
A New Species of *Taxiphyllum* (Musci: Hypnaceae) from Sri Lanka

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ABSTRACT. A new species, *Taxiphyllum townsendii* Ochyra & Ireland (Hypnaceae, Musci), is described from Sri Lanka. The species was earlier known under the name *Plagiothecium ceylonense* Brotherus ex Dixon, but this name was not validly published and therefore a new name is needed. *Taxiphyllum townsendii* is similar in many ways to the common eastern North American species, *T. deplanatum* (Bruch & Schimper ex Sullivant) M. Fleischer, but differs by its larger, often oblong-lanceolate leaves that are abruptly or gradually short- or long-acuminate; much longer and narrower mid-leaf cells; short-rectangular, very broad basal leaf cells that form a distinct 1- to 2-seriate strip at the leaf insertion; and a prominent angular group of large quadrate to short-rectangular cells that extend up the margins by four to 10 cells. *Taxiphyllum subretusum* (Thwaites & Mitten) O'Shea is transferred to the genus *Phyllocladon* Schimper as *P. subretusum* (Thwaites & Mitten) Ochyra & Ireland and the name is lectotypified. The validity of the name *Entodon isopterygioides* (Dixon) Dixon is discussed and this name is considered to be validly published.

Key words: Asia, *Entodon*, Hypnaceae, *Phyllocladon*, Sri Lanka, *Taxiphyllum*.

While studying the genus *Plagiothecium* Schimper in Africa, the first author obtained from Clifford C. Townsend (K) two specimens of a moss collected in 1973 in Sri Lanka, which superficially resembled members of that genus. Two species of *Plagiothecium* have hitherto been recorded from Sri Lanka: *P. subglaucum* Thwaites & Mitten and *P. ceylonense* Brotherus ex Dixon (Abeywickrama & Jansen, 1978; O'Shea, 2002). The former is conspecific with *P. neckeroideum* Schimper. The specimens supplied by Townsend proved to be different from this species, but they clearly match the original collection of *P. ceylonense*.

The name *Plagiothecium ceylonense* was used by Brotherus on the herbarium label of a plant collected in October 1901 by Robert Wright (*Wright 3798*) and

distributed in "Bryotheca E. Levier." However, there was no description on the label, nor was this species name mentioned for the Musci in either edition of *Die natürlichen Pflanzenfamilien* (Brotherus, 1908, 1925). This name was subsequently used by Dixon (1915) for five specimens of mosses collected in 1913 by C. H. Binstead on Ceylon. The compilers of *Index Muscorum* (Wijk et al., 1967) considered the name *P. ceylonense* to have been validated in Dixon (1915). However, careful analysis of the entry dealing with this species indicates the name was not validly published. This text (Dixon, 1915: 294) states: "*Plagiothecium ceylonense* Broth. ined. Rock in stream, deeply shaded, near Hagkala (222), det. Brotherus; by stream, &c., N. E. (353, 359, 369); shaded rock near stream, Nanuoya (424), a robust form with stems 4 in. long, and leaves less denser and less complanate than usual."

Some early botanists used "form" as a term similar to the modern term "taxon," so that the "robust form" would be the species itself, but here it seems clear that it only represents number 424 from Nanuoya that is a "robust form." Therefore, we believe that the brief description in Dixon (1915) applies only to the [unnamed] variant (forma?) that the *Binstead 424* specimen represents. In his 1915 paper, Dixon described seven new species jointly with Brotherus (*Fissidens aberrans* Brotherus & Dixon, *Macromitrium assimile* Brotherus & Dixon, *Bryum ceylonense* Brotherus & Dixon, *Camptochaete thamnioides* Brotherus & Dixon, *Acanthocladium ceylonense* Brotherus & Dixon, *Taxithelium binsteadii* Brotherus & Dixon, and *Vesicularia caloblasta* Brotherus & Dixon), and from this it seems clear Dixon had no intention of validating Brotherus' manuscript name.

