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Cover image: *Camptochaete arbuscula* var. *arbuscula*. Habit. Drawn by Rebecca Wagstaff from *J. Child 5528*, CHR 428525.

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Introduction

The Lembophyllaceae are a family of approximately 50 species in 14 genera, widely distributed in temperate and tropical areas. The New Zealand species occur mostly in forest as conspicuous tufted mats on tree trunks, exposed roots, branches and logs, also often on rocks, and sometimes soil. Eleven species (one of which is present as two varieties) in five genera occur in New Zealand. All the species are indigenous and three species and one variety are endemic. The remaining species also variously occur in Australia, southern South America, and the Pacific. Many of the species are taxonomically difficult due to variability caused by vigorous growth producing extensive tangled masses which obscure some characteristic specific features. Members of the family have a dendroid or pendent growth form, short upper laminal cells, and sometimes differentiated and coloured alar cells. Following a period of taxonomic instability, molecular analysis has provided a more settled outline of the generic limits and relationships of the Lembophyllaceae.

Lembophyllaceae Broth.

Type taxon: *Lembophyllum* Lindb.

Plants robust to slender, rigid and wiry or soft, often glossy. **Stems** mostly erect-ascendant, sometimes pendent or trailing, subdendroid to dendroid and stipitate, loosely or densely branched to form usually regular fronds, terete to complanate; paraphyllia absent. **Pseudoparaphyllia** foliose. **Leaves** erect-spreading, rarely patent or falcate-secund, moderately to deeply concave, smooth or ± wrinkled when dry; ovate to widely ovate or ± round, apices obtuse or widely acute, rarely cucullate, acute, acuminate, cuspidate or apiculate, rarely aciculate; **margins** plane, incurved, unbordered, entire or variably denticulate. **Costa** variable, mostly double and short, occasionally single and developed to mid leaf, faint, sometimes absent. **Mid laminal cells** linear or linear-rhombic, prorate and sometimes porose; becoming shorter and rhombic above; cells near base becoming shorter, wider, more irregular and porose, sometimes forming a basal band; **alar cells** short, quadrate, sometimes not distinct from adjacent basal cells.

Dioicous or **pseudautoicous**. **Inner perichaetial leaves** mostly widely spreading from an oblong base, sometimes erect, mostly acute to acuminate or lanceolate, ecostate, not or weakly bordered; areolation as in stem leaves, porose and prorate, alar cells not differentiated, margins entire, enclosing numerous filamentous hyaline paraphyses. Outer perichaetial leaves shorter and more obtuse. **Perigonia** axillary on lateral branches, gemmiform, with leaves enclosing three to several antheridia with hyaline paraphyses. **Setae** elongate, red-brown, curved or flexuose, smooth. **Capsules** mostly horizontal or sometimes ± erect, symmetric, smooth, often constricted below the mouth when dry; **exothecial cells** mostly irregularly thick-walled, elongate, not or sometimes weakly thickened at the angles. **Stomata** usually absent. **Peristome** double, hypnoid; **exostome teeth** yellow-brown, lanceolate, shouldered, bordered below, inserted at or below the capsule mouth, not furrowed; **endostome** pale yellow or hyaline, papillose, with a basal membrane c. (⅕–) ⅓–½ the exostome teeth in length, segments and cilia mostly well developed. **Operculum** conic, blunt-apiculate or rostrate. **Calyptra** narrowly cylindric, cucullate, smooth and obtuse, hairless or rarely with 2–3 hairs at the base. **Spores** spherical, light yellow-brown, papillose.

Taxonomy: The Lembophyllaceae are a moderately sized and widely distributed temperate and tropical family of pleurocarpous mosses. The generic limits of the family have been unstable. Brotherus (1925) originally included 12 genera in the Lembophyllaceae, but as subsequent authors questioned many of those placements, the family came to be viewed more narrowly, containing as few as two species (Buck & Vitt 1986; Crum 1991; Buck 1994). More recently, molecular analysis supports the recognition of a family concept close to that of Brotherus, comprising 14 genera. Perceived relationships of the family have also shifted, away from families such as the Brachytheciaceae and the Meteoriaceae, to a close relation to the Neckeraceae (Tangney 1997a; Quandt et al. 2009; Enroth et al. 2019).

The genera included in the Lembophyllaceae exhibit a diversity of peristomes, having both well-developed and reduced forms, with the latter associated with an epiphytic habit (Buck 1991; Quandt & Huttunen 2004; Huttunen et al. 2004). Within the family, epiphytic members of the main clades exhibit peristome reduction alongside taxa with well-developed peristomes. *Weymouthia mollis* is the only N.Z. Lembophyllaceae with a reduced peristome.

The Lembophyllaceae comprise three main clades/groups broadly distributed in the temperate Northern Hemisphere, South America – Africa, and Australasia – Southern South America respectively (Tangney 2007a).

Five genera, *Lembophyllum*, *Weymouthia*, *Camptochaete*, *Fifea* and *Fallaciella,* with 11 species, including one variety, are accepted as part of the New Zealand flora.

Quandt et al. (2009), using chloroplast markers trnL-trnF and pbsT-psbH and ITS2, showed that these five genera belong in Lembophyllaceae but sequence divergence is very low between the genera and their study could not test the monophyly of *Fifea* and *Fallaciella*.

Notes: A common, dendroid-stipitate, branching pattern underlies the range of form in N.Z. Lembophyllaceae. Plants produce branched fronds on unbranched stems (stipes) forming small ‘trees’ linked together by creeping stems. Fronds develop as erect side branches from creeping stems, and by the creeping stems becoming erect to form fronds. New growth may occur from the frond branches, as they grow downwards and root at the tips to form new creeping stems. Creeping stems and the unbranched stipes are characterised by leaves which are pressed to the stems making them appear leafless. Changes from one branch type to another can be traced through changes in orientation of the leaves (Tangney 2007b).

The N.Z. genera exhibit variations on the underlying pattern of growth and in the degree of frond formation. For example, *Camptochaete* forms mostly pinnate fronds with wiry stems, whereas in *Weymouthia* the fronds are only loosely branched, or fronds are lacking, and softer pendent growth is typical. These reductions in the branching are associated with an epiphytic habit (Tangney 2007b).

Variability of this pattern of growth and branching often produces elongate creeping or pendent forms where the separation of creeping stems and fronds is not clear as the orderly production of typical growth breaks down. Such forms are characteristic of some of the N.Z. species, making them difficult to identify as the distinctions between species are blurred.

Extensive tangled masses are sometimes produced as loose-lying, unattached 'moss balls' (Martin 1952). Martin noted this tendency in plants of *Camptochaete (ramulosa) deflexa,* and they are extreme forms of the elongate forms and are sometimes found in wet depressions under scrub and forest, where ongoing disturbance seems to be a factor in continually producing regenerative growth (Tangney 2007b).

A number of the species are pseudautoicous, with dwarf males reported in *Lembophyllum* (Tangney 2006) and in *Camptochaete*, *Fifea*, and *Weymouthia* by Hedenäs & Bisang (2011).

Recognition: The N.Z. members of the family share a common branching pattern that produces a range of growth forms, from relatively coarse wiry wefts to low smooth mats or soft pendent fronds. They are generally ± glossy plants with ovate-oblong, concave leaves, and a distinct cell pattern of rhombic upper laminal cells, linear mid laminal cells which are usually prorate, and differentiated basal and alar cells. The costa varies from short and double to faint or absent, and is occasionally single and extending to mid leaf. Capsules are mostly exserted on elongated setae with generally well-developed hypnoid peristomes.

In mesic and xerophytic habitats, they may be confused with members of the Brachytheciaceae, but the latter tend to have a strong single costa and typically have linear upper laminal cells. The Brachytheciaceae also lack the wiry stipe-forming stems of the Lembophyllaceae. Similarly, the Amblystegiaceae are unlikely to be confused. In wetter terrestrial habitats favoured by many Amblystegiaceae, species of Lembophyllaceae are not common. The Amblystegiaceae are often red-brown, yellow-green or sometimes blackish and have leaves that are often strongly curved to one side, with a costa single to above mid leaf, mostly elongate upper laminal cells, and alar cells that are often thin-walled and inflated. Occurrence in wetter habitats for the Lembophyllaceae is mostly in stream beds, on rocks, bark and soil, and there they are most similar to members of the Neckeraceae, particularly the dendroid-forming *Austrothamnium pandum* and *Echinodiopsis hispida*. The latter two are distinguished by strong single costae, serrate leaf margins, and laminal cells that are densely packed and irregularly quadrate to round. Other families that produce creeping stems with erect dendroid fronds are similarly distinct from the Lembophyllaceae. These include the umbrella mosses of the Hypopterygiaceae (which have flattened fronds with usually bordered and dentate leaves in three rows; two rows of larger asymmetric leaves and a third row of smaller, symmetric under-leaves, with strong single costae), and the Hypnodendraceae (that have branches in whorls rather than pinnate fronds, except *Braithwaitea sulcata*, which has leaves with strong single costae, to the leaf apex or excurrent, and laminal cells narrowly linear above). *Trachyloma*, in the Pterobryaceae produces flattened pinnate fronds on unbranched stipes, with leaves that are ovate to ovate-lanceolate and have a costa that is ± absent. However, it differs from the Lembophyllaceae in having a silver-white colouring, cells narrowly elongate mostly throughout, becoming laxer at the base, and numerous brown brood bodies amongst the apical branch leaves. The pendulous forms of *Weymouthia* with distantly and irregularly pinnate branches are similar to those of *Papillaria* in the Meteoriaceae, but *Papillaria* tends to be more strikingly coloured, with shades of orange, yellow, brown and yellow-green. The leaves are often plicate, with a strong single costa extending to the upper leaf, they lack differentiated alar cells, and the plants are dull, due to the leaf cells being strongly and multiply papillose.

1	**Plants** mostly robust, or rigid and wiry, forming scrambling wefts, occasionally pendent, or dendroid and stipitate; **secondary stems** differentiated into a lower unbranched stipe with erect-appressed leaves and upper much-branched fronds with erect-spreading leaves..... 2
1'	**Plants** robust or slender, mostly forming soft, tight mats, loose wefts or pendent masses, not dendroid or stipitate; **secondary stems** with leaves not erect-appressed below, or stipe poorly developed, not frondose, sparsely branched.....4

2	**Frond axis** and **branch leaves** aciculate, acumen greater in length than the rest of the leaf; **apical cell** linear, longer than 75 µm..... *Fifea*
2'	**Frond axis** and **branch leaves** not aciculate, apex obtuse or acute to acuminate; **apical cell** rhombic to short linear, less than 50 µm.....3
3	**Frond axis** and **branch leaves** various, ovate to widely ovate or cochleariform; **apices** obtuse or acute to acuminate; **costa** double and short; **mid laminal cells** linear..... *Camptochaete*
3'	**Frond axis** and **branch leaves** not various, cochleariform; **apices** obtuse, cucullate, less commonly widely acute; **costa** variable; **mid laminal cells** rhombic to short linear..... *Lembophyllum*
4	**Frond axis** and **branch leaves** aciculate, acumen greater in length than the leaf base; **apical cell** linear, longer than 75 µm..... *Fifea*
4'	**Frond axis** and **branch leaves** not aciculate, apex acute to acuminate; **apical cell** rhombic to short linear, less than 50 µm..... 5
5	**Plants** small, forming tight or rather loose mats; **leaves** moderately concave, ovate, broadly to narrowly acute; **apex** erect, not cucullate, sometimes mucronate-apiculate..... *Fallaciella*
5'	**Plants** large, forming loose mats or wefts, sometimes pendent; **leaves** concave to deeply concave, cochleariform, to widely ovate or ovate oblong; **apex** cucullate to widely acute, not mucronate-apiculate.....6
6	**Plants** usually weft-forming, **stems** julaceous, **leaves** cochleariform; **apex** usually cucullate; **costa** varying from short and double or absent to robust and single; **mid laminal cells** rhombic to short linear, thick-walled, sometimes weakly porose ..... *Lembophyllum*
6'	**Plants** usually or at least sometimes pendent, **stems** complanate, sometimes loosely julaceous, **leaves** ovate to oblong; **apex** erect; **costa** short and double or absent; **mid laminal cells** linear, firm-walled, sometimes strongly porose..... *Weymouthia*

Excluded Taxa: *Acrocladium chlamydophyllum* (Hook.f. & Wilson) Müll.Hal. & Broth. Brotherus (1901–1909, 1925) included *Acrocladium* in the Lembophyllaceae, and subsequent authors have either excluded it (Buck & Vitt 1986, Buck 1991, Walther 1983; Tangney 1997a) or included it (Crosby et al. 1999). Molecular data supports its exclusion from the Lembophyllaceae, and it has been placed in a monogeneric family, the Acrocladiaceae, with relations to the Lepyrodontaceae (Tangney et al. 2010; Quandt et al. 2009; see also, Fife 2014).

Camptochaete Reichardt, *Reise Novara 1,* 190 (1870)

= *Thamniella* Besch., *Ann. Sci. Nat., Bot. sér. 5,* 18: 239 (1873)

= *Ptilocladus* Lindb., *Contr. Fl. Crypt. As.* 278 (1872) nom. illeg.

Type taxon: *Camptochaete arbuscula* (Sm.) Reichardt

Plants robust, mostly rigid and wiry, pale yellow-green to light olive-green or brown-green, glossy to dull; forming loose wefts on trunks of trees, exposed roots and rocks, occasionally on the ground. **Stems** creeping to erect-ascending, stipitate; **fronds** 2(–3)-pinnate, ± regular, mostly complanate. **Branches** frequent, straight or curved when dry. **Pseudoparaphyllia** foliose, broadly triangular. **Leaves** erect-spreading, rarely falcate secund, sometimes catenulate, smooth when moist, loosely wrinkled, or not altered when dry, moderately to strongly concave, obovate, ovate to orbicular, obtuse or acute to acuminate, sometimes mucronate, sometimes cucullate; **margins** plane, incurved, entire or denticulate above. **Costa** short, double and faint, or absent, rarely single and extending to the upper lamina. **Mid laminal cells** linear, sigmoid, not or weakly porose, firm- to thick-walled, prorate; those above rhombic and thick-walled, those below irregularly rectangular, and thick-walled. **Alar cells** pigmented or not, forming a ± triangular group weakly differentiated from the adjacent basal margin.

Dioicous or **pseudautoicous**. **Inner perichaetial leaves** with apices reflexed from an oblong sheathing base, acute to acuminate. Outer perichaetial leaves much shorter and more obtuse. **Setae** mostly elongate, flexuose, smooth, red-brown to pale purple. **Capsules** nearly erect to horizontal, smooth, symmetric or curved, shortly oblong-cylindric (1.5–2:1), red-brown; **exothecial cells** oblong, sometimes quadrate, thick-walled. **Stomata** absent. **Peristome** diplolepideous; **exostome teeth**

lanceolate, shouldered, bordered below, pale yellow-brown, outer face striate or striate-papillose below and finely to coarsely baculate above, bullate at the apex, with a zigzag median line; inner face with well-developed lamellae, smooth below, and baculate above; **endostome** yellow or hyaline, finely baculate to bullate; with the basal membrane c. ½ the height of the endostome and with segments keeled and perforate-cracked, finely baculate to bullate. **Cilia** 2–3, well developed, nodulose to appendiculate. **Operculum** blunt to short-rostrate from a high conic base, symmetric. **Calyptra** smooth. **Spores** spherical, pale yellow-brown, coarsely baculate.

Taxonomy: A genus of 10 species distributed in Australasia. The generic concept utilised here excludes those species removed from *Camptochaete* by Crum (1991): *Camptochaete* (*Fallaciella*) *gracilis* and *Camptochaete* (*Fifea*) *aciphylla*. The four species recognised in N.Z. were included in section *Camptochaete* by Tangney (1997b), characterised by erect imbricate stipe leaves and a blunt-apiculate operculum.

Plants of N.Z. *Camptochaete* are typically rigid, wiry, and subdendroid, producing branched fronds held on unbranched stems (stipes), and some of the species produce elongate trailing forms. They differ from the other N.Z. Lembophyllaceae in having well developed stipes and densely branched fronds that are consistently and regularly 2-pinnate. The other genera differ in being either smaller plants with weaker stipe development (*Fallaciella*), or by having loosely branched or indistinct fronds (*Weymouthia*, *Lembophyllum*). *Fifea* can have neat 2-pinnate fronds, but it differs in its long hair-like leaf apices.

Important features for identification of the N.Z. species are: leaf size, shape, orientation, degree of concavity, disposition wet and dry, and leaf apical form. In species that produce elongate ('deflexa') forms the branches and terminal main stems become elongate and attenuate. The leaves become smaller, more slender, and distally grade into the form of 'embryonic' leaves, lacking specific characters. Leaves with characters more typical of the species can usually be found in the basal parts of elongated growth. See below for discussion of *Camptochaete deflexa*.

