAE: MARCHANTIOPHYTA) IN INDIA

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Abstract: The status of the species *Riccia fluitans* in India is discussed in detail. Most of the Indian specimens described under *R. fluitans* are *Riccia stricta*. Specimens collected from different parts of India were compared with specimens from BM. Photographs are provided for easy identification.

Introduction

Riccia fluitans L. is one among the most common species of the genus *Riccia* L. It is often cited as text book example of a liverwort occurring both as land and aquatic forms and has been reported from most parts of the world. The identity of *Riccia fluitans* L. has been largely debated for a long time (Evans 1921; Gaisberg 1921; Familler 1920; Carter 1935). This was regarded either as a distinct species with aquatic as well as terrestrial forms or as a composite species comprising the aquatic forms of many terrestrial species. Mueller (1940, 1941) has shown that *R. fluitans* is a composite species consisting of four different species, *viz.*, *R. fluitans* L. emend K. Mueller, *R. canaliculata* Hoffm., *R. rhenana* Lorb. and *R. duplex* Lorb. & K.Mueller. This concept was accepted by most hepaticologists (Meijer 1951; Schuster 1953; Klingmueller 1957, 1959). Bapna and Kachroo (1999) mentioned *R. fluitans* in the aquatic forms as cosmopolitan distribution and description closely resembles *R. stricta*. They also mentioned *R. abuensis* Bapna, described from Rajasthan, after the type collection there is no report from other localities and it is closely related with *R.*

stricta in its thallus structure. These species have also been largely misidentified. After studying Malaysian *R. fluitans,* Meijer (1958) suggested that the comments of Mueller (1940, 1941) does not hold good for the tropical habitats. Re-examination in many parts of the world such as Africa (Perold 1990, 1999) also supported these assumptions. All southern and tropical African specimens named as *R. fluitans*, examined by Perold (1990, 1995) were found belonging to *R. stricta* (Gottsche, Lindenb. & Nees) Perold. The situation in other tropical parts such as in India may not be different. Hence we conducted a detailed re-examination of *R. fluitans* known from India.

In India, *Riccia fluitans* L. emend K. Muller was known by the reports of Mitten (1860-1861) from the Himalayas including Nepal, Kumaon and Nilgiris, Stephani (1990) from the Himalayas, Japan, Siberia and other European and American countries, Kashyap (1929) from Jammu Valley, Kashmir, Peshwar, Garhwal, and Madras, Srivastava (1964) from Shillong, Chopra (1943) from Sikkim, Bengal, western Himalayas, South India and Nepal, Singh & Nath (2007) based on Srivastava (1964) from Meghalaya, Nair *et al*. (2005, 2006), Manju & Rajesh (2009) and Manju *et al*. (2009) from Kerala.

Species in the *Riccia fluitans* complex are difficult to distinguish, as the gametophytes are highly sensitive to environmental conditions and the habitat may vary from terrestrial to aquatic. *R. fluitans* is characterised by wider thallus, clearly visible distinct air chambers, apical scale not protruding and the thallus is dioicous (Jovet-Ast 1986).

Methods

Details on the occurrence of *Riccia fluitans* in India were collected by scanning through the literature. In addition to the fresh specimens from southern India the specimens available in various herbaria such as BM, CALI, NBRI were also used for the present study. Photographs were provided for easy identification (Figures 1 & 2).

Results

The species of *Riccia fluitans* and *Riccia stricta* can be distinguished from one another as shown in the key below (see also Table.1). The detailed re-examination revealed that the true *R. fluitans* does not occur in India. The specimens mentioned earlier under the name *R. fluitans* from India belong to *R. stricta*.

1a. Thallus with distinct air chambers absent; spore production very often……..…...***R. stricta***

1b. Thallus with small air chambers with distinct areolate walls; spore production very rare ……..... ***R. fluitans***

Figure 1. Riccia stricta specimens collected from different localities of Western Ghats, A: KPR 106927 (terricolous). B: MCN 84369 (terricolous). C: MCN 84511 (aquatic). D: KPR 99809 (aquatic).