After examining the original Wright material of *Plagiothecium ceylonense*, the Binstead specimens reported by Dixon (1915), as well as the two recent Townsend collections, we conclude that they all represent a single distinct species of *Taxiphyllum* M. Fleischer, instead of *Plagiothecium*, based on the

revised generic concept of *Taxiphyllum* and *Plagiothecium* proposed by Iwatsuki (1963, 1970) and Robinson (1974). These two genera share a complanate-foliate habit and a short, double costa, which prompted some authors to keep them together in the family Plagiotheciaceae (e.g., Szafran, 1961; Nyholm, 1965; Lawton, 1971; Smith, 1978; Noguchi, 1994), while Grout (1932) merged them and considered *Taxiphyllum* a subgenus of *Plagiothecium*. However, except for a similar habit and costa, *Taxiphyllum* has little else in common with *Plagiothecium* and the Plagiotheciaceae as defined by Buck and Ireland (1985). The lack of a differentiated stem epidermis, nondecurent leaves, and presence of foliose pseudoparaphyllia preclude the new species from inclusion in *Plagiothecium*. On the other hand, these features suggest its relationship lies with the Hypnaceae, in *Taxiphyllum* as Fleischer (1923) originally proposed when establishing that genus. This family placement of *Taxiphyllum* has recently gained wider acceptance by various bryologists (e.g., Iwatsuki, 1963; Crum & Anderson, 1981; Buck, 1998; Ochyra et al., 2003; Zhang & He, 2005).

***Taxiphyllum townsendii* Ochyra & Ireland, sp. nov.**

TYPE: Sri Lanka. Central Prov.: Nuwara Eliya Distr., on rocks in ravine of Nanu Oya, just outside Nuwara Eliya, 17 Mar. 1973, C. C. Townsend 73/1393 (holotype, E; isotype, KRAM). Figure 1.

Plagiothecium ceylonense Brotherus ex Dixon, J. Bot. 53: 294. 1915, nom. ined. "Plagiothecium ceylonense Broth. ms. nov. sp. (in lit. 1902) [Sri Lanka] Insula Ceylon S. W. Hinidoon-Kanda Hills (0–2200 ft.), Oct. 1901, legit Robert Wright, determ. V. F. Brotherus n° 3798."

Species haec *Taxiphylllo deplanato* (Bruch & Schimper ex Sullivant) M. Fleischer similis, sed ab eo foliis longioribus plerumque oblongo-lanceolatis et cellulis in medio laminae longioribus angustioribusque, basi brevioribus dilatatisque 1- vel 2-seriatis, margine cellulis angularibus majoribus 3- ad 5-seriatis quadratis vel oblatiis alam distinctam formantibus facillime distinguitur.

Plants medium-sized to fairly large, soft, forming extensive, thin or dense mats, lustrous, pale green to yellow-green, becoming brownish green with age; stems creeping, to 6 or occasionally 10 cm, irregularly branched, mostly complanate-foliate or occasionally terete, not or sparsely radiculose ventrally with scattered fascicles of light brown, smooth, unbranched rhizoids, transverse section rounded to elliptical, consisting of (1 to)2(to 3) rows of smaller cortical cells with yellow, thickened walls, surrounding 2 to 3 rows of enlarged, thin-walled, hyaline medullary cells;

central strand small and distinct or indistinct, sometimes absent; pseudoparaphyllia foliose, triangular; axillary hairs sparse, filiform, with 1 or 2 short, brownish basal cells and a single, elongate, hyaline distal cell. Stem and branch leaves similar, the stem leaves sometimes only somewhat larger, not or little changed and somewhat shrivelled when dry, slightly distant to close and overlapping, wide- or erect-spreading to imbricate, complanate and appearing distichous, but arranged in more than 2 rows, nondecurent, smooth, straight, symmetric, concave, 1.8–2.1 × 0.5–0.9 mm (width near leaf middle), becoming somewhat narrowed to the insertion, oblong- to ovate-lanceolate or lanceolate, usually abruptly narrowed to an acute, broad, or filiform apex of varying length or, less often, gradually slenderly long-acuminate; margins plane, sharply serrate or serrulate distally, remotely and weakly serrulate to nearly smooth in the proximal part; costa faint, short and double, usually with 1 branch longer, or often lacking; laminal cells smooth or minutely prorulose at both ends on adaxial surface, thin-walled, nonporose, linear-flexuose, with sharp, long-acuminate tips, 80–140 × 5–7 µm (width at mid-leaf), becoming somewhat shorter and wider, oblong-hexagonal near leaf apex and 40–70 × 7–10 µm at leaf base; alar cells quadrate, oblate, or some short-rectangular, 15–20 × 15–25 µm, thin- to somewhat firm-walled, arranged in 3 to 5 rows, forming a prominent group extending up the margins by 4 to 10 cells; cells at the insertion hexagonal to oblong, 30–50 × 15–20 µm, thin-walled, forming distinct 1- to 2-seriate strips at the leaf base, sharply demarcated from the adjacent laminal cells. Sex organs and sporophytes unknown.