Etymology: From the Greek: *camptos*, bent or curved, and *chaete*, loose flowing hair or mane; a reference to the habit which suggests long flowing hair.

1 **Frond axis** and **branch leaf apices** falcate-secund..... ..... *C. pulvinata*

1' **Frond axis** and **branch leaf apices** not falcate-secund..... 2

2 **Branch leaves** narrowly ovate-lanceolate (l:w > 3.5), serrulate, weakly concave..... ..... *C. angustata*

2' **Branch leaves** broadly ovate to oblong (l:w < 2.5), ± entire, concave to strongly concave 3

3 **Fronds** ± regularly 2(–3)-pinnate, mostly compact; **frond axes** and **branches** mostly complanate; **leaves** usually not in neat spirals, concave, obtuse, subobtuse or acuminate 4

3' **Fronds** not pinnate, loosely and openly branched, **frond axes** and **branches** inflated and sub-julaceous; **leaves** neatly spiralled, very deeply concave, abruptly and distinctly mucronate .... *C. arbuscula* var. *tumida*

4 **Plants** pale, light green to yellow-green; **setae** short, robust, 4–5 mm, with **capsules** held on the underside of fronds; **leaves** collapsed-wrinkled when dry, strongly concave and cochleariform, ± oblong, subobtuse to widely acute or mucronate; **cells in leaf apex** short, l:w usually < 2.... ..... *C. arbuscula* var. *arbuscula*

4' **Plants** darker, green or olive-green to brown-green; **setae** elongate, slender, 8–10 mm, with **capsules** held above the fronds; **leaves** not markedly altered when dry (and then occasionally striate-wrinkled), moderately concave, ovate to broadly ovate, acute to acuminate; **cells in leaf apex** elongate, l:w > 3, usually 4–7 .... *C. deflexa*

Camptochaete angustata (Mitt.) Reichardt, *Reise Novara 1,* 191 (1870)

≡ *Stereodon angustatus* Mitt., *J. Proc. Linn. Soc., Bot.* 4: 88 (1859)
≡ *Isothecium angustatum* (Mitt.) Hook.f., *Handb. New Zealand Fl.* 465 (1867)
≡ *Ptilocladus angustatus* (Mitt.) Lindb. in Paris, *Index. Bryol.* 233 (1894) nom. inval.
Lectotype: N.Z., near Wellington, *Stephenson* (Herb. Mitten, NY!). Isotype: Knight 132, BM 001108356! (Lectotype designated by Tangney 1997b, p. 92)

= *Isothecium obscurum* Colenso, *Trans. & Proc. New Zealand Inst.* 20: 241 (1888)
Holotype: N.Z., Waipawa, south of Dannevirke, *Colenso*, 1887, Herb. Colenso 4192, WELT M012609! Isotype WELT M000226!

Plants slender to robust, 30–60 (–70) mm long, dark green or brown, dull or slightly glossy. **Stems** ± erect to scrambling, complanate, stipitate; in cross-section oval, 650 × 530 µm, with an outer layer of 7–10 cells surrounding a parenchyma and an indistinct central strand. **Stipes** 15–20 (–30) mm. **Fronds** densely and irregularly 1(–2)-pinnate, compact, fine and feathery. **Branches** straight, complanate. **Frond axis leaves** regularly imbricate, not or scarcely altered when dry, moderately concave, sometimes conduplicate, narrowly ovate-oblong, acute, entire, (1.7–) 2.0–2.2 × 0.6–0.9 mm, with alar cells forming an extensive and conspicuous group 22 cells wide and extending 16 cells from the leaf base. **Branch leaves** smaller and narrower, narrow-elliptic or lanceolate, with a smaller alar group, 0.9–1.5 × 0.2–0.4 mm, margins serrulate to denticulate above, sometimes denticulate to the lower margin. **Costa** double and failing below mid leaf, faint, sometimes absent, rarely single and extending to the mid leaf. **Mid laminal cells** weakly porose, (37–) 50–65 (–100) × 5 µm; becoming shorter, wider, and strongly porose below to form a weakly differentiated basal band (30–) 35–45 × 7–8 µm; those above shorter, 10–12 (–25) × 5 µm at the apex.

Dioicous. **Setae** 6–8 mm. **Capsules** inclined to horizontal, symmetric, c. 1.5–2 × 1 mm; **exothecial cells** mostly 30–45 × 18–20 µm. **Operculum** conic, apiculate, c. 0.6 mm long. **Exostome teeth** c. 575 µm; **endostome** with a basal membrane ½ the exostome. **Calyptra** c. 1.8 mm. **Spores** 15–18 µm.

Illustrations: Plate 2. Tangney 1997b, figs. 6, 9, 15, 22.

Distribution: K; NI: N Auckland, S Auckland, Gisborne, Hawke's Bay, Wellington; SI: Nelson, Marlborough, Canterbury, Westland, Otago, Southland.

Endemic.

Habitat: Common in lowland broad-leaved forest where it occurs mainly on the bark of trees, including on lianes, and on logs, rocks and exposed roots. On the Kermadec Is, it occurs as an epiphyte on *Cyathea* (tree fern) trunks. Altitudinal range: sea level to 1150 m on South I. (Mt Mytton, Nelson LD), to 740 m on North I. (Erua, Wellington LD); Kermadec Is: 300–360 m.

Notes: *Camptochaete angustata* is a distinctive species characterised by its small, fine, feathery fronds, weakly concave narrowly ovate-lanceolate leaves, with l:w > 3.5, serrulate margins and extensive alar cells. It is unlikely to be confused with any other species, although some forms of *C. deflexa* may be similar. These latter, however, have broader branch leaves that are ovate-acuminate rather than narrowly ovate-lanceolate (l:w < 2.5), mostly entire, more concave, and usually have fewer alar cells (see also discussion of *C. deflexa* below). In *C. angustata* there is usually a clear contrast between the fine narrow branch leaves and the broader leaves of the main stems. *Camptochaete pulvinata* also has numerous alar cells, but it is distinguished from *C. angustata* by its ovate and falcate secund leaves.

Camptochaete arbuscula (Sm.) Reichardt, *Reise Novara 1,* 191 (1870)

≡ *Hookeria arbuscula* Sm., *Trans. Linn. Soc. London* 9: 280 (1808)
≡ *Leskea arbuscula* (Sm.) Schwägr., *Sp. Musc. Frond. Suppl. 1(2),* 112 (1819) nom. illeg.
≡ *Hypnum arbuscula* (Sm.) Hook., *Musci Exot. 2,* 112 (1819) nom. illeg.
≡ *Isothecium arbuscula* (Sm.) Brid., *Bryol. Univ. 2,* 372 (1827)
≡ *Stereodon arbuscula* (Sm.) Mitt., *J. Proc. Linn. Soc., Bot.* 4: 88 (1859)
≡ *Porotrichum arbuscula* (Sm.) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 83 (1882)
≡ *Thamniella arbuscula* (Sm.) Besch. ex Paris, *Index. Bryol.* 233 (1894) nom. inval.
≡ *Ptilocladus arbuscula* (Sm.) Lindb. in Paris, *Index. Bryol.* 233 (1894) nom. inval.
≡ *Thamnium arbuscula* (Sm.) Kindb., *Hedwigia* 41: 253 (1902)
Holotype: N.Z., Dusky Bay, *A. Menzies 73*, 1791, LINN, HS1679-10! Isotypes: BM 001108354!, BM 001108355!, BM 001108353!, E 00007784, E 00414667.

Plants usually robust and rigid, light to dark olive-green or brown, dull or slightly glossy, forming loose wefts on bark, rocks, rotten logs and on the ground. **Stems** ± erect to scrambling, 30–60 (–100) mm, complanate to loosely julaceous, stipes (10–) 15–20 (–30) mm, fronds often irregular, 2(–3)-pinnate; variably complanate, often elongate in cross-section c. 800 × 610 µm, with an outer layer of 10–12 cells surrounding a core of parenchyma and an indistinct central strand. **Branches** straight or curved, complanate to julaceous. **Stem leaves** imbricate, inflated-smooth when moist, loosely collapsed-wrinkled when dry, broadly oblong-ovate, obtuse to widely acute, entire or denticulate at the apex, (1.9–) 2.2–2.5 (–3.0) × 1.2–1.6 mm, with alar cells irregularly walled and porose, forming a dense dark group 12–16 cells wide and extending 6–8 cells from the leaf base. **Costa** weak usually double and failing below mid leaf, sometimes absent. **Branch leaves** smaller, with a smaller alar group, 1.2–1.7 × 0.6–0.8 (–1.0) mm. **Mid laminal cells** linear, weakly prorate, weakly porose, (50–) 60–75 (–95) × 5 µm; becoming more porose towards the base, (25–) 35–60 × 8–10 µm; at the apex irregularly short-rhombic, c. 8–12 µm long.

Dioicous or **pseudautoicous. Setae** 4–5, or 8–13 mm. **Capsules** 1.8–2.0 (–2.2) × 1.0 mm; **exothecial cells** mostly 30–60 × 15–20 µm. **Operculum** blunt to apiculate, 0.6 mm. **Exostome teeth** c. 440 µm long; **endostome** with a basal membrane c. ⅓ of exostome. **Calyptra** c. 2 mm. **Spore**s (12–) 13–14 µm.

Notes: A significant variant with varietal status – var. *tumida* – occurs in New Zealand.

Recognition: Typically, *C. arbuscula* has a robust dendroid habit with irregularly branched ± untidy fronds, and deeply concave cochleariform leaves which are collapsed-wrinkled when dry and inflated-smooth when moist. The frond axis leaves are usually complanate while those of the branches are subdistichous to loosely julaceous. The capsules often are borne on short, robust, arcuate setae from the underside of the fronds.

1 **Plants** light green to yellow-green, **setae** short, robust, 4–5 mm, with **capsules** held on the underside of fronds; fronds pinnate, **frond axes** and **branches** mostly complanate, untidy in appearance; **leaves** usually not in neat spirals, concave, obtuse, subobtuse or acuminate.... ..... *C. arbuscula* var. *arbuscula*

1' **Plants** darker, green to brown-green; **setae** elongate, slender, 8–13 mm, with **capsules** held above fronds; **fronds** loosely branched, **frond axes** and **branches** inflated and sub-julaceous; **leaves** neatly spiralled, very deeply concave, abruptly and distinctly mucronate.... ..... *C. arbuscula* var. *tumida*

Camptochaete arbuscula (Sm.) Reichardt, *Reise Novara 1,* 191 (1870) var. *arbuscula*

Plants 40–60 (–100) mm, light green to brown or yellow-green. **Fronds** irregularly 1(–2)-pinnate, complanate, loose and untidy. **Stipes** (10–) 15–20 mm. **Branches** mostly straight, complanate or sometimes loosely julaceous, attenuate and loosely cuspidate. **Frond axis leaves** imbricate, concave, ovate-oblong, with the apex erect, obtuse to widely acute, (1.9–) 2.2–2.5 (–3.0) × 1.2–1.6 mm, entire. **Branch leaves** complanate to loosely spiralled, 1.2–1.7 × 0.6–0.8 (–1.0) mm. **Mid laminal cells** (50–)

60–75 (–95) × 5 µm; those above (at extreme apex) 8–12 µm; **alar cells** forming group c. 12 cells wide and extending 8 cells from the leaf base.

Setae 4–5 mm. **Capsules** held below the frond, ± erect, 1.8–2.0 × 1.0 mm; **exothecial cells** mostly 36–60 × 15–20 µm. **Exostome teeth** c. 575 µm long and inserted c. 75 µm below the mouth.

Illustrations: Plate 1. Sainsbury 1955, pl. 69, fig. 3; Beever et al. 1992, fig. 64; Tangney 1997b, figs. 6, 7, 9, 10, 15, 16.

Distribution: NI: N Auckland, including offshore islands (PK, HC, RT, LB, GB), S Auckland, Gisborne, Hawke's Bay, Taranaki (Taranaki Maunga), Wellington; SI: Nelson, Marlborough, Canterbury, Westland, Otago, Southland; St; Ch; Sn; A; C.

Australasian. Tasmania*, mainland Australia (Vic.*); also Hawai'i*.

Habitat: Common in lowland forests across a range of habitats including stream banks and the forest floor. It is most commonly on bark and exposed roots and occasionally found on rocks and rotten logs; rarely on the ground. It also extends to higher altitudes and to open edge habitats. Altitudinal range: from sea level to 1080 m on South I. (Mt Mytton, NW Nelson), and to 1200 m (Mt Ruapehu) on North I.

Recognition: *C. arbuscula* (var. *arbuscula*) may be confused with *C. deflexa*, which has more regular fronds, with leaves, especially branch leaves, very regularly imbricate and little altered when dry. Differences between *C. arbuscula* and *C. deflexa* are discussed under the latter species. Some monopodial forms with elongate creeping stems are similar to *Weymouthia cochlearifolia*, from which fertile plants of *C. arbuscula* differ in their shorter setae and reflexed perichaetia. In sterile material, non-dendroid, monopodial forms of *C. arbuscula* lack strongly porose mid laminal cells, and *W. cochlearifolia* is also a generally larger, softer plant with wider branches compared to the more compact and wiry plants of *C. arbuscula.*

Camptochaete arbuscula var. *tumida* Tangney, *J. Hattori Bot. Lab.* 81: 84 (1997)

Holotype: N.Z. Fiordland, Borland Burn near Borland Lodge, c. 10km by road from Lake Monowai, *Tangney 2443*, OTA 075721! Isotypes CHR 681191!, WELT!, AK!, NY!, BM!

Plants 30–60 mm tall, green to brown-green. **Fronds** loosely 1(–2)-pinnate. **Stipes** 15–20 (–30) mm. **Branches** curved, swollen, loosely julaceous, attenuate and loosely cuspidate. **Frond axis leaves** regularly imbricate, deeply concave, very widely ovate to oblong, often becoming ± cucullate above, obtuse, with an abrupt erect mucro, 2.0 × 1.3 mm, entire. **Branch leaves** arranged in neat catenulate spirals 0.8–1.0 × 0.5–0.7 mm. **Mid laminal cells** 40–50 × 4–5 µm; those above (at extreme apex) 10–15 µm; **alar cells** forming a group c. 4 cells wide and extending 6 cells from the leaf base.

Setae 8–13 mm. **Capsules** held above the frond, horizontal, 2.0–2.2 × 1.0 mm; **exothecial cells** mostly 42–52 × 15–20 µm. **Exostome teeth** c. 600–650 µm long and inserted c. 70 µm below the mouth.

Illustrations: Plate 1. Tangney 1997b, figs. 15, 18.

Distribution: SI: Nelson (Nelson Lakes, Mt Arthur, Murchison), Marlborough (Pelorus Bridge), Westland (Kelly's River), Canterbury (Rockwood, Okuku Pass, Mt. Richardson), Otago (Paradise, Kingston, Blue Mts, Otanomomo, Herbert Forest), Southland (Waikaia Valley, Lake Monowai).

Endemic.

Habitat: Found on the ground and humus over rocks, the trunks and exposed roots of trees, in mostly edge habitats in lowland forest. It is also found in wetter areas, on the ground and silty tree bases near lake shores and rivers, and depressions with standing water (as at Lake Monowai, eastern Fiordland) and may extend to open higher elevation forests (as in the Cobb Valley, Nelson). Altitudinal range: from less than 100 m (Otanomomo, Herbert Forest, Pelorus Bridge) to 940 m (Mt Mytton, Nelson LD).

Recognition: The more loosely branched fronds, julaceous frond axes and branches, longer branches, distinctly mucronate leaf apices and longer setae distinguish this variety. The plants are similar in size to typical var. *arbuscula*, but tidier in appearance. The frond axis and branch leaves are in neat spirals, with markedly mucronate apices. They are little altered when dry, ± round and very deeply concave, giving the axes a swollen appearance. The capsules are borne above the fronds.

Some populations of the var. a*rbuscula* may have subjulaceous branches and mucronate leaves, but these differ characteristically from the var. *tumida* in being more densely branched, with the frond axes and branches not so uniformly swollen, and with leaves less concave, and only weakly mucronate.

Camptochaete deflexa (Wilson ex Müll.Hal.) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1875–1876: 309 (1877)

≡ *Hypnum deflexum* Wilson in Müller, *Syn. Musc. Frond. 2,* 680 (1851)
≡ *Isothecium arbuscula* var. *deflexa* (Wilson) Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II,* 104 (1854) – as deflexum
≡ *Stereodon deflexus* (Wilson) Mitt., *J. Proc. Linn. Soc., Bot.* 4: 88 (1859)
≡ *Porotrichum deflexum* (Wilson) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 83 (1882)
≡ *Thamnium deflexum* (Wilson) Kindb., *Hedwigia* 41: 255 (1902)
≡ *Camptochaete arbuscula* var. *deflexa* (Wilson) Dixon, *Bull. New Zealand Inst.* 3: 273 (1927)
Lectotype: N.Z., *W. Stephenson 7*, 1843–44, BM 000667771! (Lectotype designated by Tangney 1997b, p. 87.). Isolectotype: BM 00066770!