Riccia fluitans auct. mult. non L., Species Plantarum 1139. 1753; emend K.Mueller, Aufl. 6 Bd. 1. Abt. 204. f. 134. 1907. *Ricciella fluitans* (L.) A.Braun, Species Plantarum 1139. 1753. *Riccia canaliculata* Hoffm., Deutsch. Fl. 2: 96. 1795. *R. canaliculata* Hoffm. var. *fluitans* Schiffn., Oester. Bot. Zeitsch. 49: 387. 1899. *Riccia duplex* Lorb. & K.Mueller, Hedwigia 80: 100. 1941. *Riccia media* Klingm., Flora 146: 616. 1958.

Thallus broad, thin, 1-1.5 cm x 0.8-2 mm, dichotomously branched, yellowish-green; terrestrial thallus much broader, apex of thallus wider than rest of the thallus, rhizoids pegged, ventral scales rudimentary; both lacking in free-floating form; thallus segments broadly channelled in free-floating form, spongy, air chambers occur through out thallus. Walls of small air chambers from above is distinctly areolate, clearly visible, grove not very distinct apically, otherwise absent.

The species shows both aquatic and terrestrial forms but the main difference is that *Riccia fluitans* sporulates very rarely and the species is dioecious whereas *Riccia stricta* produces spores very often and it is monoecious. The above description is mainly based on the following specimens from BM.

Specimens examined

Flora Romaniae Exsiccata, A Herbario Universitatis Napocensis Edita 3045 a. *Riccia fluitans* L. as *Ricciella fluitans* (Leg. et. Det. E.I. Nyárády *et* St. Péterfi, Rev. Tr. Ştefureac) BM000962754; 3045 b. *Riccia fluitans* L. as *Ricciella fluitans* (Leg. et. Det. E.I. Nyarady *et* St. Rev. Tr. Ştefureac) BM000962755.

Hepaticae Suecicae A Museo Upsaliensi Distributae; VIII. 1880, *Riccia fluitans* (Smaland Par. O Torsas, Sunnansjo Det. C.J. Johansson, BM000962756.

Musci Suecici, Ex. Herb. H.W. Arnell, A Museo Botanico Upsaliensi Distributi (*Riccia fluitans* (Smaland 11. IX 1883, leg. H. Wilh Arnell, BM000962757.

Riccia stricta (Gottsche, Lindenb. & Nees) Perold, Bothalia 20: 197. 1990; Udar & Agarwal, J. Indian Bot. Soc. 64:248. 1985; Bapna & Kachroo, Hep. India, 2: 457. 2000. *Riccia fluitans* var. *stricta* Gottsche, Lindenb. & Nees, Synopsis Hepaticarum 4: 610. 1846. *Fysonia tenera* Kashyap, Liv. W. Him. Punjab Pl. 1: 97. 1929. *Riccia fluitans* auct. mult; Kashyap, Liv. W. Him. Punjab Pl. 1: 96. 1929; Bapna, Bryologist 64: 250. 1961; Bapna & Kachroo, J. Indian Bot. Soc. 54: 221. 1975 & Hepatic. India 2: 452. 2000; Singh & Nath, Hep. Khasi & Jaintia hills 343. 2007; Nair *et al*., Bryophytes Wayanad W. Ghats 39. 2005 & Geophytology 36: 8. 2006; Manju & Rajesh, Acta Bot. Hungarica 51: 332. 2009; Manju *et al*., Archive Bryology 42: 5. 2009, non L., 1753 emend K. Muell., 1907.

Thallus spongy, long, 15-20 x 0.2-0.5 mm broad, light greenish, scales absent, air spaces not clearly marked out in distinct air chambers; ventral scales slightly protruding ventrally at apex, other scales paired or single; *Ricciella* type, Monoecious, Sporogonia in 1 or 2 rows, situated anterior, ventrally conspicuously projected; spores brown, 50-76 ìm diam., distal face reticulate with 2-4 large reticulations, triradiate mark thick and very prominent, 5µm wide, in proximal face on each facet 6-10 areolae, some incomplete or subdivided by faint radiating ridges, winged, wings thick, 7.5 µm wide, single pore at marginal angles; distal face large, deep areolae across diameter, 17-20 µm wide, with central boss, walls thick.

