

The 23 papers of this Nova Hedwigia Beiheft 138 span a broad range of topics in **Systematics, phytodiversity, phytosociology and ecology of Bryophytes** reflecting the still continuing importance of Bryology.

In the **Systematic part** (8 contributions), a new genus, *Kuerschneria*, and four new species are described as new to science. Two papers include molecular analyses (genera *Oxystegus* and *Palustriella*), one a morphometric analysis of the genus *Gymnostomiella*, and five papers deal with classical morpho-anatomical systematic treatments (moss genus *Forsstroemia* and liverwort genera, *Ceratolejeunea* and *Lejeunea*). The **Phytodiversity part** (9 contributions) presents an impressive example for the recent ongoing worldwide survey on the diversity of bryophytes, ranging from Europe to South-West Asia, Macaronesia (Selvagens Islands), the Himalayan region, southern South America and to Île Amsterdam in the South Indian Ocean. These are contributions to different countries and regions (Greece, Montenegro, Turkey, Bhutan, Chile, Sino-Himalayan region), and to the oceanic islands Selvagens and Île Amsterdam.

The **Phytosociology and Ecology part** (5 papers) gives an impression of the phytosociological and ecological work in the Tropics (2 contributions, neotropical trunk-epiphytes), two concern vegetation units in Europe and one the ecology of genus *Porella* in Madeira. The volume is completed with a contribution on asexual reproduction (propagula types) in pleurocarpous mosses.

The papers have been written by colleagues, former scholars and friends of Professor Dr. Harald Kürschner, to honour his distinguished scientific and academic career and his outstanding contributions to the bryology of South-West Asia, the tropical rain forests and to Geobotany.

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## The Euxinian-Hyrcanian endemic species *Forsstroemia remotifolia* (Lindb. ex Broth.) Hedenäs & Zare, comb. nov. (Neckeraceae, Bryophyta)

Lars Hedenäs<sup>1</sup> and Habib Zare<sup>2</sup>

<sup>1</sup> Swedish Museum of Natural History, Department of Cryptogamic Botany, Box 50007, SE-104 05 Stockholm, Sweden; lars.hedenas@nrm.se (corresp. author)

<sup>2</sup> Herbarium of Nowshahr Botanical Garden, Agriculture and Natural Resources Research Center of Mazandaran, Iran

With 1 figure and 1 table

**Abstract:** The predominantly Hyrcanian species that was traditionally called *Pseudoleskeella laxiramea* (Schiffn.) Broth. has a characteristic leaf areolation, conspicuous perichaetial branches, relatively large secondary shoots, smooth leaf lamina cells, and sporophytes with a short seta. This combination of features places the species in *Forsstroemia* rather than in any of the three genera, *Leskea*, *Pseudoleskea*, or *Pseudoleskeella*, with which it has been associated earlier. The oldest name at the species level is *Pseudoleskea remotifolia* (Lindb. ex Broth.) Paris (described from Georgia as *Leskea catenulata* subsp. *remotifolia* Lindb. ex Broth.), and we therefore make the new combination *Forsstroemia remotifolia*. This species is most similar to *F. indica* (Mont.) Paris, but has different leaf orientation, appearance of the apical costa, median and apical leaf lamina cell shape and length, alar group appearance, and perigonal and perichaetial paraphyses. Male plants and plants with young and old sporophytes are reported for the first time in this species. The position in *Forsstroemia*, with a closest relative in southern India, Sri Lanka, and Taiwan, underlines the well-known biogeographic connection between the Euxinian and Hyrcanian regions and S-SE tropical Asia.