= *Isothecium ramulosum* Mitt., *Hooker's J. Bot. Kew Gard. Misc.* 8: 263 (1856)
≡ *Camptochaete ramulosa* (Mitt.) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1875–1876: 309 (1877)
≡ *Porotrichum ramulosum* (Mitt.) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 84 (1882)
≡ *Ptilocladus ramulosus* (Mitt.) Lindb. in Paris, *Index. Bryol.* 234 (1894) nom. inval.
≡ *Thamnium ramulosum* (Mitt.) Kindb., *Hedwigia* 41: 257 (1902)
Syntypes: Australia. *Dr F. Mueller*: Victoria (No. 170), NY 01256948; Steep-bank River (No. 58), NY 01256947. Isosyntypes: *Mueller 170*: MEL 1002094, MEL 1002078, MEL 1002111, BM 015671406!, BM 015671407!, BM 015671408!, BM 015671410!; Mueller 58: MEL 1002096, BM 015671411!.

Plants usually robust, 40–80 (–100) mm long, green or green-brown, or olive green. **Stems** ± erect to scrambling, complanate; in cross-section oval, 560 × 380 µm with an outer layer of 3–4 cells surrounding a parenchyma and an indistinct central strand. **Stipes** 10–15 (–20) mm. **Fronds** densely and regularly 1(–2)-pinnate, variably complanate. **Branches** straight, distichous, moderately complanate. **Frond axis leaves** regularly imbricate, not or scarcely altered when dry, rarely striate, concave, ovate, acuminate-cuspidate, entire, (1.4–) 1.6–2.0 (–2.4) mm × 0.6–1.2 mm, with alar cells variable, usually forming a small group 4–6 cells wide and extending 6 cells from the leaf base, sometimes more numerous, up to 10 cells wide and extending 12 cells from leaf base. **Branch leaves** smaller, ovate-elliptic, with a smaller alar group, (0.9–) 1.2–1.6 × 0.5–0.9 mm. **Costa** double and failing below mid leaf, faint, sometimes absent. **Mid laminal cells** weakly porose, (32–) 40–57 (–67) × 5 µm; those above sometimes elongate, 30–40 × 5 µm, at the extreme apex c. 12–15 × 5–8 µm.

Dioicous. Setae 8–10 mm. **Capsules** erect or horizontal, symmetric, c. 2 × 1 mm; **exothecial cells** mostly 40–55 × 18–22 µm. **Operculum** conic, blunt or sometimes apiculate, c. 0.6 mm long. **Exostome teeth** c. 550–600 µm; **endostome** with a basal membrane ½ the exostome. **Calyptra** c. 2 mm. **Spores** (12–) 13–14 µm.

Illustrations: Plate 2. Tangney 1997b, figs. 6, 7, 9, 10, 15, 20.

Distribution: NI: N Auckland, including offshore islands (LB, GB), S Auckland, Gisborne, Taranaki (Taranaki Maunga), Wellington; SI: Nelson, Marlborough, Canterbury, Westland, Otago, Southland; St; Ch; Sn; A; C.

Australasian. Tasmania*, mainland Australia* (Qld, N.S.W., A.C.T., Vic.).

Habitat: Occurs mostly commonly in lowland forest on exposed roots and rocks close to the ground, often in or near streambeds or close to waterfalls. It also tolerates quite deep shade and can be found in shaded rock clefts and on damp soil in deeply shaded overhangs at stream margins. Altitudinal range: on North I. to 820 m at Dawson Falls (Taranaki LD), and higher on Blythe Track, Mt Ruapehu (Wellington LD) where the elevation ranges from 920 to 1380 m; on South I. from sea level (Waihōpai River, Southland LD) to 1240 m on Mt Mytton and 1460 m at Lake Peel (both Nelson LD).

Notes: *Camptochaete deflexa* is an earlier name for C. *ramulosa.* Most authors have considered it (under the latter name) to be similar to, but distinct from, *C. arbuscula*. Confusion has arisen from both species producing elongate forms that blur species boundaries, and that these forms were also referred to as ‘deflexa’ forms (Sainsbury 1955). The name *deflexa* was first used as a variety of *Hypnum* (*Camptochaete*) *arbuscula* (Hooker & Wilson 1844; Wilson 1854) and their concept included some of the features of *C. deflexa*, particularly acuminate leaves and elongate setae.

When Müller (1850–1851) published the name *Hypnum deflexum* Wilson, based on the variety, he stressed the elongate, complanate-filiform, deflexed branching as distinguishing the new species. These features are common to both species, and the name *deflexa* was treated as a variety by Dixon (1927) but included as a form of *C. arbuscula* by Sainsbury (1955).

Subsequent authors continued to recognise two separate species. Both Dixon and Sainsbury considered two species to be recognisable, with Sainsbury (1955) noting (of *C. ramulosa*) that "… this species is very near *C. arbuscula*, and its characters are not of great structural importance, but it is usually recognisable by the rigidly imbricated smooth leaves, with longer points, and by the longer seta. The capsule, too, is somewhat longer."

Conversely, Scott & Stone (1976) considered only one species was present: "this (*Camptochaete arbuscula*) is a perplexingly variable plant. The distinction between *arbuscula* and *ramulosa* given by the Handbook does not seem to hold consistently and we are provisionally treating the two species as conspecific." (p. 385). Scott and Stone considered the variability of leaf characters as too great to be of use and the seta length character as: "too feeble a specific criterion. Some other features are needed to give a convincing separation" (p. 386).

More recently, two species have been recognised (Beever et al. 1992, Fife 1995, Tangney 1997b), and they can be separated based on the characters outlined above, particularly when the variation of leaf characters associated with ‘deflexa’ forms is recognised. It is generally possible to find some leaves (particularly stem or frond axis leaves) with features typical of the *C. deflexa* and they are a reliable guide to identification (Tangney 1997b).

Recognition: *Camptochaete deflexa* is a moderately robust plant, with densely and regularly branched compact, tidy fronds. It has regularly and neatly imbricate leaves which are ± unaltered when dry, with acuminate or cuspidate leaf apices.

Camptochaete deflexa has frequently been discussed in relation to *C. arbuscula* (var. *arbuscula*) and they may approach each other in their extreme variations. Both species produce elongate creeping forms with flattened stems and branches with a range of leaf shapes and sizes that blur the species’ boundaries. Because of this, there has been considerable confusion surrounding these two taxa, here treated as separate species.

While robust forms do occur, *C. deflexa* is generally a smaller plant than *C. arbuscula*, with often weakly developed stipes. The leaves are less concave, less wrinkled, more or less unaltered when dry, and most importantly, are usually very rigidly and regularly imbricate. This last feature, combined with leaf apices that are acute to acuminate, and densely and regularly branched compact fronds, gives this species a characteristic 'tidy' appearance which contrasts with the commonly untidy appearance of *C. arbuscula*. *C. arbuscula* is a larger plant, typically more robust than *C. deflexa*, with strong stipes, and large concave leaves that are collapsed-wrinkled when dry, smooth when moist, and apices that are mostly widely acute with the apex shortly pointed, if at all, rather than acuminate. Areolation is similar in both species, with *C. deflexa* differing in typically having longer cells in the apex. The capsules of *C. deflexa* are always held above the axis of the frond on elongate, slender setae, whereas those of *C. arbuscula* are usually borne on short, robust setae on the underside of the fronds.

Some epiphytic populations of *C. deflexa* with fronds smaller and finer than typical may be difficult to separate from *C. angustata*. When these species approach each other, they can be separated as follows: *C. angustata* has leaves that are narrowly elliptic-acuminate, gradually narrowed to the apex from the widest part of the leaf, which is usually at or below mid leaf. In contrast, *C. deflexa* has ovate-acuminate leaves, with a leaf margin that is usually somewhat concave in outline between the apex and the widest part of the leaf, with narrowing of the leaf to the apex beginning mostly above mid leaf.

Confusion may also exist between this species and *C. pulvinata*. *C. deflexa* may rarely have weakly or obscurely falcate leaves and small such forms may be difficult to separate from small, weakly falcate forms of *C. pulvinata*. In the latter, there are usually at least some leaves distinctly falcate at the tips, and *C. pulvinata* generally has broader leaf apices and more numerous alar cells.

Camptochaete pulvinata (Hook.f. & Wilson) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1875–1876: 309 (1877)

≡ *Isothecium pulvinatum* Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II,* 105 (1854)

≡ *Ptilocladus pulvinatus* (Hook.f. & Wilson) Lindb. in Paris, *Index. Bryol.* 234 (1894) nom. inval.

≡ *Thamniella pulvinata* (Hook.f. & Wilson) Besch. ex Paris, *Index. Bryol.* 234 (1894) nom. inval.
Lectotype: N.Z., North Island, *Colenso* "o", BM-Wilson 000850973! Isotype: BM-Hooker 000850977! (Lectotype designated by Tangney 1997b, p. 95).

= *Camptochaete beckettii* Broth., *Öfvers. Finska Vetensk.-Soc. Förh.* 42: 114 (1900)
Holotype: N.Z., S Auckland, Thames, *D. Petrie*, July 1896, H-Brotherus (not seen). Isotype: CHR 629483!

= *Camptochaete falcifolia* Broth., *Bernice P. Bishop Mus. Bull.* 40: 23 (1927)
Holotype: Hawai'i, Maui: without locality, *Baldwin, D.D. s.n.*, H-Brotherus (*ex. herb.* Levier)!

= *Stereodon maculosus* Dixon, *Bull. New Zealand Inst.* 3: 337 (1929)

≡ *Camptochaete maculosa* (Dixon) Sainsbury, *Rev. Bryol. Lichénol., n.s.* 21: 222 (1952)
Holotype: New Zealand, Great Barrier Island, *Hutton & Kirk, 81*, *ex herb.*-Mitten, BM 015671412 ! Isotypes: OTA 075721!, NY 00913352!, NY 00913353!

Plants slender to robust, (10–) 15–25 (–40–50) mm, dark to pale, green or green-brown, or olive green. **Stems** ± erect to scrambling, moderately complanate, stipitate; in cross-section oval, 530 × 420 µm with an outer layer of 3–4 cells surrounding a parenchyma and an indistinct central strand. **Stipes** often weakly developed, 4–7 mm. **Fronds** loosely and ± irregularly (bi-) pinnate, complanate. **Branches** straight, distichous, moderately complanate. **Frond axis leaves** falcate-secund, not altered when dry, concave, oblong-ovate, acute to finely acuminate, entire, (1.4–) 1.6–2.0 × 0.5–0.6 mm, with alar cells forming an often extensive group 10 cells wide and extending c. 14 cells from the leaf base. **Branch leaves** smaller, sometimes denticulate to the lower margin, with a smaller alar group, 1.0–1.2 (–1.6) × 0.3–0.5 mm. **Costa** double and failing below mid leaf, faint, sometimes absent. **Mid laminal cells** not porose, (40–) 53–58 (–85) × 5 µm; becoming moderately porose below to form a weakly differentiated basal band, (18–) 30–50 × 8–10 µm; those above 32–40 × 5 µm, at the extreme apex c. 12–18 (–22) × 5–8 µm.

Dioicous or **pseudautoicous. Setae** 8–10 mm. **Capsules** inclined to horizontal, c. 2 mm long; **exothecial cells** mostly 28–48 × 20–28 µm. **Operculum** conic, blunt or apiculate, c. 0.7– 0.8 mm long. **Exostome teeth** c. 500 µm; **endostome** with a basal membrance ½ the exostome. **Calyptra** c. 2 mm. **Spores** 10–12 µm.

Illustrations: Plate 2. Tangney 1997b, fig. 24.

Distribution: NI: N Auckland, including offshore islands (TK, HC, GB, LB, Whale I.), S Auckland, Gisborne, Taranaki (Taranaki Maunga), Wellington; SI: Nelson, Marlborough, Canterbury, Westland, Otago, Southland.

Endemic? Also recorded for Hawai'i *, see note below.

Habitat: Common in lowland forests on rocks and the lower bark of trees, it also extends to mid elevations. It occurs in a wide range of mostly shaded habitats from wet forest near streams in Fiordland to drier habitats such as rocks under coastal kanuka scrub. Altitudinal range: near sea level (Akatore Creek, Otago LD) to 940 m (Mt Cook National Park) and 1000 m on Mt Fyffe (Marborough LD) on the South I., and near sea level on Little Barrier Island, Great Barrier Island, and Raukokore River (Gisborne LD) to 1310 m (north end of Kaweka Range, Hawke's Bay LD) on the North I.

Notes: *Camptochaete falcifolia* Broth. from Hawai'i is treated here as a synonym of *C. pulvinata*. Bartram (1933) compared the type of *C. falcifolia* with *C. pulvinata* and found it to be 'almost in complete accord' with *C. pulvinata*, and both Hoe (1974) and Miller et al. (1978) followed Bartram in accepting the synonomy. *Camptochaete falcifolia* is apparently only known from the type specimen. This specimen is incomplete, lacking sufficient material to establish whether or not the plants are stipitate, but it is otherwise typical of *C. pulvinata* in its wiry pinnate fronds and falcate weakly costate leaves (Bartram 1933; Tangney 1997b). *Camptochaete pulvinata* is otherwise known from N.Z. *Camptochaete arbuscula* is also present in Hawai'i, and Weymouthia mollis is shared with Tahiti (Allen & Magill 2003).

Recognition: *C. pulvinata* forms low often dense wefts on rocks and the lower bark of trees. It is easily distinguished by its falcate-secund leaves. It is sometimes difficult to separate from some forms

of *C. deflexa* which may rarely have falcate leaves, but the latter usually lacks the numerous alar cells of *C. pulvinata.*

While the falcate-secund leaves are unusual in *Camptochaete*, the rigid stems, dendroid-stipitate growth form and the laminal cell pattern are typical. The sporophyte is that of the genus

C. pulvinata exhibits two forms: a larger (25–40 (–50+) mm) southern form with widely acute leaves and perichaetia and an often small (c. 5–7 × 5–7) group of alar cells, and a northern form which is smaller (10–15 (–20) mm), and has narrower leaf apices, aciculate perichaetia and numerous alar cells (often forming a group 14 × 10–12). However, because of variation within both forms, they are not well separated morphologically and are not here formally recognised. Beever (1986, 1990) has noted the variability of leaf and cell form in *C. pulvinata* and she treated *C. maculosa* (Dixon) Sainsbury as a synonym of the former. The features of *C. maculosa* are characteristic of the northern form.

Fallaciella H.A.Crum, *J. Hattori Bot. Lab.* 69: 320 (1991)

Type taxon: *Fallaciella gracilis* (Hook.f. & Wilson) H.A.Crum

Plants slender to moderately robust, not rigid, pale, brown- to light green, dull or glossy, forming usually tightly appressed mats or compact wefts, on rocks, bark and humus. **Stems** creeping to erect-ascending, weakly stipitate, irregularly and sometimes sparsely 1(–2)-pinnately branched, subcomplanate to loosely terete. **Branches** blunt to weakly cuspidate, curved when dry. **Pseudoparaphyllia** foliose, widely to irregularly ovate, serrate. **Leaves** radial to homomallous, erect-spreading, inflated-smooth when moist, little altered or collapsed-wrinkled when dry, weakly to strongly concave, obovate to elliptic, sometimes weakly auriculate, acute, widely acute or obtuse, sometimes with a short apiculus; **margins** incurved, or sometimes weakly revolute below, serrulate to serrate above, entire to serrulate below; **costa** absent, or short, double and faint; **mid laminal cells** linear to linear-rhombic, ± sigmoid, not or weakly porose, firm-walled, prorate to prorate-papillose; those above shorter, at the extreme apex rhombic; those below similar to those of the mid leaf; **alar cells** forming a small ± triangular group of irregularly quadrate cells (mostly < 2:1), sometimes weakly enlarged in the branch leaves.

Dioicous. **Inner perichaetial leaves** with apices reflexed from an oblong sheathing base, acute to acuminate. **Setae** elongate, flexuose, smooth, red-brown. **Capsules** inclined to horizontal, mostly symmetric, cylindric to oblong-cylindric, roughened, red-brown; **exothecial cells** mostly irregularly oblong and firm-walled, not thickened at the angles. **Stomata** several at the base of the capsule, superficial. **Exostome teeth** lanceolate, lacking a distinct shoulder, pale yellow-brown, bordered and joined at the base; outer face cross-striate below and finely baculate above, with a zig-zag median line; inner face with well-developed lamellae, smooth below and baculate above; **endostome** yellow or hyaline, finely and sparsely papillose below, more densely so above, with the basal membrane equal to half the height of the exostome, and with segments keeled and perforate; **cilia** 2 (–3), well developed, nodulose, papillose. **Operculum** apiculate or short-rostrate from a high conic base, asymmetric or ± symmetric. **Calyptra** smooth. **Spores** spherical, pale yellow-brown, papillose.