Riccia stricta grows on damp soil or mud, mostly in association with other *Riccia* or *Anthoceros* spp. Occasionally it is seen as aquatic and floats in masses on still water. The land form of *R. stricta* sometimes forms bulbils at the apices of the thalli to survive drought conditions. *R. stricta* can generally be recognized by its mostly smooth dorsal surface through which the large air chambers are faintly to fairly clearly visible, by small ventral scales and by small spores with large, deep-walled alveoli containing a central boss on the distal face and, on the proximal face, a prominent triradiate mark.

Distribution: INDIA: Tamil Nadu (Kodaikanal), Kerala (Munnar, Silent Valley), Madhya Pradesh and Uttar Pradesh (Pachmarhi); all over tropical and So-

uth Africa (Wigginton & Grolle 1996). According to Schuster (1992: 469) the tropical American *Riccia stenophylla* Spruce is also synonymous with *Riccia stricta*, hence the species can be considered, as Pantropical.

Specimens examined from Kerala

Wayanad District, Sulthanbathery (920 m) *MCN 84369* (terr.), Kurichiad Range, Chikkanji (900 m) *MCN 84537a, 84538a* (terr.), Begur RF, Tholpetty Range, (830-880 m) *MCN 84570, 84589* (terr.), Muthanga Range, Keeradamkolli, (786m), *MCN 84511* (floating), Ambalavayal (900 m) *KPR 99869* (terr.); Kannur District, Aralam WLS, *Ambalappara* (1400 m), (Aqua.) *KPR 99809*, *MATTOOL* (sea level) *KPR 84560* (terr.). Idukki District, Chinnar WLS, Pudukkudi, Way to Olikkudy (760-1700 m) *MCN 87669*, *Saju 84637* (terr.), Palapatty(1420 m) *MCN 87348a*, Ollavayal (1775 m), *MCN 87380, MCN 99466* (terr.) (All specimens deposited in CALI); Idukki District, Neriamangalam (900 m) *Nikesh 2446*, Munnar, Kallar (1800 m) *Nikesh 2450* . (St. Alberts College, Ernakulam).