**Key words:** *Forsstroemia*, Euxinian-Hyrcanian endemic, Iran, Neckeraceae

### Introduction

*Pseudoleskeella laxiramea* (Schiffn.) Broth. is a characteristic epiphytic pleurocarpous moss of the Hyrcanian forests of northern Iran (Frey & Probst 1974, Frey & Kürschner 1979). This species was described more than 100 years ago, but its systematic affinities are still unclear (Frey & Kürschner 1979, Crosby et al. 1999). When Schiffner (1908) described *Leskea laxiramea*, he was aware of the potential relationship between his new taxon and *Leskea catenulata* subsp. *remotifolia* Lindb. ex Broth. and *Pseudoleskea catenulata* var. *laxifolia* Kindb., although he had not access to material of the latter two. The holotype and isotypes of *Pseudoleskea catenulata* var. *laxifolia* Kindb. present in S (reg. nos. B169800 (holo), B169801, B169802) clearly belong to *Pseudoleskeella catenulata* (Brid. ex Schrad.) Kindb. and this name therefore does not need

further consideration in this context. However, when Townsend (1966) studied an isotype of *Leskea catenulata* subsp. *remotifolia* it became clear to him that this was the same species as *Pseudoleskeella laxiramea*. After studies of the isotype of *L. catenulata* subsp. *remotifolia* that is present in S, we agree with this conclusion. Townsend (1966) noted that Brothrus' (1892) taxon, if interpreted as being at the species level (as *Leskea remotifolia* Lindb. ex Broth.), is a later homonym of *L. remotifolia* Hook. (described in 1830) and *L. remotifolia* Müll. Hal. (1846). However, the asterisk rather than a species number before the name '*Leskea remotifolia* Lindb.' in Brothrus (1892) work indicates that he meant the name to be at the subspecific level. This is also how it is understood today (TROPICOS; <http://www.tropicos.org/Name/35139560>, accessed 14 Jan. 2010), and the first time this taxon is correctly treated as a species is actually in 1898, as *Pseudoleskea remotifolia* (Lindb. ex Broth.) Paris, based on the original name of the subspecific taxon (Paris 1894–1898). Since the species level name *P. remotifolia* is ten years older than *Leskea laxiramea* (Schiffner 1908), *remotifolia* is also the epithet to apply at the species level.