Taxonomy: *Fallaciella* differs from the other N.Z. Lembophyllaceae in its smaller size and tendency to produce pale mats, rather than more robust and darker wefts, which has led previous authors to suggest a range of familial placements. *Fallaciella* was erected by Crum (1991) for *Camptochaete gracilis* (Hook.f. & Wilson) Paris, which he considered a 'discordant element' in *Camptochaete*, and he transferred it to the Sematophyllaceae. Previous authors had also questioned its placement in the Lembophyllaceae. Wilson (1854) compared it to *Pterogonium* (*Pterygynandrum*) *filiforme*, a widespread Northern Hemisphere species, Dixon (1927) thought it was misplaced in *Camptochaet*e, Sainsbury (1955) suggested transferring it to *Glossadelphus* in the Sematophyllaceae, and Buck & Goffinet (2000) suggested placement in the Hypnaceae.

Despite differing from other members of the family in its creeping mat-forming habit, and its mostly terrestrial habitat, it does have many of the critical features of the Lembophyllaceae (Tangney 1997a), especially when the family is taken to include *Camptochaete*, *Weymouthia* and *Lembophyllum*. When the family is conceived in this broader sense, with the wider morphological diversity it comprises, separation of *Fallaciella* is difficult to justify at family level; there are similarities in leaf cell pattern, alar cells, and costa, as well as in capsule characters. Within the family, *F. gracilis* differs most strongly in its leaf prorae and inflated alar cells and both are variably present in other Lembophyllaceae.

The addition of a second species, *Fallaciella robusta* (Tangney & Fife 2003), with affinities to other N.Z. Lembophyllaceae, further supports the placement of *Fallaciella* in the Lembophyllaceae based on morphological features.

This position is also supported by molecular data (Quandt et al. 2000, de Luna et al. 2000, Quandt et al. 2009, Goffinet et al. 2009). The genus includes two species, both occurring in N.Z.

Recognition: The two species grow in compact, low growing mats or wefts. The plants have a weak stipe with differentiated leaves. The fronds are loosely and irregularly pinnate, with branches often arched–curved and typically orientated in the same direction, particularly when dry, and loosely julaceous with the leaves somewhat homomallous. They share the same laminal cell pattern, and both may have enlarged alar cells in the branch leaves.

Etymology: Crum (1991) named *Fallaciella* for the "fallacious or deceitful nature of this interesting moss, with its strong gametophytic resemblance to an unrelated genus, *Pterigynandrum*."

1 **Plants** slender, creeping, forming closely adhering, low mats or wefts; branches 0.4–0.6 mm wide; **branch leaves** 0.45–0.8 × 0.25–0.3 (–0.4) mm, obtuse to widely acute, lacking an apiculus, when moist weakly concave and with the margins plane or only weakly incurved above, when dry mostly unaltered, cells prorate, often with a single papilla on the distal prorae ..... *F. gracilis*

1' **Plants** more robust, erect-ascending, forming loosely attached wefts; branches 0.7–1.0 mm wide; **branch leaves** (0.8–) 0.85–0.9 × 0.4–0.5 mm, acute to widely acute, with a short and slightly reflexed apiculus, when moist strongly concave and with the margins incurved, when dry collapsed-wrinkled, cells prorate, with a papilla lacking .... *F. robusta*

Fallaciella gracilis (Hook.f. & Wilson) H.A.Crum, *J. Hattori Bot. Lab.* 69: 320 (1991)

≡ *Hypnum gracile* Hook.f. & Wilson, *London J. Bot.* 3: 553 (1844) nom. illeg., non *Hypnum gracile* (Hedw.) With. 1801
≡ *Isothecium gracile* Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II,* 106 (1854)
≡ *Stereodon gracilis* (Hook.f. & Wilson) Mitt., *J. Proc. Linn. Soc., Bot.* 4: 88 (1859)
≡ *Microthamnium gracile* (Hook.f. & Wilson) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1876–1877: 426 (1878)
≡ *Porotrichum gracile* (Hook.f. & Wilson) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 84 (1882)
≡ *Ptilocladus gracilis* (Hook.f. & Wlson) Lindb. in Paris, *Index. Bryol.* 234 (1894) nom. illeg.
≡ *Camptochaete gracilis* (Hook.f. & Wilson) Paris, *Index. Bryol.* 234 (1894)
≡ *Thamnium gracile* (Hook.f. & Wilson) Kindb., *Hedwigia* 41: 255 (1902)
Holotype: N.Z., South Island, Otago, *J. Buchanan* (Herb. Gourlie), BM!

= *Hypnum microvagum* Beckett, *Trans. & Proc. New Zealand Inst.* 26: 275 (1894) – as micro-vagum
≡ *Lembophyllum microvagum* (Beckett) Beckett, *Trans. & Proc. New Zealand Inst.* 29: 444 (1896) – as Lembophyllum micro-vagum
Lectotype: N.Z., South Island, Ben More, North Canterbury, *T.W.N. Beckett 366*, CHR 539613! (Designated by Tangney & Fife 2003, p. 124.)

= *Camptochaete tasmanica* Broth. in Rodway, *Pap. & Proc. Roy. Soc. Tasmania* 1913: 229 (1914)
Holotype: Australia, Tasmania, Western Tiers, *Rodway 19/1912*, H-BR 2531! Probable isotype: WELT M10747!

= *Taxithelium novae-zealandiae* E.B.Bartram & Dixon, *Bot. Not.* 1937: 83 (1937)
≡ *Camptochaete novae-zeelandiae* (E.B.Bartram & Dixon) P.E.A.S.Câmara, *Novon* 20: 139 (2010)
Holotype: N.Z., Wellington, *S. Berggren* 1874, 550 (p.p.), BM 000850512!

Plants slender, dull or slightly glossy, usually forming tightly appressed mats on rocks or bark. **Stems** usually creeping and forming ± irregular but mostly pinnate fronds; in cross-section c. 210 × 250 mm, with an outer layer of 4–5 cells surrounding an inner core of parenchyma, with no central strand. **Branches** 0.4–0.6 mm wide. **Pseudoparaphyllia** c. 110 µm long. **Stem leaves** usually homomallous, inflated-smooth and weakly concave when moist, little altered when dry, ovate to elliptic, obtuse to widely acute, 0.75–1.1 × 0.5–0.6 mm, at the margins mostly plane (sometimes weakly incurved above or weakly revolute below) and serrulate above, with alar cells ± quadrate, pigmented, and forming a group c. 6–8 cells wide and extending c. 10 (–13) cells from the leaf base. **Branch leaves** smaller than stem leaves, usually homomallous, blunt and lacking an apiculus, 0.45–0.8 mm, with a smaller alar group. **Mid laminal cells** prorate to prorate-papillose, (18–) 24–36 × 4–6 µm, those at apex rhombic or ± irregular, c. 9–12 µm long.

Dioicous. **Setae** c. 12–20 mm, weakly twisted to the left. **Capsules** c. 1.5–1.8 mm long; **exothecial cells** 25–45 × 12–17 µm. **Operculum** highly variable, apiculate or short-rostrate from a high conic base, asymmetric or symmetric, c. 0.35–0.5 mm. **Calyptra** c. 2 mm. **Spores** 12–15 µm.

Illustrations: Plate 3. Sainsbury 1955, pl. 61, fig. 1 (as *Camptochaete gracilis*); Tangney & Fife 2003, fig. 1.

Distribution: NI: N Auckland, including offshore islands (LB, GB), S Auckland, Gisborne, Taranaki (Taranaki Maunga), Wellington; SI: Nelson, Marlborough, Canterbury, Westland, Otago, Southland; St; Ch; A; C.

Austral. Tasmania*, mainland Australia* (Qld, N.S.W., A.C.T., Vic.), Chile*.

Habitat: Relatively common in forested stream beds, where it is found mainly on rocks and exposed tree roots, occasionally on damp earth. It is also found on the same substrates in more open and upper elevation habitats, including subalpine scrub and more rarely on soil in subalpine grasslands. It occurs from sea level to c. 1430 m on the South I. (Temple Basin, Arthur's Pass, Canterbury L.D.), and to nearly 1300 m on the North I. (Taranaki Maunga and the Tararua Range).

Notes: The type material of *Isothecium gracile* in BM (*J. Buchanan* (*in herb.* Gourlie), comprises a number of specimens (BM 000850985 to BM 000850993 inclusive. A lectotype has not been selected.

Recognition: *Fallaciella gracilis* is a distinctive plant not readily confused with other species. The plants are small and form pale, tightly attached, olive green to brown mats with narrow stems and branches. Amongst the N.Z. Lembophyllaceae, it is the only species that produces tightly attached mats. This distinctive feature is, however, underlain by the same branching architecture that is shared by the other genera and is typical for the family (Tangney 1998). This feature is somewhat obscured by the plant size, but it is observable across a range of material.

The plants are soft, compared to the larger tough and wiry plants of *Camptochaete*. *Fallaciella gracilis* also differs from *Camptochaete* in having its leaves dull and little altered when dry, and only slightly concave when moist, with the upper margins plane. The leaf apex is usually widely acute and lacks an apiculus. In other N.Z. Lembophyllaceae the leaves are typically semi glossy and greener, only occasionally brown, more deeply concave, and with the upper margins typically incurved. Unusually for the family, *F. gracilis* often produces papillae on the distal cell prorae. The presence of leaf prorae is common in *Camptochaete* and in other Lembophyllaceae, where they are present as slight protrusions of the cell ends, but in *Fallaciella gracilis* they are marked, and are sometimes visible protruding from the backs of leaves.

Fallaciella gracilis is a smaller, more tightly attached and often duller plant than *F. robusta*, which tends to be larger, more loosely attached and with glossier leaves. *Fallaciella gracilis* is a finer plant with slender stems and branches, and leaves little altered when dry, typically ovate, slightly concave when moist, with the upper margins plane, and the apex is usually broadly acute. *F. robusta* has leaves more deeply concave with upper margins incurved and an apiculus which is often recurved. In addition, prorae of the mid-laminal cells of the branch leaves are frequently papillose in *F. gracilis*, whereas the prorae of *F. robusta* are smooth.

Etymology: The epithet means slender.

Fallaciella robusta Tangney & Fife, *J. Bryol.* 25: 124 (2003)

Holotype: N.Z., Nelson, Scarlett Range, Shelter Rock Basin, *A.J. Fife 8137*, CHR 438186!

Plants moderately robust, occasionally slender, green, yellow-green to brown, mostly glossy, forming compact wefts or mats, mostly on rock. **Stems** creeping to erect-ascending, forming ± regularly 1(–2)-pinnate weakly stipitate fronds, in cross-section c. 250 × 360 µm, with an outer layer of 5–6 cells surrounding an inner core of parenchyma and an indistinct central strand. **Branches** 0.7–1.0 mm wide. **Pseudoparaphyllia** c. 120 µm long. **Stem leaves** inflated-smooth and strongly concave when moist, mostly collapsed-wrinkled when dry, broadly ovate to oblong, acute to widely acute, sometimes weakly auriculate at base, 1.5–1.55 × 0.9–1.2 mm, at margins mostly incurved and bluntly serrulate above, with alar cells ± quadrate, pigmented and forming a group c. 8 cells wide and extending c. 10 cells from the leaf base. **Branch leaves** smaller than stem leaves, usually homomallous, with a short apiculus that is often ± recurved, 0.8–0.9 mm, with a smaller alar group. **Mid laminal cells** prorate, lacking papillae, (24–) 27–34 × 5–7 µm; those at the apex rhombic, 12–20 µm long.

Dioicous. **Setae** c. 15 mm, not or weakly twisted to the left. **Capsules** c. 1.6 mm long; **exothecial cells** 38–55 × 18–30 µm. **Operculum** and **calyptra** not seen. **Spores** 12–15 µm.

Illustrations: Plate 4. Tangney & Fife 2003, fig. 2.

Distribution: NI: Wellington; SI: Nelson (Flora Saddle, Cobb Valley, Lake Peel, Mt Mytton), Marlborough (Mt Stokes), Westland (Jacobs River), Otago (Routeburn, Caples), Southland (Milford Sound, Stuart Range, Deep Cove, and Edwardson Sound).

Endemic.

Habitat: Mostly on rock. Occurs in a range of vegetation types. In Nelson these include montane southern beech forest, subalpine grassland dominated by snow tussock *Chionochloa*, *Dracophyllum* -dominated subalpine shrubland, and alpine cirque bluffs. In Southland its known habitats include lowland seral forest dominated by *Metrosideros umbellata* and *Pterophylla racemosa*, lowland southern beech forest, and upper elevation boulderfield scrub. The collection from Mt Stokes comes from *Lophozonia* (*Nothofagus*) *menziesii*-dominated forest, and that from Jacobs River from subalpine short grassland on a steep slope. Ranging from sea level (Doubtful Sound, Milford Sound) to 900 m (Edwardson Sound) in Southland, 930 m in Otago (Caples), 1400 m in Westland (Jacobs River), 1320 m in Nelson L.D., and 1000 m in Marlborough L.D. (Mt Stokes). The North I. locality is at 380 m.

Notes: A collection from North I. in CHR (Wellington L.D., E Wairarapa, Ruakokoputuna, Hurangi Rd, *P. Beveridge*, 10.12.2001, CHR 564888) is probably this species. It differs from the typical form in having a coarser, more compact and denser form, and, occasionally, longer, markedly pointed leaf apices.

Recognition: *Fallaciella robusta* is larger than *F. gracilis*, forming taller and looser mats, and it has a more pronounced stipe. It is glossier with wider stems and branches and its leaves are collapsed-wrinkled when dry, ovate-oblong, rather than ovate, and more concave, with a sharp, slightly recurved, apiculus. It lacks the papillae commonly produced by distal cell prorae in *F. gracilis.*

This suite of characters is suggestive of *Camptochaete* spp., but it lacks the tufted dendroid growth of the latter and produces mostly soft procumbent stems. Some monopodial forms of *F. robusta* are similar to such forms in the genus *Lembophyllum* but these differ in being mostly larger plants with leaves more widely concave, lacking an apiculus, and in having areolation that is more rhombic to isodiametric.

Fifea H.A.Crum, *J. Hattori Bot. Lab.* 69: 319 (1991)

Type taxon: *Fifea aciphylla* (Dixon & Sainsbury) H.A.Crum

Plants generally robust, mostly rigid, pale or dark, olive-green, dull, forming loose, scrambling wefts on trunks of trees, exposed roots and occasionally on rock. **Stems** creeping to erect-ascendant, stipitate, sparingly 1(–2)-pinnate, forming mostly irregular fronds, mostly complanate. **Branches** mostly straight. **Pseudoparaphyllia** foliose, widely ovate, serrate. **Leaves** imbricate, erect to erect-spreading, smooth when moist, mostly unaltered when dry, concave, abruptly and long aciculate from a widely ovate-oblong lamina, apex flexuose, ending in uniseriate hair points; **margins** plane, entire. **Costa** short and double, faint, failing below mid leaf. **Mid laminal cells** linear, ± sigmoid, weakly porose, firm-walled, prorate; those above becoming shorter at the upper margins and more elongated centrally, in the subula linear; those below irregularly rectangular and thick-walled. **Alar cells** more pigmented and forming a triangular group.

Dioicous or **pseudautoicous**. **Inner perichaetial leaves** with apices aciculate and flexuose, from an oblong sheathing base. **Setae** elongate, flexuose, smooth, dark red-brown. **Capsules** inclined to horizontal, smooth, symmetric or curved, oblong-cylindric, red-brown; **exothecial cells** irregularly quadrate to hexagonal-isodiametric, firm-walled. **Stomata** present at the capsule base, superficial. **Exostome teeth** lanceolate, shouldered, bordered below, pale yellow-brown, outer face closely cross-striate-papillose below and finely to coarsely baculate above, with a zigzag median line; inner face with well-developed lamellae, smooth below, baculate above; **endostome** pale yellow to hyaline, finely papillose; basal membrane ½–¾ of the height of the exostome and with process keeled, perforate and papillose above. **Cilia** 2 (–3), well developed, nodulose to appendiculate, papillose. **Operculum** blunt to short-rostrate from a high conic base, symmetric. **Calyptra** smooth. **Spores** spherical, light yellow-brown and sparsely papillose.

Taxonomy: Monotypic. A segregate of *Camptochaete* (Crum 1991), endemic to New Zealand.