Habitat and distribution. *Taxiphyllum townsendii* is an epilithic moss growing on shaded rocks by and in streams and waterfalls. The species is endemic to Sri Lanka, where it occurs in the mountainous region in the south-central part of the island.

IUCN Red List category. No additional information on biology and size of the populations of *Taxiphyllum townsendii* is available. Therefore, the species is included in the category Data Deficient (DD) according to IUCN Red List categories and criteria (IUCN, 2001). However, the discovery of the species at several sites may indicate that it is not rare in the region.

Etymology. This species is named in honor of Clifford C. Townsend (1926–), the eminent British bryologist who rediscovered it in Sri Lanka and has contributed much to the knowledge of the taxonomy and distribution of mosses in various parts of the globe.

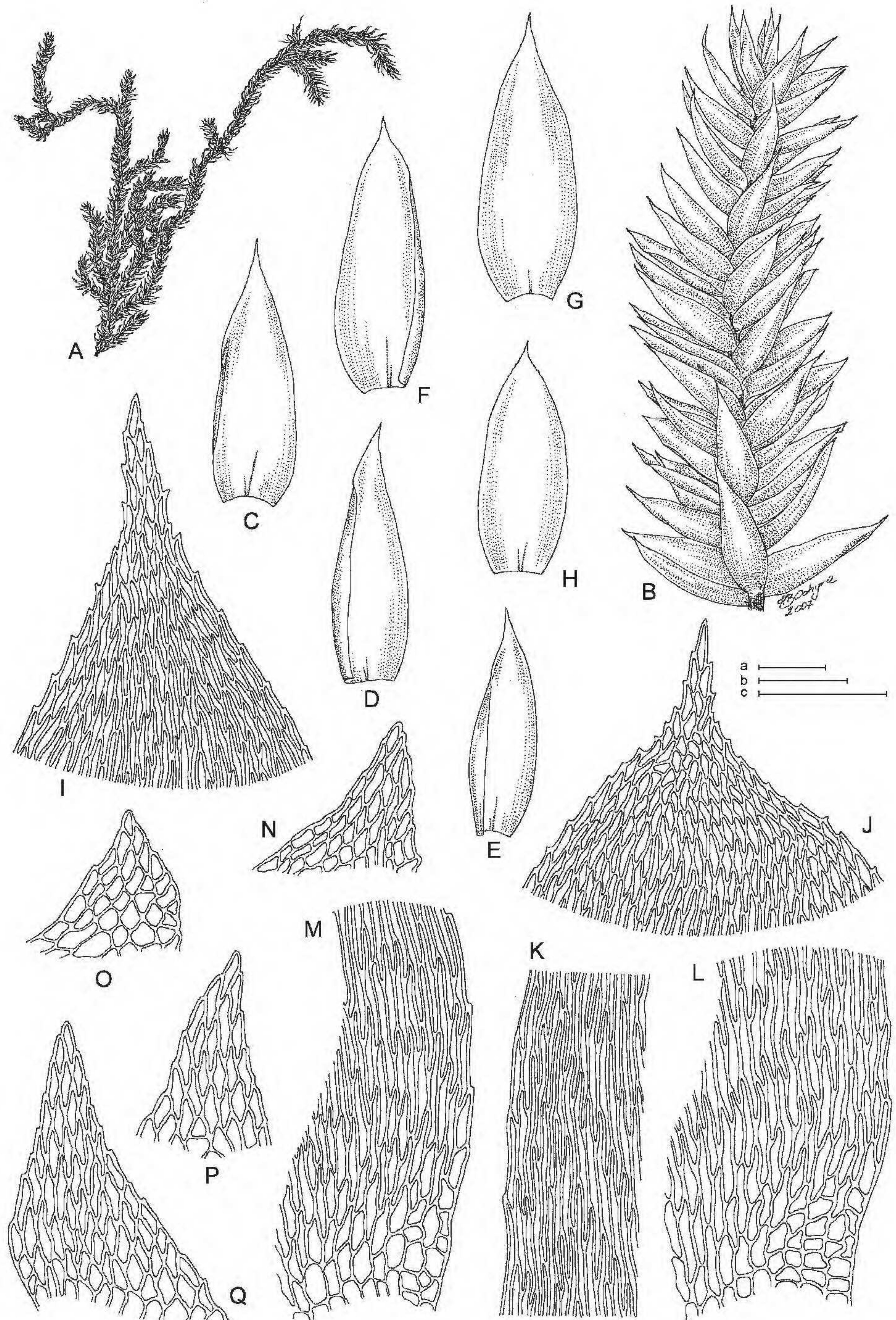


Figure 1. *Taxiphyllum townsendii* Ochyra & Ireland. —A. Habit, dry. —B. Portion of branch, moist. —C–H. Leaves. —I, J. Leaf apices. —K. Mid-leaf cells at margin. —L, M. Angular cells. —N–Q. Pseudoparaphyllia. A, F–H, J, L, N, O drawn from the paratype (*Wright 3798*, KRAM); B–E, I, K, M, P, Q drawn from the isotype (*Townsend 73/1393*, KRAM). Scale bars: a = 1 mm (B); b = 1 cm (A); c = 1 mm (C–H) and 100 μ m (I–Q).

Discussion. *Taxiphyllum townsendii* is recognized from its congeners by its leaf areolation. The mid-leaf cells are linear-flexuose, $80\text{--}140 \times 5\text{--}7 \mu\text{m}$, and the alar region forms a prominent group of large, mostly quadrate cells, $15\text{--}20 \times 15\text{--}25 \mu\text{m}$, with four to 10 cells extending upward along the margins. In addition, the basal leaf cells differ markedly from the adjacent laminal cells, being much shorter and wider, hexagonal to oblong, $30\text{--}50 \times 15\text{--}20 \mu\text{m}$, and forming a distinct strip along the leaf insertion composed of one or two rows of cells. As is the case with the majority of *Taxiphyllum* species, its stems are complanate-foliate. Occasionally the branches are terete-foliate.