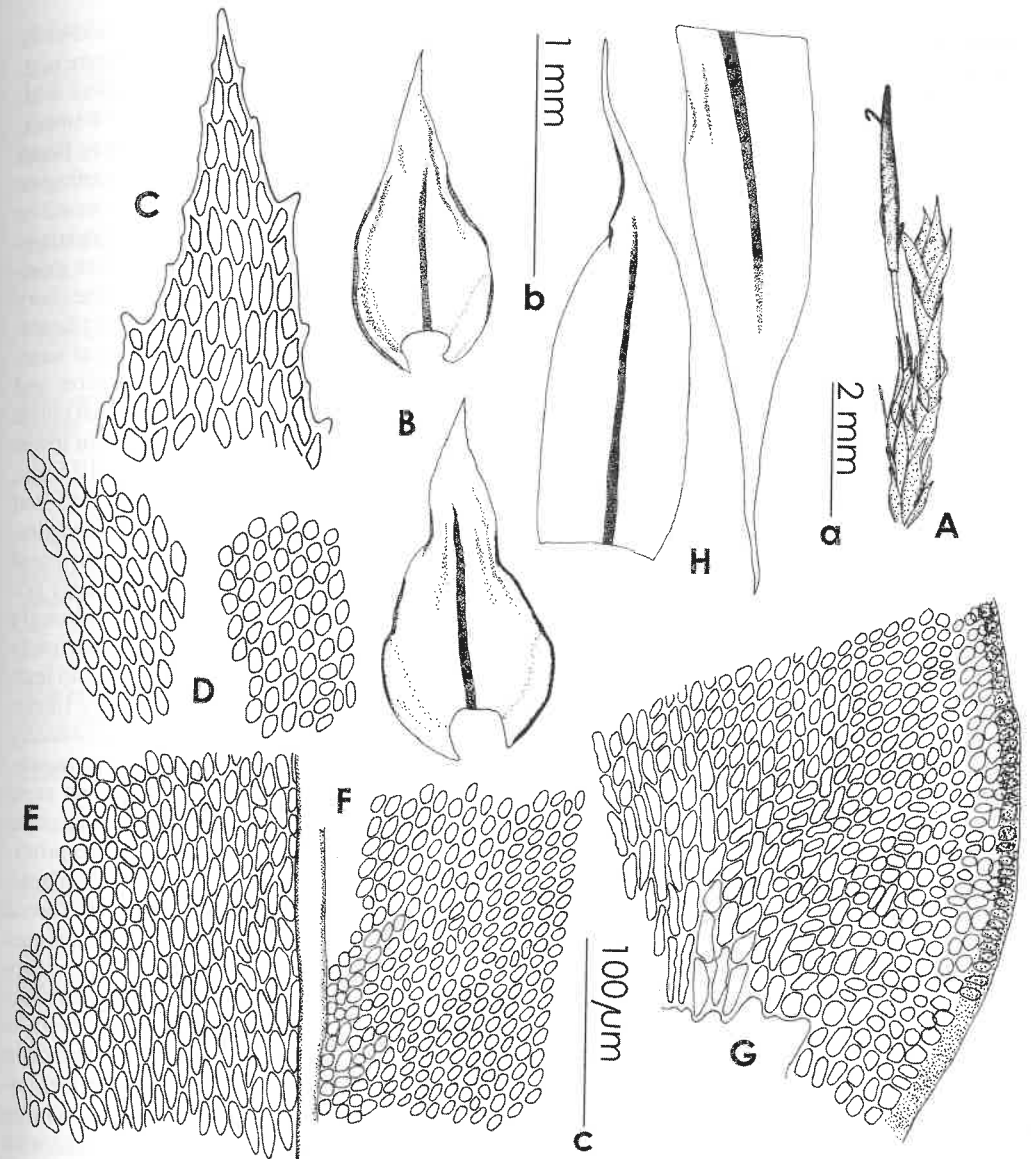
During studies of epiphytic Hyrcanian forest mosses, it became evident to us that the species that has until now been called *Pseudoleskeella laxiramea* does not belong to *Pseudoleskeella*, but to *Forsstroemia*. The characteristic leaf areolation and conspicuous perichaetial branches actually made us identify material of this species as *Forsstroemia* sp. before realising that it had already been described in a different genus. However, the combination of relatively large size of well developed secondary shoots, smooth leaf lamina cells, and sporophytes with a short seta does not fit with *Leskea*, *Pseudoleskea*, or *Pseudoleskeella*, where it has been placed earlier. The species is very similar to the south Indian, Sri Lankan, and Taiwanese species *F. indica* (Mont.) Paris. Careful studies of material of both the northern Iranian and the S and E Asian taxa, and comparison of the Iranian species with the description of *F. indica* by Stark (1987), showed that the two differ from each other in a number of significant features. We therefore make the new combination *Forsstroemia remotifolia*. When dealing with the northern Iranian taxon, Townsend (1966) found it interesting '...that all the material of *P. laxiramea* so far collected has had abundant female flowers (as is the case with the present gatherings and the isotype of *L. remotifolia*), but neither the male plant nor the fruit has yet been seen.' We have now seen male plants, young sporophytes, calyptrae, and old sporophytes where only the seta remains. To be able to fully discuss the differences towards *F. indica*, and to provide a description of so-far unknown details of the now both Euxinian (type of *Leskea catenulata* subsp. *remotifolia*) and Hyrcanian species, we provide an updated species description.

## Taxonomy

### *Forsstroemia remotifolia* (Lindb. ex Broth.) Hedenäs & Zare comb. nov.

**BASEONYM:** *Leskea catenulata* subsp. *remotifolia* Lindb. ex Broth., Acta Soc. Sci. Fenn. 19(12): 96. 1892. *Pseudoleskea remotifolia* (Lindb. ex Broth.) Paris, Index Bryol. 1037. 1898. *Leskea remotifolia* Lindb. ex Paris, Index Bryol. 1037. 1898, nom. inval. *Pseudoleskeella catenulata* subsp. *remotifolia* (Lindb. ex Broth.) Podp., Consp. Musc. Eur. 528. 1954. **TYPE:** *Pseudoleskeella catenulata* \**P. remotifolia* (Lindb.) [Georgia] Bryotheca Caucasia. Imeretia, Mekvena ad fl. Rion, ad moles umbr. calcar., 6/6 1877, leg. V. F. Brothrus (Isotype; S, reg. no. B169789; isotype in BM, not seen).