Fifea aciphylla combines the unique presence of very long leaf aristae, with a number of features present in the other N.Z. genera in the family.

Originally described as a *Camptochaete* (Sainsbury 1945); it has rigid and wiry stems, dendroid-stipitate growth, erect stipe leaves and a blunt operculum, all typical of the New Zealand species of

Camptochaete (Tangney 1997b). It is most similar to *C. deflexa* in its tidy 1(–2)-pinnate fronds and its neatly arranged imbricate leaves that are little altered when dry, and the original authors considered them to be closely related.

Within the family, *Fifea* is clearly differentiated from the other Lembophyllaceae, including *Camptochaete*, by the presence of its remarkable leaf subulae which are longer than the leaf laminae. Crum (1991) removed it from *Camptochaete*, and he erected *Fifea* to accommodate it. He emphasised its leaf aristae and very widely ovate stem leaves, with rhombic laminal cells, as being misplaced in *Camptochaete.*

Recognition: The stem and stipe leaves of *F. aciphylla* are unique in N.Z. Lembophyllaceae in being wider than long. The leaves in *Lembophyllum* are as wide as long, and the other species have leaves longer than wide. The tendency to produce rhombic cells in the stipe leaves approaches the short-rhombic cells of *Lembophyllum*.

Fifea aciphylla also has well-developed stomata at the capsule base, absent in *Camptochaete* and otherwise present only in *Fallaciella gracilis*, and its exothecial cells are irregularly quadrate to hexagonal, rather than shortly oblong as in the other N.Z. Lembophyllaceae.

Fifea combines its unique leaf shape with features of *Camptochaete*, *Lembophyllum* and *Fallaciella*, to produce a combination of morphological characters that supports the recognition of *Fifea* separate from the other N.Z. genera.

Etymology: *Fifea* was named by Crum (1991) "for Allan J. Fife in recognition of his contributions to the bryology of New Zealand".

Fifea aciphylla (Dixon & Sainsbury) H.A.Crum, *J. Hattori Bot. Lab.* 69: 319 (1991)

≡ *Camptochaete aciphylla* Dixon & Sainsbury in Sainsbury, *Trans. & Proc. Roy. Soc. New Zealand* 75: 183 (1945)
Holotype: N.Z., Otago, Conical Hill, *G.B. Rawlings* Nov. 1936, (com. Plant Research Bureau, no. 17165), 880, BM 001108368!, Isotypes: CHR 527853!, WELT M005678/A!, WELT M005678/B!

Plants usually robust, (20–) 30–40 (–100) mm long, dark olive-green, dull, forming loose wefts on bark, exposed roots and rocks. **Stems** ± erect to scrambling, variably stipitate; in cross-section oval, c. 700 × 500 µm, with an outer layer of c. 6–8 (–10) cells surrounding a core of parenchyma and an indistinct central strand. **Branches** straight, sometimes rooting at the tips. **Pseudoparaphyllia** c. 240 × 155 µm. **Stem leaves** imbricate, inflated-smooth when moist, ± unaltered when dry, widely ovate-oblong, concave, apex flexuose, aciculate, with the hair point 1.2 to 1.7 times the length of the lamina, wider than long, 0.85–1.0 × 1.2 mm, with alar cells irregularly walled, porose, to form a dark group 8–10 cells wide and extending 8–10 cells from the leaf base. **Costa** weak usually double and failing below mid leaf. **Branch leaves** smaller, with a smaller alar group, longer than wide, 0.7–0.8 × 0.4–0.6 mm, with hair points 0.8–1.1 mm. **Mid laminal cells** linear, ± sinuous, firm-walled, prorate, weakly porose, 40–50 (–60) × 5.0 µm; becoming longer above (–100 µm), those of the hair point (40–) 50–60 (–90) × 5 µm.

Setae to c. 10 (–15) mm, flexuose. **Capsules** 2.0 × 0.7 mm; **exothecial cells** ± irregularly arranged, c. 15–20 (–27) × 12–15 µm. **Stomata** present on the capsule base. **Operculum** blunt to apiculate, c. 0.5 mm. **Exostome teeth** c. 450–500 µm long; **endostome** with a basal membrane c. ½ –¾ of exostome. **Calyptra** c. 2 mm. **Spores** 15–17 µm.

Illustrations: Plate 5. Sainsbury 1955, pl. 61, fig. 2 (as *Camptochaete aciphylla*).

Distribution: SI: Nelson (Owen Range, Cobb Valley, Lake Peel, Mt Mytton), Otago (Blue Mts, Mt Cargill), Southland (Chalky Inlet, The Catlins, Eyre Mts); A; C.

There are specimens of *Fifea aciphylla* in WELT from Westland LD (Nephrite Creek, Griffin Range, *D. Glenny*) and Southland LD (Mores Scenic Reserve, Riverton, *P. Beveridge*, *P. Brownsey*). (Not seen).

Endemic.

Habitat: Relatively rare, sometimes locally common; on tree trunks and logs, rocks and crevices, humus and leaf litter in mostly shaded habitats, in forest and in open grassland and shrubland. Occurring mostly above 900 m; from near sea-level in Fiordland (Chalky Inlet) to 1480 m in Nelson (Mt

Owen), and 1450 m (Lake Peel), and at lower elevations in Otago, 150 m in The Catlins, and 500 m on Mt Cargill.

Notes: The specimen in BM-Dixon was annotated by Dixon as 'Type', and specimens in WELT are annotated by Sainsbury as 'co-type'.

The stipes are mostly weakly developed, only occasionally are plants strongly stipitate, and the fronds are typically regularly bi-pinnate and tidy. New shoots can be produced from the fronds and the branches may become attenuate, with rooting at the tips relatively rare (e.g. *H.H. Allan*, 1.2.46, Fisherman's Bay, Chalky Inlet, Fiordland, Herb. Sainsbury, WELT M005680; *P.N. Johnson 14/47*, Auckland Island, WELT M10553).

Recognition: The leaf apices extended into a long arista as long as or longer than the leaf lamina are diagnostic for this species, and it is unlikely to be confused with the other species.

Lembophyllum Lindb., *Contr. Fl. Crypt. As.* 277 (1872)

Type taxon: *Lembophyllum clandestinum* (Hook.f. & Wilson) Lindb.

Plants robust, firm to rigid, light olive-green to brown-green or red-brown, dull; forming loose wefts or mats on trunks of trees, exposed roots and rocks. **Stems** creeping to erect-ascending, mostly stipitate, sparingly 1(–2)-pinnate, forming loose irregular fronds, julaceous to subcomplanate. **Branches** sparing to frequent, often curved, bluntly cuspidate. **Pseudoparaphyllia** foliose, widely oblong and irregularly serrate. **Leaves** regularly imbricate or sometimes distant, ± catenulate, smooth when moist, loosely wrinkled, sometimes weakly striate, or not altered, when dry, deeply concave, orbicular to widely ovate, auriculate, mostly cucullate or, rarely, erect at the apex, obtuse to widely acute; **margins** incurved, sometimes denticulate to the lower margin. **Costa** variable, short, double and faint, absent, or single, robust and extending to the upper lamina. **Mid laminal cells** linear to rhombic, not or weakly porose, thick-walled, moderately prorate; those above rhombic, at the extreme apex short-rhombic, those below irregularly rectangular, at the lateral and basal margins linear-rhombic to ± quadrate. **Alar cells** pigmented or not, forming a small group weakly differentiated from the adjacent basal margin, quadrate to irregularly so, porose or not.

Pseudautoicous or **dioicous**, with male plants in leaf axils on the lower parts of fruiting plants, or, more rarely, with gametangia axillary on lateral branches and main stems. **Inner perichaetial leaves** with apices reflexed from an oblong sheathing base, widely acute to obtuse or with a short mucro. **Setae** elongate, flexuose, smooth, red-brown. **Capsules** horizontal, smooth, symmetric or curved, oblong-cylindric (3–4:1), red-brown; **exothecial cells** mostly oblong, sometimes quadrate, thick-walled. **Stomata** absent. **Peristome** diplolepideous; **exostome teeth** lanceolate, lacking a distinct shoulder, bordered below, pale yellow-brown, outer face striate or striate-papillose below and finely to coarsely baculate above, bullate at the apex, with a zigzag median line; inner face with well-developed lamellae, smooth below, and baculate above; **endostome** yellow or hyaline, finely baculate to bullate; with the basal membrane c. ¼–½ the height of the endostome and with segments keeled and perforate-cracked, finely baculate to bullate. **Cilia** 2–3, well developed, nodulose to appendiculate. **Operculum** blunt to short-rostrate from a high conic base, asymmetric or ± symmetric. **Calyptra** smooth. **Spores** spherical, pale yellow-brown, coarsely baculate.

Taxonomy: The tendency of species in the Lembophyllaceae to produce wide, deeply concave leaves is well developed in *Lembophyllum*. Both species have loosely branched elongate and tumid stems and branches, with ovate, deeply concave leaves. The variable costae and a cell pattern of elongate mid laminal cells that become much shorter at the apex and margins are marked in *Lembophyllum*, with costae sometimes being single and extending to the upper leaf and the rhombic apical cells typical of the other genera extending down the leaf margins.

Variation in costal structure has been central to discussions of the differences between *L. clandestinum* and *L. divulsum*. The costa in *L. clandestinum* varies from short and double to faint or absent, and in *L. divulsum* varies from single and extending to the midleaf, to faint or absent. Overlap in these features and the lack of a single costa sometimes in *L. divulsum* led Sainsbury to reject Dixon's (1927) view that there were two species and to treat *L. divulsum* as a variety of *L. clandestinum* (Sainsbury 1948, 1955).

Two species are recognised here, with cell pattern being diagnostic (Tangney 2008). Differences in basal margin and marginal cells at mid leaf, are useful in distinguishing these two species. In *L. clandestinum* the mid laminal cells are rhombic to short-linear and become shorter towards the apex and the lateral margins. These short-rhombic apical cells extend to the basal margins where they contrast with the alar cells and the basal cells. In contrast, *L. divulsum* has mid laminal cells that are

rhombic and become shorter at the apex and extend down the lateral margins as a zone of short-rhombic to quadrate cells from which the alar and basal cells are not markedly differentiated. Other differences are summarised in the key to species below.

Two species of *Lembophyllum* are present in N.Z.

Recognition: *Lembophyllum* is similar to *Weymouthia cochlearifolia* (with which it has been confused) in having rather soft, sparingly branched stems, ± julaceous stems, and orbicular concave leaves, but differs is having smaller plants with narrower stems and branches with the leaves mostly dull. Laminal cells are much shorter and thick-walled in *Lembophyllum*, rather than elongate in *Weymouthia*. It differs from *Camptochaete* in having fronds sparingly 1(–2)-pinnate, rather than more regularly 2(–3)-pinnate as in *Camptochaete*. It also differs from the latter in having mostly julaceous stems, rhombic laminal cells, and cochleariform leaves that are often wider than long.

1 **Plants** slender, forming compact mats or wefts, sometimes creeping; **stems and branches** julaceous or subcomplanate, branches 0.75–0.9 mm wide, branch leaves cucullate to erect, as wide as long, 0.65–0.85 × 0.65–0.82 mm; **mid laminal cells** rhombic, thick-walled, cells at basal and lateral margins not elongate, quadrate to very short-rhombic, at the lateral margins 7.5–10.0 (–12.5) × 5.0–7.5 µm; **costa** single, extending to mid leaf, broad and well-defined, sometimes faint and divided above or absent; **alar cells** not markedly differentiated from the adjacent marginal cells, regularly quadrate, sometimes weakly porose and pigmented..... *L. divulsum*

1' **Plants** generally robust, forming loose open wefts; **stems and branches** julaceous, sometimes stipitate, branches 1.1–1.3 (–1.7) mm wide, branch leaves cucullate, wider than long, 0.75–0.9 × 1.0–1.25 mm; **mid laminal cells** linear to short linear, firm- to thick-walled, cells at the basal and lateral margins elongate, linear to rhombic, not quadrate, at the lateral margins (12.5–) 15–20 × 3.75–5.0 µm; **costa** short and double, sometimes faint or absent; **alar cells** differentiated from the adjacent marginal cells, irregularly quadrate, usually porose and pigmented..... *L. clandestinum*

Lembophyllum clandestinum (Hook.f. & Wilson) Lindb. in Paris, *Index. Bryol.* 718 (1896)

≡ *Hypnum clandestinum* Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II,* 111 (1854)
≡ *Isothecium clandestinum* (Hook.f. & Wilson) Mitt. in Lindsay, *Trans. Bot. Soc. Edinburgh* 8: 281 (1866)
≡ *Coelidium clandestinum* (Hook.f. & Wilson) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1876–1877: 3l8 (1878)
≡ *Porotrichum clandestinum* (Hook.f. & Wilson) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 84 (1882)
≡ *Lembophyllum divulsum* var. *clandestinum* (Hook.f. & Wilson) Wijk & Margad., *Taxon* 10: 24 (1961)
Holotype: N.Z., Port William, Stewart Island, *Dr Lyall 165*, March 1850, BM 000675014!

Plants usually robust, light to dark olive-green or brown, dull or slightly glossy, forming loose wefts on bark, rocks, rotten logs, and on the ground. **Stems** ± erect to scrambling, julaceous, attenuate, stipitate, sometimes subdendroid; in cross-section c. 350 × 280 µm with an outer layer of c. 4 cells surrounding a core of parenchyma and an indistinct central strand. **Branches** blunt to loosely cuspidate, often attenuate, 1.1–1.25 (–1.7) mm wide (including leaves), 0.9 mm wide towards the tips. **Pseudoparaphyllia** c. 225 × 145 µm. **Stem leaves** imbricate, inflated-smooth when moist, loosely wrinkled when dry, orbicular, wider than long, obtuse, cucullate, denticulate at the apex, (0.7–) 1.0–1.3 × 1.2–1.8 mm, with alar cells irregularly walled, porose, to form a dark group 8–12 cells wide and extending 6–8 cells from the leaf base. **Costa** weak usually double and failing below mid leaf, sometimes absent. **Branch leaves** smaller, with a smaller alar group, 0.75–0.9 × 1–1.25 mm. **Mid laminal cells of branch leaves** linear to short-linear, ± sinuous, thick walled, weakly prorate, sometimes weakly porose, 12.5–20 (–25) × 3.5–5.0 µm; becoming longer, wider and weakly porose towards the central base, 35–43 × 5–6 µm; at the apex irregularly short-rhombic, (7.5–) 10–15 (–18) × (2.5–) 5 µm, the marginal cells at mid leaf (12.5–) 15–20 × 3.75–5.0 µm, at the extreme margin 15–20 × 3.75 µm.

Setae to c. 3 cm, loosely twisted to the left. **Capsules** 1.75 × 0.5–0.6 mm; **exothecial cells** c. 39–43 × 12–15 µm. **Operculum** blunt to apiculate, 0.75 mm. **Exostome teeth** c. 440 µm long; **endostome** with a basal membrane c. ⅓ of exostome. **Calyptra** c. 2.5 mm. **Spores** 10–17 µm.

Illustrations: Plate 6. Sainsbury 1955, pl. 60, fig. 1; Tangney 2008, fig. 1.

Distribution: NI: N Auckland, including offshore islands (RT, GB, PK (Aorangi I.)), S Auckland (including Mayor I.), Hawke's Bay, Gisborne, Taranaki (Taranaki Maunga), Wellington; SI: Nelson, Marlborough, Canterbury, Westland (Mt Sewell, Paparoa Ra; Otira; Haast Pass), Otago, Southland; St; Sn; Sol; A.

Australasian. Tasmania*, mainland Australia (Qld, N.S.W., A.C.T., Vic.*), Macquarie I*.

Habitat: *Lembophyllum clandestinum* is most common in forest, on bark, rocks, rotten logs, and on the ground. It is also found on the same substrates in more open habitats, including subalpine shrubland and subalpine and alpine grassland. It ranges in altitude from sea level on the Auckland Islands, Stewart Island, and southern South Island, to 1650 m on Mt Arthur in Nelson.

Recognition: *Lembophyllum clandestinum* forms robust, loose open mats and wefts of elongate, julaceous stems and branches, with leaves mostly glossy, obtuse and cucullate, deeply concave and cochleariform. The branches are typically attenuate, and often stoloniferous and rhizoidal at the tips. *L. clandestinum* has mid laminal cells linear to short linear and those of the basal and lateral margins are rhombic, or shortly elongated. The costa is typically absent or short double and faint. Alar cells are differentiated from the adjacent basal cells; they are usually pigmented and shorter to form a dark, porose, excavate group.