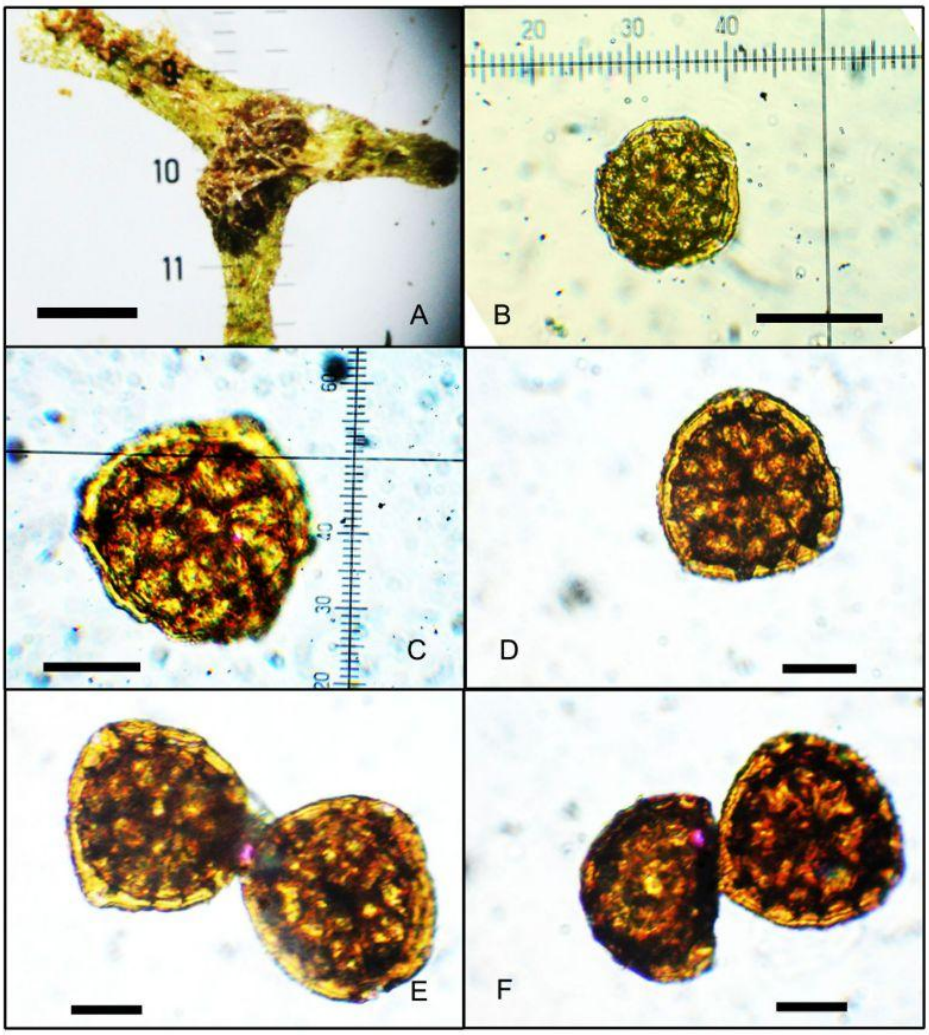

Fig.2. Riccia stricta specimens from Africa. A: Thallus with two sporangia, ventral view (scale bar 0.5 mm). B-F: Spori, different views (scale bar in B 50 µm, in the rest 25 µm). A–C: specimen from Tanzania, Rasmussen & W. Esbensen B 85. D–F: specimens from South Africa, F. Eyles 1405.

Other specimens examined

Madhya Pradesh, Pachmarhi, Mahadeo (1,000 m) damp rocks near caves, 17.12.1993, [V. Nath & Asthana, 205644] (NBRI)

Andra Pradesh, Hosely Hills (Chittoor District), [T. Pulliah, S. Sandhya Rani & K.S. Nagesh, 31611]. Tanzania: Kilimanjaro Mts. Mweka, on soil, at 100 m alt. Coll. *K. Rasmussen & W. Esbensen B 85* (EGR ex C). South Africa: Port Stephensone Distr., Imberzana, on streambank, at 30 m alt. Coll. *F. Eyles 1405* (EGR ex SRGH).

Rehmann, A.: Hepaticae Austro-Africanae, *Riccia fluitans* det, F. Stephani (*Riccia stricta* (Lindenb.) Perold. Det. S.M. Perold, 1990, BM000962749.

Like the other members of the *Riccia fluitans* complex, *Riccia stricta* is highly sensitive to the water availability and humidity. It shows great variation in its morphology, the thalli generally ranging from thicker and narrower in drier localities, to thinner and wider in wetter places.

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TABLE 1.-Comparison of some characters of R. stricta and R. fluitans
Characters of R. fluitans based on Jovet-Ast (1986)

Characters	***Riccia stricta***	***Riccia fluitans***
Habitat	Aquatic and terrestrial	Aquatic and terrestrial
Branch length	15-20 mm	10-15 mm
Branch width	0.2-0.5 mm	0.8-2 mm
Branch thickness	0.25-0.35-0.5 mm	± 0.2 mm
Apex	Slightly narrower than rest of the Thallus, or bulbous, notched	Generally wider than rest of the thallus
Grove	Only visible in living plants	Not very distinct apically, otherwise absent
Walls of air chambers from above	Not clearly marked out in distinct air chambers	Distinctly areolate with walls of rather small air chambers clearly visible
Ventral scales	Slightly protruding ventrally at apex, other scales paired or single	Apical scale not protruding, 2 or 3 others mostly single
Stolons	Sometimes present	Not mentioned
Sexuality	Monoicous	Dioicous
Fertility	Quite often	Extremely rare
Sporangium orientation	Oblique	± horizontal
Spore diameter	(50-)62-70(-76) μm	(50-)56-75(-80) μm
Wing	Thick, 7.5 μm wide, single pore at marginal angles	Fairly distinct, thin, 4-5 μm wide; single pore at marginal angles
Triradiate mark	Thick and very prominent, 5μm wide	Fairly distinct, thin, 4-5 μm high
Proximal face	On each facet 6-10 areolae, some incomplete or subdivided by faint radiating ridges	Up to ±10, mostly incomplete areolae on each facet
Distal face	(4-)5-6(-12) large, deep, complete, often subdivided areolae across diameter, 17-20 μm wide, with central boss, walls thick.	5-7 incomplete areolae across diameter, 8-16(-20) μm wide, mostly empty, walls fairly thick.
Distribution	Common and widespread in tropical countries.	Except in tropical countries, widespread in temperate regions.