**SYNONYMS:** *Leskea laxiramea* Schiffn., Österr. Bot. Z. 58: 344. 9 f. 55–60. 1908. *Pseudoleskeella laxiramea* (Schiffn.) Broth., Nat. Pflanzenfam. (ed. 2) 11: 304. 1925. **TYPE:** *Leskea laxiramea* Schiffn. n. sp., ster. ♀, [Iran] Flora Persia bor., In vallé fluvii Sefidrud, ad Rudbar, 300 m.s.m., 1902 7/V, leg. J. Bornmüller no. 5887, det Schiffner 12.10.1907, Herbarium J. Bornmüller, in Herb. Schiffner (Holotype; FH, reg. no. 286647).



**Fig. 1.** *Forsstroemia remotifolia* (Lindb. ex Broth.) Hedenäs & Zare (A–E, G–H; Iran. Prov. Mazandaran, Nowshahr, H. Zare, S; reg. no. B170927) and *F. indica* (Mont.) Paris (F; India, Upper Pulney, G. F., S; reg. no. B170638). A. Portion of shoot with young sporophyte. B. Stem leaves. C. Upper leaf lamina. D. Leaf lamina cells from around upper end of costa. E, F. Leaf lamina cells close to costa in broadest portion of leaf (costa to the right, E; or left, F). G. Basal and alar portion of leaf. H. Inner perichaetial leaves from perichaetium with young sporophyte. Scales: a: A; b: B, H; c: C–G.

**Plants** from primary stem with erect or up to 25 cm long and hanging secondary shoots, these irregularly to pinnately branched, sometimes with branches secondarily branched, branches often long and longly attenuate. **Stem** in transverse section round or elliptic, without central strand,

cortex including epidermis of 2–4 layers of small and incrassate cells. **Rhizoids** inserted at or just below leaf insertion, sometimes on lowermost costa, red-brown, not or hardly branched, smooth. **Pseudoparaphyllia** foliose, outer ones narrowly triangular to linear, sometimes with an irregular marginal tooth; paraphyllia absent. **Axillary hairs** 3–4 per axil, with 2–4 upper, hyaline cells, 9.5–12.0 µm wide, basal cells 1–2, quadrate or shortly rectangular, brown. **Stem leaves** when moist (almost erect), erect-patent or from erect to patent base patent-spreading or homomallous to falcate-secund, not or hardly spirally arranged, when dry entirely appressed or sometimes leaf acumen sub-patent, straight or homomallous to falcate-secund; leaves narrowly ovate, ovate, oblong-ovate, or occasionally obovate, narrowed at decurrent insertion, above gradually narrowed to acuminate or shortly acuminate apex, occasionally curved, acumen plane (very rarely twisted to 45–90 deg), well developed leaves 0.92–1.68 mm long, concave, not plicate; costa single (rarely forked above), ending 55–72 % way up leaf, 31.5–56.5 µm wide near base, cells on both ad- and abaxial sides linear, in middle portion much longer, near insertion and above longer than adjoining lamina cells, smooth, not ending in a spine; margin in acumen entire or mostly denticulate to irregularly dentate, entire below, more or less broadly recurved in lower 2/5–2/3(–3/4), in one or both sides; median leaf lamina cells 10.5–31.5(–35.5) × 8.5–10.5 µm, more elongate along costa than towards margin, especially distinct in lower portion of mid-leaf (most distinct in large leaves, sometimes only on one side), rhomboidal or mostly elongate-rhomboidal, or near costa shortly linear, incrassate, collenchymatous, eporose, smooth; basal lamina cells linear or shortly so, up to 67.0 µm long, strongly incrassate, sometimes strongly porose; alar cells transversely elongate, rhomboidal, quadrate, rectangular, partly irregular, strongly incrassate and collenchymatous, eporose, forming a somewhat indistinctly delimited, narrowly triangular or narrowly ovate group along basal leaf margin, extending up to 25–40 % way up leaf, longly and broadly decurrent; some or numerous cells near leaf apex elongate or shortly linear, up to 31.5(–37.5) µm long, clearly more elongate than cells around upper costa, occasionally elongate or slightly elongate cells are found only in a small area just below leaf apex, incrassate, eporose, sometimes slightly collenchymatous. **Branch leaves** smaller and narrower than stem leaves, especially in long attenuate branches in specimens hanging from tree branches; costa weaker and shorter than in stem leaves; margin sometimes less strongly denticulate above; proximal branch leaves semi-orbicular, more or less broadly obtuse. **Dioicous**, with large male plants. **Perigonia** lateral on secondary stem; perigonal leaves from broad basal part suddenly narrowed to narrow acumen, bordered at shoulder, entire, or near apex of longest acumina sometimes finely denticulate; paraphyses abundant, as long as antheridia. **Perichaetia** lateral on secondary stem and larger branches; inner perichaetial leaves from straight and erect base with slightly flexuose acumen, from oblong or ovate-oblong base narrowed to narrow acumen, acumen 25–35 % of leaf length, not plicate; costa single, long, ending 65–85 % way up leaf; margin entire or in acumen partly denticulate, rarely with single sharp tooth, at shoulder sometimes weakly denticulate, bordered or indistinctly so; paraphyses 12–>75-cells long, incrassate, uniseriate or in large portions biseriata. **Calyptra** (only young seen) 2–4-stratose, cells homogeneous, smooth, with scattered paraphyses in lower portion. **Seta** at least 2 mm long (only young and very old seen), yellow, smooth.