Lembophyllum divulsum (Hook.f. & Wilson) Lindb. in Paris, *Index. Bryol.* 718 (1896)

≡ *Hypnum divulsum* Hook.f. & Wilson, *London J. Bot.* 3: 556 (1844)
≡ *Thamniella divulsa* (Hook.f. & Wilson) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1876–1877: 319 (1878)
≡ *Porotrichum divulsum* (Hook.f. & Wilson) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 83 (1882)
≡ *Coelidium divulsum* (Hook.f. & Wilson) Paris, *Index. Bryol.* 278 (1894)
Lectotype: Tasmania, *Hooker 2583*, (53), BM 000674900! (Designated by Tangney 2008, p. 44.) Isolectotypes: BM!

Plants moderately robust to slender, pale, yellow-brown to red-brown or olive green, mostly dull, forming loose wefts on rocks, bark, rotten logs and on the ground. **Stems** ± erect to scrambling, julaceous to subcomplanate, weakly stipitate, in cross-section c. 360 × 260 µm, with 4–5 layers of cells surrounding a core of parenchyma and an indistinct central strand. **Branches** blunt, 0.75–0.9 mm wide (including leaves). **Pseudoparaphyllia** c. 200 × 150 µm. **Stem leaves** imbricate to occasionally distant, inflated-smooth when moist, mostly unaltered when dry, orbicular to widely ovate, sometimes sub-spathulate, obtuse to widely acute, usually cucullate, deeply concave, 0.8–0.95 (–1.1) × 0.8–1.0 (–1.1) mm, with alar cells irregularly quadrate, porose and forming a group 6–7 cells wide and extending 6–8 cells from the leaf base. **Costa** variable, single robust and extending to upper lamina, 75–100 µm wide in lowest third, often shorter and divided 2–3 times, sometimes absent. **Branch leaves** smaller, 0.65–0.85 × 0.65–0.82 mm, with the alar group smaller and similar to the cells of the adjacent basal margin. **Mid laminal cells of branch leaves** rhombic, sigmoid, not or weakly porose, thick-walled, 6–8 (–9) × 2–2.5 µm, longer and narrower than the adjacent juxta-costal cells, 15–20 (–23) × 5–6 µm, at the apex rhombic to quadrate, 7.5–10 × 5–7.5 µm, marginal cells at mid leaf, 7.5–10 (–12.5) × 5–7.5 µm, extending to the lower margin.

Setae (1.0–) 1.5–2.0 (–2.5) cm. **Capsules** oblong cylindric, 1.1 × 0.3 mm; **exothecial cells** irregularly rectangular to quadrate, thick walled, (17–) 20–25 (–30) µm × 17–20 µm. **Operculum** apiculate, to 0.65 mm. **Exostome teeth** c. 450–500 µm. **Calyptra** c. 2 mm. **Spores** 12–15 µm.

Illustrations: Plate 6. Beever et al. 1992, fig. 65; Tangney 2008, fig. 1.

Distribution: NI: Hawke's Bay, Wellington; SI: Nelson, Marlborough, Canterbury, Otago, Southland (Awarua Bay; Bluff; Lake Manapouri); Ch; A.

Australasian. Tasmania*, mainland Australia (N.S.W.*, A.C.T.*, Vic*, S.A.*), Macquarie I*.

Habitat: Similar in ecology to *L. clandestinum*, *L. divulsum* is a common forest species, occurring on bark, rocks, and rotten logs and on the ground. It is also found in more open habitats, including subalpine shrubland and grassland. In New Zealand it ranges in altitude from sea level on Auckland

Island, Stewart Island, coastal Otago and Canterbury to 1470 m on the Arthur Range in Nelson. It is more southern and eastern in distribution compared to *L. clandestinum*, being absent from N Auckland, S Auckland, Gisborne and Taranaki on the North I., and from Westland on the South I. In Fiordland it is present only on its eastern edge (Lake Manapouri).

Recognition: *Lembophyllum divulsum* characteristically forms compact mats of elongate, slender julaceous stems and branches. The leaves are mostly unaltered when dry, obtuse to widely acute and cucullate or sometimes erect, deeply concave and cochleariform to subspathulate. *L. divulsum* has mid laminal cells rhombic and weakly sigmoid and thick-walled, becoming shorter towards the apex and lateral margins and extending towards the basal margin as a zone of non-porose, short, ± quadrate cells. Alar cells are usually not porose and not differentiated from the adjacent basal and marginal cells. The costa is generally single, broad and tapering, extending to the upper leaf, often divided 2–3 times above, sometimes faint, or absent. Smaller plants may be somewhat complanate, with leaves distant so that the stem is visible between the leaves.

Weymouthia Broth., *Nat. Pflanzenfam. [Engler & Prantl] 1(3),* 811 (1906)

Type taxon: *Weymouthia mollis* (Hedw.) Broth.

Plants robust or slender, soft, light to olive-green or brown-green, dull to glossy, forming wefts or pendent masses on trunks of trees. **Stems** creeping to erect-ascendent or pendent, sometimes stipitate, mostly complanate to neatly julaceous. **Branches** frequent or sparse, simple and erect from creeping stems, or lateral from pendent stems, sometimes forming ± regular complanate fronds, sometimes flagelliferous. **Pseudoparaphyllia** foliose, widely oblong and irregularly serrate. **Stem leaves** erect or erect-spreading, imbricate, loosely collapsed-wrinkled when dry, inflated smooth when moist, moderately to deeply concave, ovate to oblong, obtuse or widely acute, erect at the apex, ± entire or denticulate above and occasionally to lower margin. **Costa** double and failing below mid leaf, faint or absent. **Mid laminal cells** linear, ± sigmoid, firm- to thick-walled, porose or not, prorate; towards the leaf base shorter, wider, more irregular, thicker walled and usually porose to form a weak basal band; those above shorter, rhombic and thick-walled at the apex. **Alar cells** pigmented and forming a distinct group of smaller, isodiametric to short-rectangular cells which contrast with adjacent laminal and basal cells.

Dioicous or **autoicous**. **Inner perichaetial leaves** erect, sheathing, lanceolate, acuminate, ecostate, unbordered. **Setae** short or elongate, red-brown flexuose, smooth. **Capsules** exserted, smooth, horizontal, symmetric, oblong and weakly constricted below the mouth when dry; **exothecial cells** irregularly oblong to quadrate and firm- to thick-walled, with several rows of smaller, isodiametric cells below capsule mouth. **Exostome teeth** pale yellow-brown to hyaline, lanceolate, shouldered, with a zigzag median line; outer surface cross-striate below and papillose above, inner surface lamellate, smooth; **endostome** pale yellow-brown to hyaline, papillose, with a basal membrane c. (⅕–) ¼–½ of the exostome; with segments equal to the height of the exostome, keeled, perforate, cilia present or absent. **Calyptra** narrowly cucullate, smooth and enclosing the entire capsule, sometimes with 2–3 hairs at the base. **Operculum** symmetric and apiculate or asymmetric and rostrate. **Spores** spherical, pale yellow-brown, papillose.

Taxonomy: A genus of two species, both of which occur in N.Z.

Buck (1994, p. 70) designated *W. mollis* as the type of *Weymouthia.*

The genus has been placed in the Meteoriaceae, a mostly tropical family with epiphytic, pendent growth forms that *Weymouthia* also exhibits. *W. cochlearifolia* was treated by Brotherus (1901–1909) as both *W. billardierei* in the Meteoriaceae and as *Lembophyllum cochlearifolium* in the Lembophyllaceae (Dixon 1927). Dixon (1927) treated *Weymouthia* in the Neckeraceae, but also noted similarities to the Lembophyllaceae. Subsequent authors have treated *Weymouthia* either in the Meteoriaceae (Sainsbury 1955; Scott & Stone 1976; Streimann 1991; Beever et al. 1992; Buck 1994), or in the Lembophyllaceae, the latter on both morphological (Tangney 1997a) and molecular grounds (Quandt et al. 2000; Quandt et al. 2009; Enroth et al. 2019), and this placement is followed here.

Recognition: The two species of *Weymouthia* share a growth form of predominantly simple lateral branches from a main or primary stem. In *W. cochlearifolia* lateral branches are mostly erect, produced from a creeping primary stem, and form relatively robust wefts. Pendent shoots are formed as elongate extensions of the creeping stems. In *W. mollis* the main stems are pendent, with only shortly attached creeping parts, and the lateral branches are widely spreading. The plants form extensive tangled masses usually only lightly attached to twigs and branches of trees and shrubs.

Both species have erect sheathing inner perichaetial leaves, while the other N.Z. Lembophyllaceae have squarrose to spreading inner perichaetial leaves.

Both Dixon (1927) and Sainsbury (1955) noted that spores in *Weymouthia* are larger than the other NZ Lembophyllaceae, reporting spore size in the range of 20–30 µm for both species. While *W. mollis* produces spores up to 33 µm, almost twice the size of spores in the other species, in *W. cochlearifolia* spores are smaller, from 17–24 µm.

1	**Plants** slender usually pendent; **stems** complanate, with leaves not neatly spiralled; **mid laminal cells** not porose; **endostome** reduced, with a low basal membrane and cilia lacking..... ..... *W. mollis*
1'	**Plants** robust erect or pendent; **stems** tumid, with leaves often in neat spirals; **mid laminal cells** porose; **endostome** well developed, with a basal membrane ½ the height of the exostome and 2–3 cilia..... ..... *W. cochlearifolia*

Weymouthia cochlearifolia (Schwägr.) Dixon, *Bull. New Zealand Inst.* 3: 255 (1927)

≡ *Hypnum cochlearifolium* Schwägr., *Sp. Musc. Frond. Suppl. 1(2),* 221 (1816)
≡ *Isothecium cochlearifolium* (Schwägr.) Mitt., *Hooker's J. Bot. Kew Gard. Misc.* 8: 264 (1856)
≡ *Stereodon cochlearifolius* (Schwägr.) Mitt., *J. Proc. Linn. Soc., Bot.* 4: 88 (1859)
≡ *Coelidium cochlearifolium* (Schwägr.) Reichardt, *Reise Novara 1,* 191 (1870)
≡ *Porotrichum cochlearifolium* (Schwägr.) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 84 (1882)
≡ *Lembophyllum cochlearifolium* (Schwägr.) Lindb. in Paris, *Index. Bryol.* 718 (1896)
Type: Australasia: *La Billardiere*. Not seen.

Plants robust, soft, light to dark olive-green to brown-green, dull or slightly glossy, forming wefts or pendent masses on bark, rocks and rotten logs, rarely on the ground. **Stems** prostrate-scrambling to pendent, sometimes ± erect, sometimes subdendroid, tumid, bluntly cuspidate to attenuate; in cross-section c. 280 × 220 µm with an outer layer of c. 5 cells surrounding a core of parenchyma and an indistinct central strand. **Branches** loosely cuspidate, sometimes abruptly and multiply flagelliferous with microphyllous shoots. **Pseudoparaphyllia** c. 250 × 200 µm. **Stem leaves** imbricate, erect to erect-spreading, smooth when moist, loosely wrinkled when dry, widely ovate to oblong, obtuse or widely acute, very concave, with the apex erect, ± entire, 2.1–2.3 × (1.3–) 1.4–1.7 mm, with alar cells irregularly walled, porose, to form a dark group 10–13 cells wide and extending 5–6 cells from the leaf base. **Branch leaves** loosely imbricate, sometimes more widely spreading than stem leaves, ± shorter and narrower, (0.6–) 0.8–0.9 (–1.0) × (0.4–) 0.5–0.6 mm, with a smaller alar group, 8–9 cells wide and 4–5 high. **Mid laminal cells of branch leaves** linear, weakly sinuous, thick-walled, prorate, porose, (38–) 43–57 (–67) × 2.4–3.6 µm; becoming wider and thicker-walled towards the central base, 4.8–7.2 µm; **apical** cells rhombic-sinuous, (4.8–) 10–21 (–48) × 2.4–4.8 µm.

Dioicous or **pseudautoicous**. **Setae** short and stout or elongate, (5–) 10–12 or 15–20 mm, sometimes loosely twisted to the left in longer forms. **Capsules** oblong-cylindric, (1–) 1.6 × 0.7 mm; **exothecial cells** irregularly oblong to ± quadrate, c. 30–36 (–43) × 19–24 (–29) µm. **Operculum** symmetric, blunt to apiculate, occasionally rostrate, to 0.8 mm. **Exostome teeth** 520–550 µm long; **endostome** with a basal membrane c. ½ the height of the exostome, with 2–3 cilia. **Calyptra** c. 3 mm. **Spores** 17–24 µm.

Illustrations: Plate 7. Sainsbury 1955, pl. 56, fig. 1.

Distribution: NI: N Auckland, including offshore islands (PK, HC, LB, GB, RT), S Auckland, Gisborne, Hawke's Bay, Taranaki (Taranaki Maunga), Wellington; SI: Nelson, Marlborough, Canterbury, Westland, Otago, Southland; St; Ch; Sol; A; C.

Austral. Tasmania*, mainland Australia (Vic.*); Chile*.

Habitat: *Weymouthia cochlearifolia* forms robust wefts and pendent fronds on a range of substrates including bark, rocks, logs and soil, tree fern trunks and exposed roots in a wide range of habitats. It occurs from lowland forest floor and stream beds to more open and upper elevations where it can be epiphytic on small twigs. It occurs close to sea-level in Westland (Lake Matheson and Pororari River) and Southland (Dusky Sound) on the South I., and it is most commonly found from 100 m to 800 m; up to 1000 m in Abel Tasman National Park (Mt Evans) on the South I., and to 1200 m on the North I. (Mt Ruapehu).

Recognition: *Weymouthia cochlearifolia* is a quite variable plant. It is typically robust and weft forming, with thick ± tumid stems and branches, and deeply concave, widely ovate leaves that are often neatly spirally arranged. Its stems and branches are cuspidate, sometimes attenuate, and occasionally rhizoidal at the tips. More rarely, plants are flagelliferous from filiform shoots developing distally on branches. Creeping stems are sometimes stoloniferous, with leaves between the branches closely pressed to the stem or very reduced. Creeping stems can also become pendent to produce elongate growth, with widely spaced lateral branches.

This elongate growth in *W. cochlearifolia* has a parallel in *W. mollis*, where the leaves along the main stem contrast with those of the branches. In the latter, the main stem leaves are more closely pressed to the stem than the branch leaves which are more widely spreading. This makes the main stems narrower than the branches, echoing the stoloniferous growth of the creeping and pendent main stems of *W. cochlearifolia*.

Despite this variability, the combination of robust, relatively soft, green-brown wefts of thick erect branches makes *W. cochlearifolia* readily recognisable. It is most commonly confused with *Camptochaete arbuscula*, which is, typically, a wiry plant with much branched fronds supported on unbranched stipes. However, the variability of both can produce similar forms that are difficult to separate. *Camptochaete arbuscula* can have tumid branches, but its leaves are more usually complanate or subdistichous and this feature is usually evident in elongate growth. Both have leaves which are somewhat glossy and wrinkled when dry, concave and widely acute. *Weymouthia cochlearifolia* differs in having leaves more deeply concave and wider than *C. arbuscula*. Both have the same cell pattern of elongate mid-laminal cells, shorter apical cells and differentiated alar cells, but mid-laminal cells in *W. cochlearifolia* are more strongly porose, and this can be quite a marked feature. In fertile plants, there can be overlap in the length of setae, but the erect inner perichaetial leaves of *W. cochlearifolia* are diagnostic. The operculum varies from apiculate to rostrate in *W. cochlearifolia*, but it is always apiculate in *C. arbuscula*. *Camptochaete arbuscula* var. *tumida* may be confused with *W. cochlearifolia* in its loose branching and tumid stems, but it differs in being a more wiry plant and in having a distinct leaf apiculus lacking in the latter.

Weymouthia cochlearifolia has been confused with *Lembophyllum* spp., particularly *L. clandestinum*, and the main differences have been outlined above. The cell pattern in *Lembophyllum* is distinctive amongst the N.Z. Lembophyllaceae and is diagnostic in identifying *W. cochlearifolia* in cases where variability of growth form makes separation difficult.

Weymouthia mollis (Hedw.) Broth., *Nat. Pflanzenfam. [Engler & Prantl] 1(3),* 812 (1906)

≡ *Leskea mollis* Hedw., *Sp. Musc. Frond.* 234 (1801)
≡ *Meteorium molle* (Hedw.) Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II,* 100 (1854)
≡ *Isothecium molle* (Hedw.) Mitt., *Hooker's J. Bot. Kew Gard. Misc.* 8: 263 (1856)
≡ *Stereodon mollis* (Hedw.) Mitt. in Mitten, *J. Proc. Linn. Soc., Bot.* 4: 88 (1859) nom. illeg.
≡ *Pilotrichella mollis* (Hedw.) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1875–1876: 260 (1877)
Lectotype: N.Z., *St. Crypt.* IV. P. 103. T 40, G-Hedwig, G00040342. (Lectotype designated by Tangney 2010, p. 147.)