Taxiphyllum townsendii is one of the largest species of the genus, with plants as long as 10 cm. In Asia, *Taxiphyllum* is represented by about eight species, some of which have not yet been critically evaluated. Five distinct and well-defined species are known from Japan (Noguchi, 1994) and mainland Asia (Zhang & He, 2005), but none match *T. townsendii* in morphological and anatomical characters. *Taxiphyllum arcuatum* (Bosch & Sande Lacoste) S. He, *T. alternans* (Cardot) Z. Iwatsuki, and *T. taxirameum* (Mitten) M. Fleischer are morphologically different from *T. townsendii* in having poorly differentiated alar cells. *Taxiphyllum cuspidifolium* (Cardot) Z. Iwatsuki has prominent alar cells, but the distinctly julaceous habit and shorter and wider laminal cells ($80\text{--}100 \times 7\text{--}9 \mu\text{m}$) make it very distinct from all other congeners, including *T. townsendii*. The fifth species, *T. aomoriense* (Bescherelle) Z. Iwatsuki, is a strongly complanate moss with markedly distichous leaves and apices turned down toward the substratum. This characteristic habit, coupled with its much shorter cells ($65\text{--}85 \times 6\text{--}7 \mu\text{m}$), differentiates it from *T. townsendii*. The other two continental species, *T. inundatum* Reimers and *T. giraldii* (Müller Hallensis) M. Fleischer, are poorly known taxa that have no differentiated alar cells or only poorly developed ones; they appear to be closely related to *T. taxirameum*. The Malaysian *T. punctulatum* M. Fleischer is described by Fleischer (1923) as having very small leaves, $0.7\text{--}0.8 \times 0.3 \text{ mm}$, with very short, narrow laminal cells, $30\text{--}40 \times 4\text{--}5 \mu\text{m}$. Finally, *T. maniae* (Renauld & Paris) M. Fleischer, which is known from India, Malaysia, and New Guinea, is conspecific with *T. taxirameum* (O'Shea et al., 2003).

Taxiphyllum townsendii seems to be most similar to *T. deplanatum* (Bruch & Schimper ex Sullivant) M. Fleischer, primarily an eastern and southwestern North American plant (Ireland, 1969) that is also known from Mexico and Honduras (Ireland & Buck, 2009). The two species share a similar leaf shape, although *T. deplanatum* generally has shorter leaves, averaging 1.3–1.7 mm long. Its plants are usually

complanate with the leaves arranged in two rows, giving them a characteristic appearance of being regularly plaited or braided with apices turned slightly downward. This species is very distinct from *T. townsendii* in its shorter, wider mid-leaf cells that are $50\text{--}90 \times 5\text{--}12 \mu\text{m}$, possessing a smaller alar group with smaller cells at the leaf insertion.