## Discussion

Because of its morphological plasticity (Frey & Probst 1974), gross morphology and leaf shape are strongly variable in this species, depending on both substrate and humidity. Creeping shoots attached to the substrate in drier situations look strikingly different from the almost Meteoraceae-like, hanging shoots of up to 15–25 cm length in humid places. However, the stem leaves of the largest secondary shoots are usually distinct and make this species easily distinguished

Table 1. Characters separating *Forsstroemia remotifolia* from *F. indica*.

Character	<i>F. indica</i>	<i>F. remotifolia</i>
Stem leaf acumen	Frequently twisted	Mostly plane
Stem and branch leaf orientation when moist	Patent, frequently distinctly spirally arranged	Erect-patent or from erect to patent base patent-spreading to falcate-secund, not or hardly spiral
Stem leaf orientation when dry	Erect, with acumen often patent, or homomallous	Leaves entirely appressed, or leaf acumen sub-patent, sometimes homomallous to falcate-secund
Upper costa	Often with scattered teeth above, or ending in a short spine	Smooth, never ending in a distinct spine
Median leaf lamina cell length	8.5–23.0 µm, only slightly more elongate near costa than towards margin	10.5–31.5(–35.7) µm, more elongate near costa than towards margin, especially in lower mid-leaf (most distinct in large leaves, sometimes only on one side of costa)
Median leaf lamina cell shape	Rhomboidal or elongate-rhomboidal (to shortly linear), mostly in rows directed obliquely outwards-forwards from costa	Rhomboidal or mostly elongate-rhomboidal, near costa often shortly linear
Alar group extending up along leaf margin	Up to 20–25 % way up leaf	Up to 25–40 % way up leaf
Lamina cells near leaf apex	Linear or shortly so, up to 42.0 µm long	Some or numerous cells elongate or shortly linear, to 31.5(–37.5) µm long, clearly more elongate than lamina cells around costa end
Perigonial paraphyses	Few and short, mostly reaching 1/2 way up antheridia, sometimes as long as the latter	Abundant, as long as antheridia
Perichaetial paraphyses	9–25-cells long, sparse, uniseriate	12–>75-cells long, abundant, uniseriate or in large portions biseriata

from other *Forsstroemia* species. *Forsstroemia remotifolia* keys out as a member of Section *Microforsstroemia* Nog. in the key of Stark (1987), because of its relatively short leaf lamina cells and long, single costa. Within Section *Microforsstroemia* the dioicous sexual condition, and the mostly more than 1 mm long stem leaves with the leaf lamina cells close to the apex longer than the median ones place this species close to *F. indica*.