Plants slender, light to dark olive-green, slightly glossy, forming extensive loosely attached masses on shrubs and trees. **Stems** pendent or sometimes creeping, loosely complanate, attenuate, not stipitate; in cross-section ± round, 230 × 190–210 µm, with an outer layer of 4–5 cells surrounding a core of parenchyma and an indistinct central strand. **Branches** wider than stems, cuspidate, sometimes attenuate. **Pseudoparaphyllia** c. 200 × 125 µm. **Stem leaves** erect, imbricate, inflated-smooth when moist, loosely wrinkled when dry, oblong, obtuse to widely acute, erect at the apex, denticulate above and occasionally to the lower margins, 1.5–1.7 (–1.8) × 0.6–0.7 mm, with alar cells thick-walled and irregularly porose, forming a dark excavate group 5–6 cells wide and extending 5–6 cells from the leaf base. **Branch leaves** shorter, erect-spreading, with a smaller alar group, 1.2–1.5 × 0.6–0.7 mm. **Mid laminal cells of branch leaves** linear, ± sinuous, firm-walled, prorate, not porose, 40–50 (–60) × 2.4–3.2 µm; becoming somewhat shorter, wider and porose towards the base, (24–) 36–55 × 3.2.–4.8 (–6.4) µm, at the apex rhombic, 5–12 (–28) × 3.6–4.8 µm.

Dioicous or **pseudautoicous**. **Setae** short, to c. 3.5 mm, not twisted. **Capsules** oblong, (0.9–) 1.0–1.2 × 0.6–0.7 mm; **exothecial cells** irregularly rectangular to hexagonal or ± isodiametric, 30–38 (–50) × (14–) 26–30 µm. **Operculum** rostrate, 0.5–0.9 mm. **Exostome teeth** 325–35 µm long;

endostome with a basal membrane c. ⅕ of the height of the exostome. **Calyptra** c. 2 mm. **Spores** 28–33 µm.

Illustrations: Plate 7.

Distribution: NI: N Auckland, including offshore islands (PK, HC, LB, GB), S Auckland, Gisborne, Hawke's Bay, Taranaki (Taranaki Maunga), Wellington; SI: Nelson, Marlborough, Canterbury, Westland, Otago, Southland; Ch.

Austral. Tasmania*, mainland Australia (Vic.*); Tahiti*; Chile*.

Habitat: *Weymouthia mollis* typically forms pendent masses on twigs and small branches in humid forest habitats, particularly over streams and river margins. It also occurs on damp logs and rocks. It mainly occurs in forest, particularly upper elevation forest, and also grows in more open and shaded shrubland. It occurs close to sea-level at Riccarton Bush, Christchurch, but mostly from 60 m to 800 m across much of its range. It is known up to 1100 m in Abel Tasman National Park on South I., and to 1200 m on North I. (Pihanga,Taupo).

Recognition: *Weymouthia mollis* is a comparatively slender plant that is always pendent and lacks a weft-forming habit. It differs from *W. cochlearifolia* in a number of features, principally in growth form and cell structure, and it is the only member of the N.Z. Lembophyllaceae which consistently produces pendent fronds. The other species, *W. cochlearifolia,* is mostly weft-forming, but does frequently produce pendent fronds. The mid laminal cells of *W. mollis* are non-porose, contrasting with the cells of *W. cochlearifolia* which are strongly porose. Sporophytically, the two taxa differ in several respects. The operculum of *W. cochlearifolia* is variable, apiculate to rostrate, compared to the rostrate operculum of *W. mollis*, and the endostome of *W. mollis* is reduced. The calyptra of *W. mollis* may rarely be sparsely hairy, a feature absent in the other species.

As noted above, the pendulous forms of *Weymouthia mollis* are similar to species of *Papillaria* which differ in a range of features including plant colour, leaf plication and costae, a lack of alar cells and papillose cells.

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Conventions

Abbreviations and Latin terms

Abbreviations	Meaning
A	Auckland Islands
A.C.T.	Australian Capital Territory
aff.	allied to (*affinis*)
agg.	aggregate
Ant	Antipodes Islands
a.s.l.	above sea level
auct.	of authors (*auctorum*)
B	Bounty Islands
C	Campbell Island
c.	about (*circa*)
cf.	compare with, possibly the species named (*confer*)
c.fr.	with fruit (*cum fructibus*)
Ch	Chatham Islands
comb. nov.	new combination (*combinatio nova*)
D'U	D'Urville Island
et al.	and others (*et alia*)
et seq.	and following pages (*et sequentia*)
ex	from
fasc.	fascicle
fide	according to
GB	Great Barrier Island
HC	Hen and Chicken Islands
Herb.	Herbarium
hom. illeg.	illegitimate homonym
I.	Island
ibid.	in the same place (*ibidem*)
incl.	including
in herb.	in herbarium (*in herbario*)
in litt.	in a letter (*in litteris*)
inter alia	among other things (*inter alia*)
Is	Islands
K	Kermadec Islands
KA	Kapiti Island
LB	Little Barrier Island
L.D.	Land District or Districts
leg.	collected by (*legit*)
loc. cit.	in the same place (*loco citato*)
l:w	length:width ratio
M	Macquarie Island
Mt	Mount
nec	nor
NI	North Island
no.	number
nom. cons.	conserved name (*nomen conservandum*)
nom. dub.	name of doubtful application (*nomen dubium*)
nom. illeg.	name contrary to the rules of nomenclature (*nomen illegitimum*)
nom. inval.	invalid name (*nomen invalidum*)
nom. nud.	name published without a description (*nomen nudum*)
non	not
N.P.	National Park
N.S.W.	New South Wales
N.T.	Northern Territory (Australia)
N.Z.	New Zealand
op. cit.	in the work cited (*opere citato*)
pers. comm.	personal communication

PK	Poor Knights Islands
P.N.G.	Papua New Guinea
pro parte	in part
Qld	Queensland
q.v.	which see (*quod vide*)
RT	Rangitoto Island
S.A.	South Australia
s.coll.	without collector (*sine collectore*)
s.d.	without date (*sine die*)
sect.	section
SEM	scanning electron microscope/microsopy
sensu	in the taxonomic sense of
SI	South Island
sic	as written
s.l.	in a broad taxonomic sense (*sensu lato*)
s.loc.	without location (*sine locus*)
Sn	Snares Islands
s.n.	without a collection number (*sine numero*)
Sol	Solander Island
sp.	species (singular)
spp.	species (plural)
s.s.	in a narrow taxonomic sense (*sensu stricto*)
St	Stewart Island
stat. nov.	new status (*status novus*)
subg.	subgenus
subsect.	subsection
subsp.	subspecies (singular)
subspp.	subspecies (plural)
Tas.	Tasmania
TK	Three Kings Islands
U.S.A.	United States of America
var.	variety
vars	varieties
Vic.	Victoria
viz.	that is to say (*videlicet*)
vs	versus
W.A.	Western Australia

Symbol	**Meaning**
µm	micrometre
♂	male
♀	female
±	more or less, somewhat
×	times; dimensions connected by × refer to length times width
>	greater than
<	less than
≥	greater than or equal to
≤	less than or equal to
=	heterotypic synonym of the preceding name
≡	homotypic synonym of the preceding name
!	confirmed by the author
*	in distribution statements, indicates non-N.Z. localities from which material has been confirmed by the author

Technical terms conform to Malcolm, B.; Malcolm, N. 2006: *Mosses and other Bryophytes: an Illustrated Glossary*. Edition 2. Micro-Optics Press, Nelson.

Abbreviations for Herbaria follow the standard abbreviations listed in *Index Herbariorum*.

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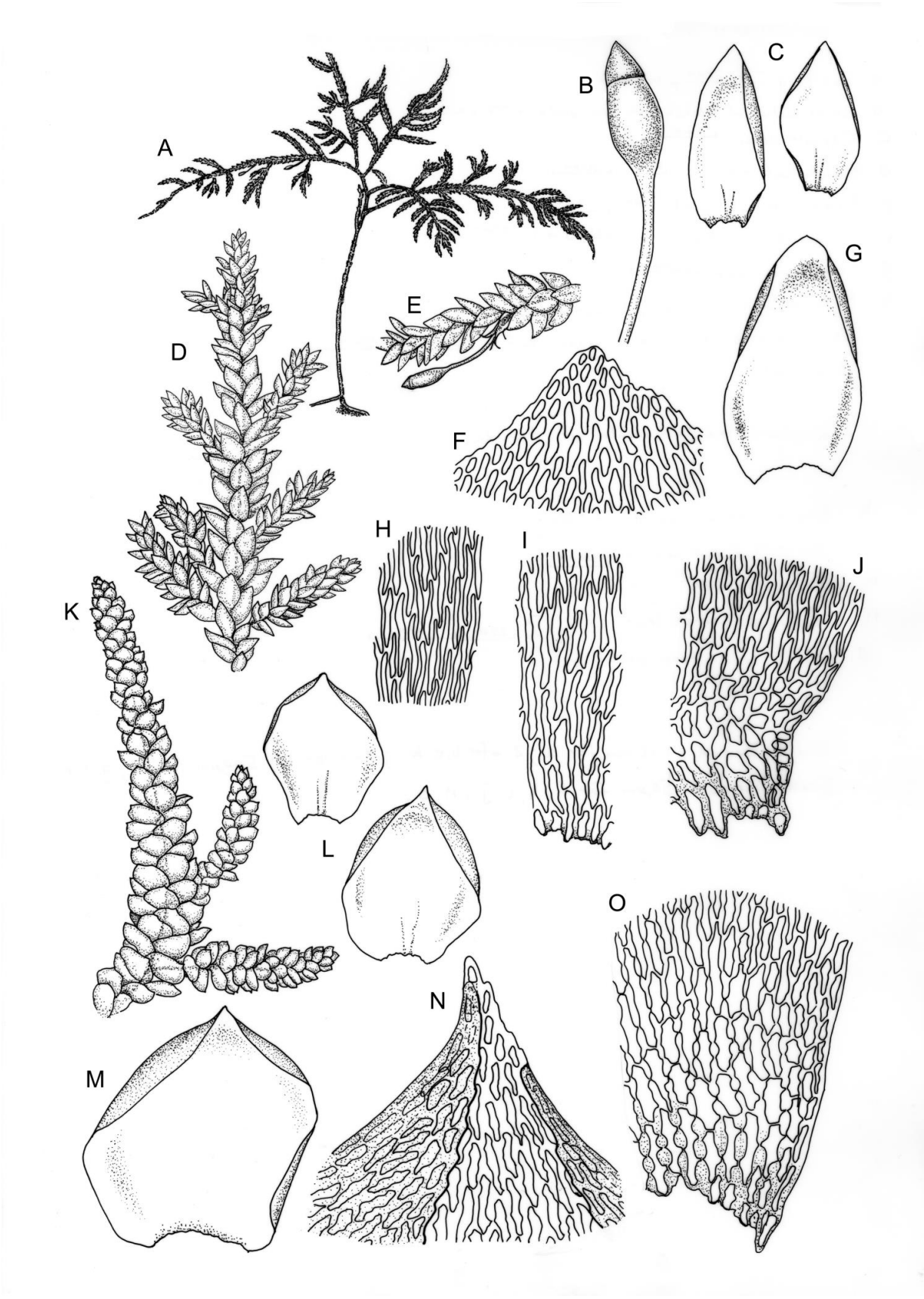


Plate 1: ***Camptochaete.*** **A–J:** ***C. arbuscula*** **var.** ***arbuscula***. A, habit. B, capsule. C, branch leaves. D, portion of frond. E, branch detail with capsule. F, apex of branch leaf. G, frond axis leaf. H, mid laminal cells of branch leaf. I, basal laminal cells of branch leaf. J, alar cells. **K–O:** ***C. arbuscula*** **var.** ***tumida***. K, branch detail. L, branch leaves. M, frond axis leaf. N, apex of branch leaf. O, alar cells of branch leaf. *C. arbuscula* var. *arbuscula* drawn from *J. Child 5528*, CHR 428525. *C. arbuscula* var. *tumida* drawn from *E.M. Chapman s.n.*, 11 Dec. 1971, CHR 163840.

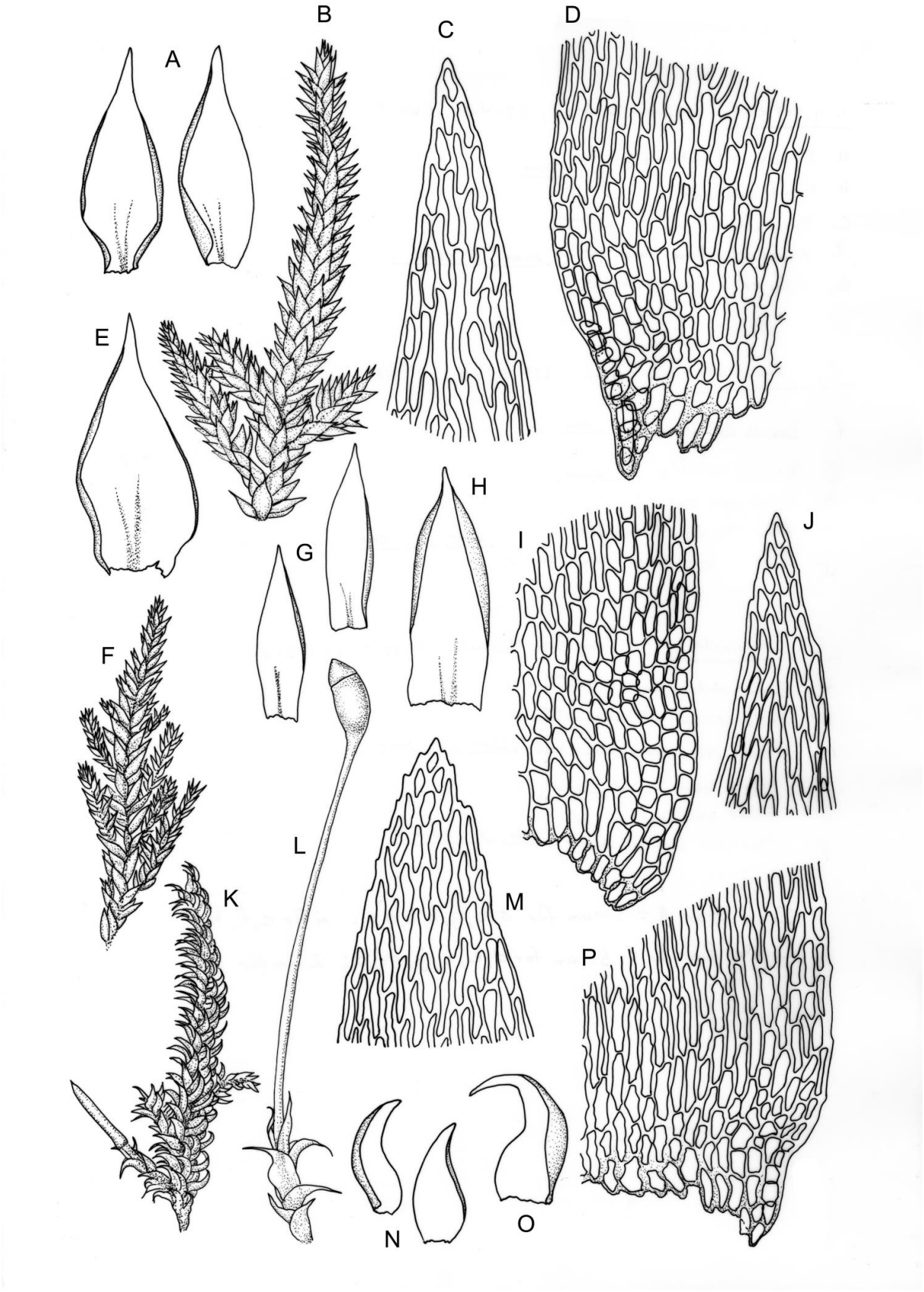


Plate 2: ***Camptochaete.*** **A–E:** ***C. deflexa***. A, branch leaves. B, branch detail. C, apex of branch leaf. D, alar cells of branch leaf. E, frond axis leaf. **F–J:** ***C. angustata***. F, branch detail. G, branch leaves. H, frond axis leaf. I, alar cells of branch leaf. J, apex of branch leaf. **K–P:** ***C. pulvinata***. K, branch detail. L, perichaetium with capsule. M, apex of branch leaf. N, branch leaves. O, frond axis leaf. P, alar cells of branch leaf. *C. deflexa* drawn from *D. Glenny 89-466*, CHR 527742. *C. angustata* drawn from *A.J. Fife 8589*, CHR 461007. *C. pulvinata* drawn from *B.H. Macmillan 93/95*, CHR 506181.