Paratypes. SRI LANKA. **Central Prov.:** near Hagkala, rocks in stream, deeply shaded, 1 Mar. 1913, *C. H. Binstead* 222 (BM); Nanuoya, shaded rocks near stream, 13 Mar. 1913, *C. H. Binstead* 424 (BM); Nuwara Eliya, by stream, 1913, *C. H. Binstead* 353 (BM); Nuwara Eliya, rock near waterfall, Feb. 1913, *C. H. Binstead* 359 (BM); Nuwara Eliya, on rocks below waterfall above Grand Hotel, 19 Mar. 1973, *C. C. Townsend* 73/1556 (E, KRAM, US); Himidoon, Kanda Hills, Oct. 1901, *Wright* 3798 (BM, H-BR, KRAM, PC).

Taxonomic notes. There are three other species of *Taxiphyllum* known from Sri Lanka (O'Shea, 2002): *T. taxirameum* (Mitten) M. Fleischer, *T. subretusum* (Thwaites & Mitten) O'Shea, and *T. isopterygioides* (Dixon) W. R. Buck. The leaf areolation readily separates *T. townsendii* from *T. taxirameum*, a pantropical and subtropical species that is common and widely distributed in Asia. The median leaf cells are variable in *T. taxirameum*, ranging in length from 40–125 μm , but they average only 50–70 μm , and are usually prorate and shortly acute, rounded, slanted, or truncate at both ends rather than smooth, sharp, and long-acuminate. The alar cells are only slightly differentiated and form a small group composed of one to three rows, with only one to five cells in the marginal row, and the cells at the leaf insertion are not markedly larger from the laminal cells above the base. In addition, the leaves are rigid, not or only somewhat overlapping, and usually far apart rather than being soft, close, and overlapping.

The other two Sri Lankan species, *Taxiphyllum subretusum* and *T. isopterygioides*, actually do not belong within *Taxiphyllum*. *Taxiphyllum subretusum* has ligulate leaves that are broadly obtuse and coarsely, often doubly, dentate at the apex with margins above mid-leaf having distinctly prorate distal cells and lacking differentiated alar cells. These features are all typical of the genus *Phyllocladon* Schimper and accordingly this species is transferred to that genus.

Phyllocladon subretusum (Thwaites & Mitten) Ochrya & Ireland, comb. nov. Basionym: *Ectropothecium subretusum* Thwaites & Mitten, J. Linn. Soc., Bot. 13: 321. 1873. *Taxiphyllum subretusum* (Thwaites & Mitten) O'Shea, J. Hattori Bot. Lab. 92: 126. 2002. TYPE: [Sri Lanka.] "Ins. Ceylon, [s.d.], Dr. Thwaites [246 in sched., NY]" (lectotype, designated here, NY-Mitten 780336;

isotypes, "Ectrop. subretusum C. M. 246 Ambagamara, Centr. Prov., Ceylon 300 ft.," BM 662671, BM 662672, BM 662673).

It should be noted that such a relationship of this species was first suggested by Fleischer (1923) and later Tixier (1988) when they placed it in the genus *Glossadelphus* M. Fleischer, which is congeneric with *Phyllodon* (Buck, 1987).

Taxiphyllum isopterygioides has a very complanate habit and broadly ovate, ecostate leaves that are broadly rounded-obtuse to broadly acute at the apex, serrate in the distal part, and distinctly constricted at the base, with numerous large, subhyaline cells at the base forming a prominent alar group. These features suggest this species belongs to *Entodon* Müller Hallensis. This species was originally described as *Taxithelium isopterygioides* Dixon (Dixon, 1915), and it was subsequently transferred to *Entodon* by Dixon (1933). The compilers of *Index Muscorum* (Wijk et al., 1962) treated *E. isopterygioides* as a nomen nudum, but they overlooked the parenthetical author citation "Dix." in Dixon's (1933: 27) paper, and this represents an indirect reference to the basionym, *Taxithelium isopterygioides*. Therefore, *E. isopterygioides* (Dixon) Dixon should be considered a validly published name.

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