There are several details in which *F. remotifolia* differs from *F. indica*, the most important of which are compared in Table 1. Further, the branches in *F. remotifolia* tend to be much longer and more longly attenuate than in *F. indica* and there is a tendency that *F. remotifolia* has a longer costa than *F. indica*, both in the vegetative and perichaetial leaves (ending 55–72 % vs. 47–66 % way up leaf in the vegetative leaves; 65–85 % vs. 60–70 % in the perichaetial ones). The median leaf lamina and alar cells tend to be more strongly collenchymatous in *F. indica* than in *F. remotifolia* and the upper acumina of the longest perigonial and inner perichaetial leaves tend to be more strongly denticulate or dentate in the first than in the latter.

The *Cryphaea* sp. of Størmer (1963), called *Cryphaea* cf. *heteromalla* (Hedw.) D. Mohr by Akhiani & Kürschner (2004), may actually belong to *Forsstroemia remotifolia*. Størmer (1963) also referred to an earlier report of sterile *Cryphaea* from Bengerdud in Gilan (Boissier & Buhse 1860), and remarked on the similarity between his own material and *C. heteromalla* in leaf shape and cell texture. Plants lacking the frequent long, attenuate branches, as well as leaf shape and areolation of *F. remotifolia* (cf. Fig. 1) remind a bit about *Cryphaea*. However, all *Cryphaea* species are autoicous and have mostly sporophytes, and the *C. heteromalla* specimen from prov. Ghilan in S (reg. no. 69974) is possibly the only correct record of this species from Iran (Rao 2001).

With its new taxonomic position, the Euxinian-Hyrcanian endemic moss *Forsstroemia remotifolia* fits well into a biogeographic pattern well known for other Euxinian and Hyrcanian plant species [e.g., Frey & Probst 1986 (Caucasian-Euxino-Hyrcanian province of the Euro-Siberian region), Browicz 1989]. Although we will explore such biogeographic patterns in greater detail elsewhere (Zare, Hedenäs, Denk, in prep.), it is obvious that the distribution of *F. remotifolia* in relation to *F. indica* and other species of Section *Microforsstroemia* that occur in S-SE Asia and Africa makes perfect sense from a biogeographic point of view.

ADDITIONAL SPECIMENS EXAMINED: *Forsstroemia indica*: **India**. [Tamil Nadu], Upper Pulney, 1925, G. F. (S; reg. no. B170638); [Tamil Nadu / Kerala] Nilgheris Mountains, [Herbarium G. Roth] (S; reg. no. B170639). **Sri Lanka**. Parawella-Wasserfalls, 1906, T. Herzog 95 (S; reg. no. B170640). *Forsstroemia remotifolia*: **Iran**. Prov. Gilan: Elburs occident., Selfidrud ad Rudbar, 1902, J. & A. Bornmüller 5887b (HBG); Prov. Gorgan (Asterabad): Hadjilang, 1948, K. H. & F. Rechinger 7434 (S; reg. No. B170934); Ters-okan prope Gumbet, 1914, A. J. Michelson 570 (HBG). Prov. Mazandaran: Amol, Karasang, 1909, F. Bruns (HBG); same data, no collector (HBG); Ladjim, 1963, V. Tregubov 17e (S; reg. No. B170936); Ladjim Eroo, 1963, V. Tregubov 9a (S; reg. No. B170937); Nowshahr, Mashlak, 2009, H. Zare (S; reg. no. B170928); Nowshahr, Mashlak, 2009, H. Zare (S; reg. no. B170931); Nowshahr, Mashlak, 2009, H. Zare (S; reg. no. B170932); Nowshahr, between Mashlak and Veisar, 2009, H. Zare (S; reg. no. B170927); Nowshahr, between Mashlak and Veisar, 2009, H. Zare (S; reg. no. B170930); Nowshahr, Veisar, 2009, H. Zare (S; reg. no. B170929); Between Sari and Beshar, 1967, K. H. Rechinger (S; reg. No. B170935); Between Abbasad and Cahi, 1937, K. H. Rechinger 2275 (S; reg. No. B170933).

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