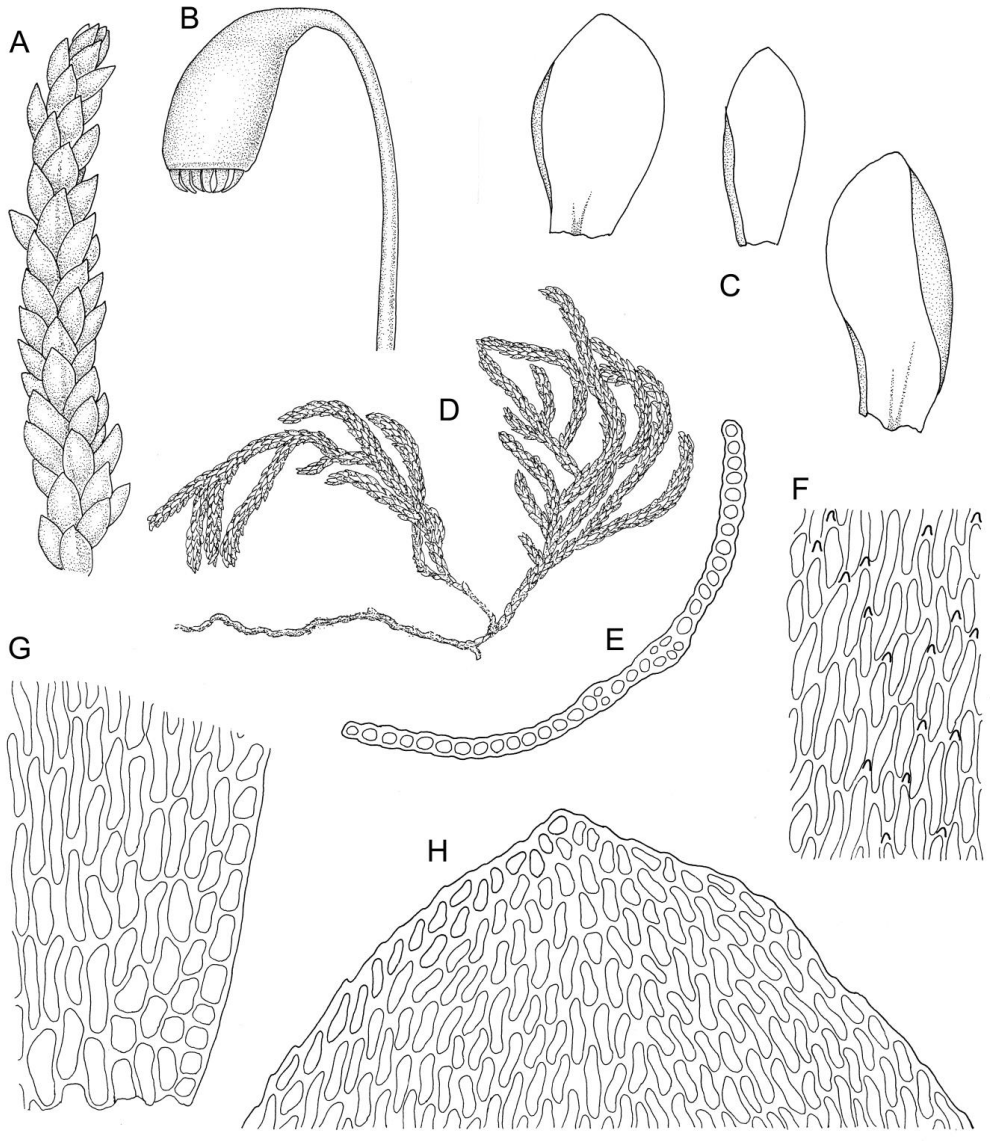


Plate 3: ***Fallaciella*. A–H: *F. gracilis***. A, branch detail. B, capsule. C, three leaves. D, habit. E, cross-section of lower laminal cells including double costa. F, mid laminal cells. G, alar cells of branch leaf. H, leaf apex. Drawn from *B.H. Macmillan 68/65*, CHR 163380.

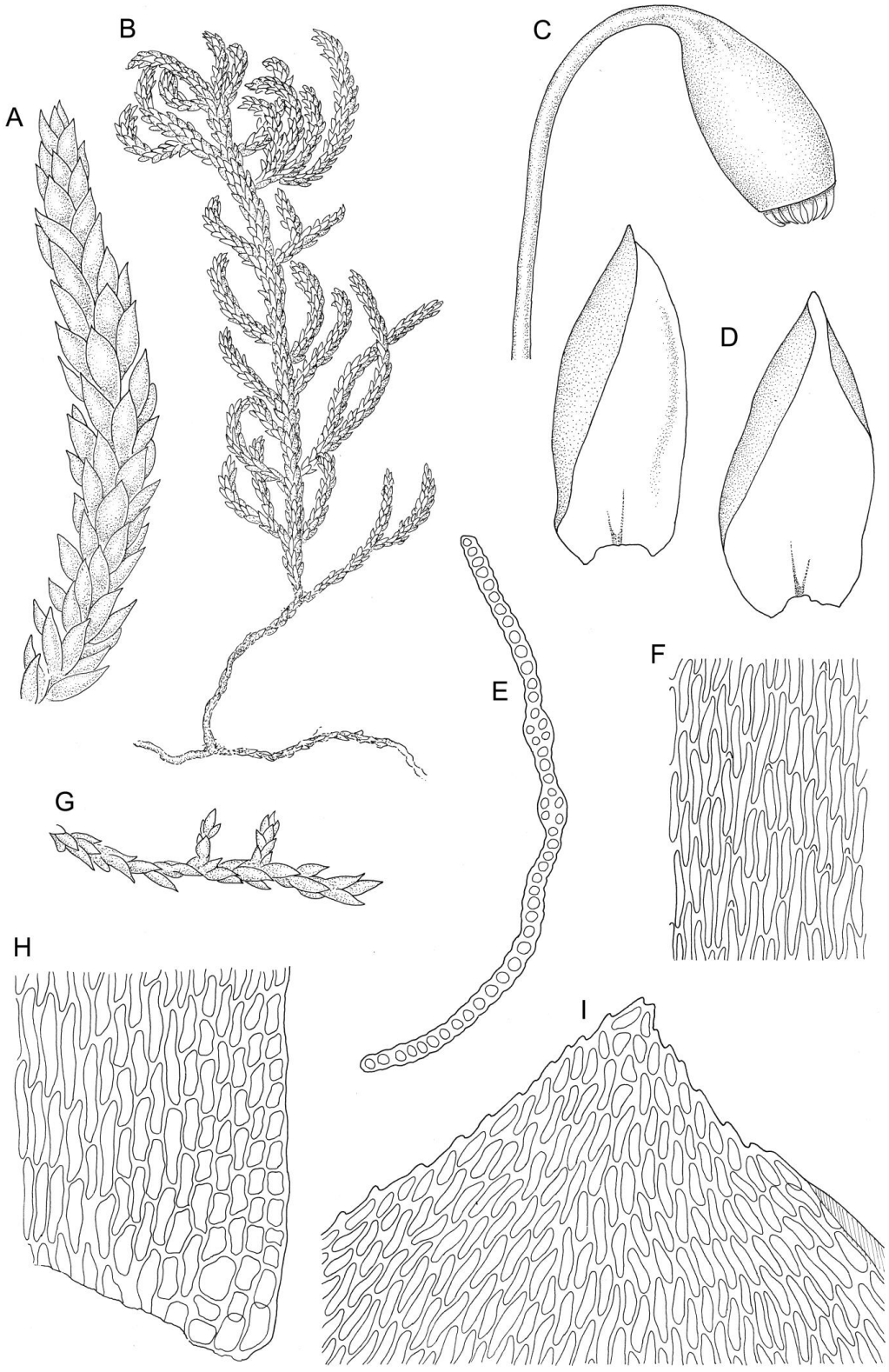


Plate 4: ***Fallaciella*. A–I: *F. robusta***. A, branch detail. B, habit. C, capsule. D, leaves. E, cross-section of lower laminal cells including double costa. F, mid laminal cells. G, part of stoloniferous shoot. H, alar cells of branch leaf. I. leaf apex. Drawn from holotype, *A.J. Fife 8137*, CHR 438186.

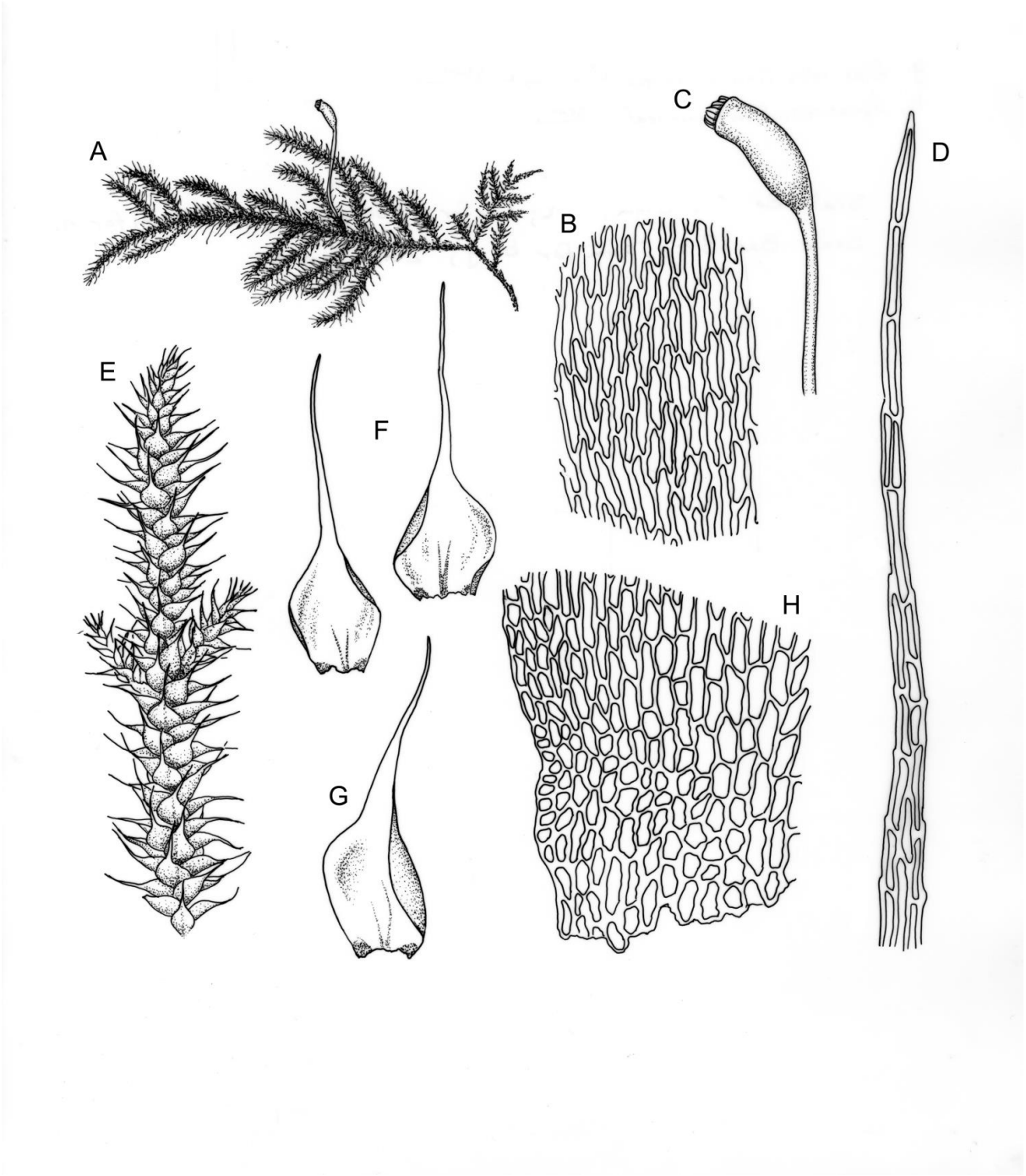


Plate 5: ***Fifea*. A–H: *F. aciphylla***. A, habit with capsule. B, mid laminal cells of branch leaf. C, capsule. D, apex of branch leaf. E, branch detail. F, branch leaves. G, frond axis leaf. H, alar cells of branch leaf. Drawn from *A.J. Fife 9168*, CHR 476986.

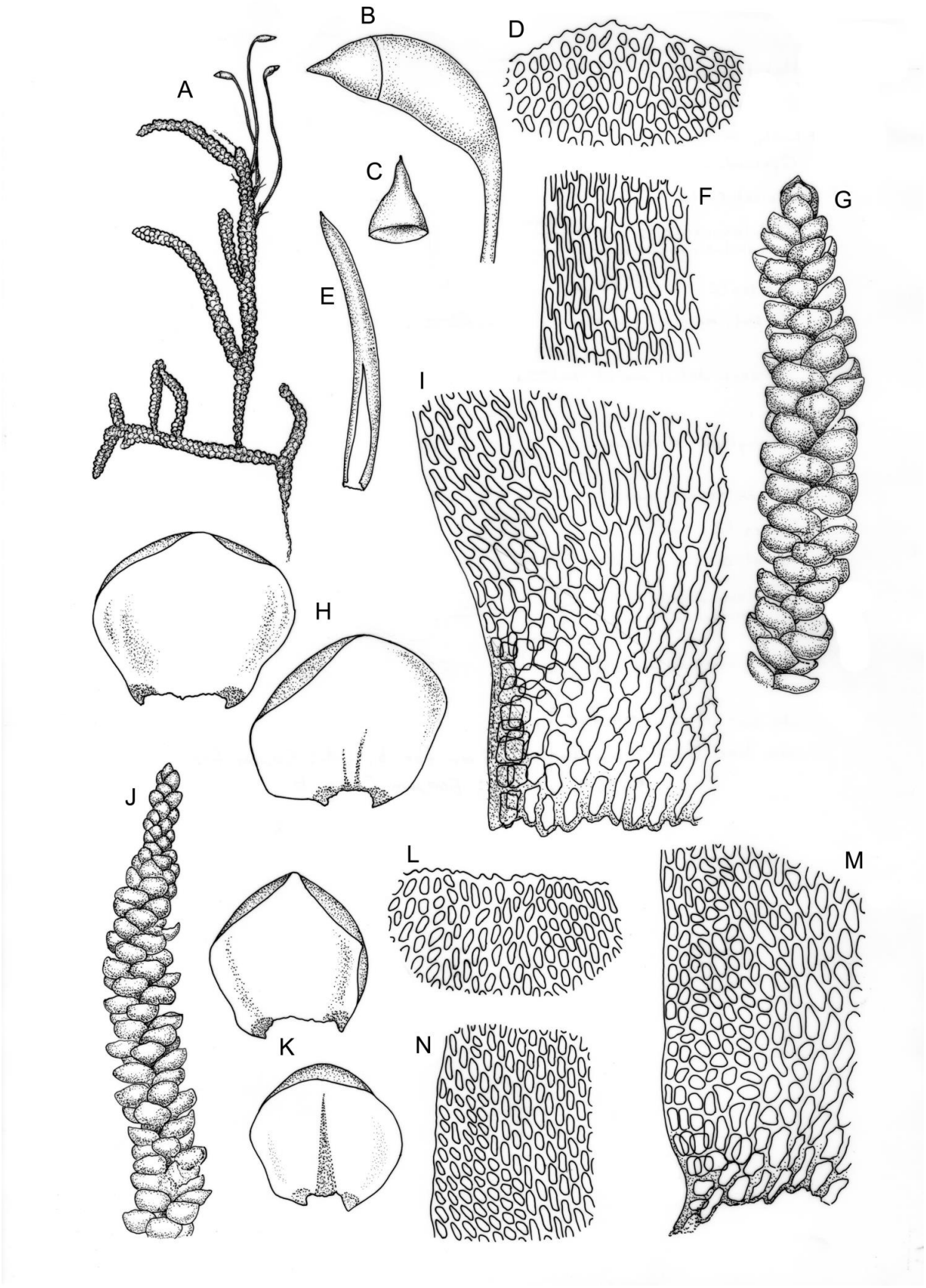


Plate 6: ***Lembophyllum*. A–I: *L. clandestinum***. A, habit. B, capsule. C, operculum. D, leaf apex. E, calyptra. F, mid laminal cells at margin. G, branch detail. H, leaves. I, alar cells. **J–N: *L. divulsum***. J, branch detail. K, leaves. L, leaf apex. M, alar cells. N, mid laminal cells at margin. *L. clandestinum* drawn from *W.R. Buck 7049*, CHR 412514 and *K.W. Allison 2942*, CHR 523703. *L. divulsum* drawn from *B.H. Macmillan 94/180*, CHR 509251, *W. Martin s.n.*, Feb. 1944, CHR 457948, and *B.A. Fineran 1297*, CHR 523728.

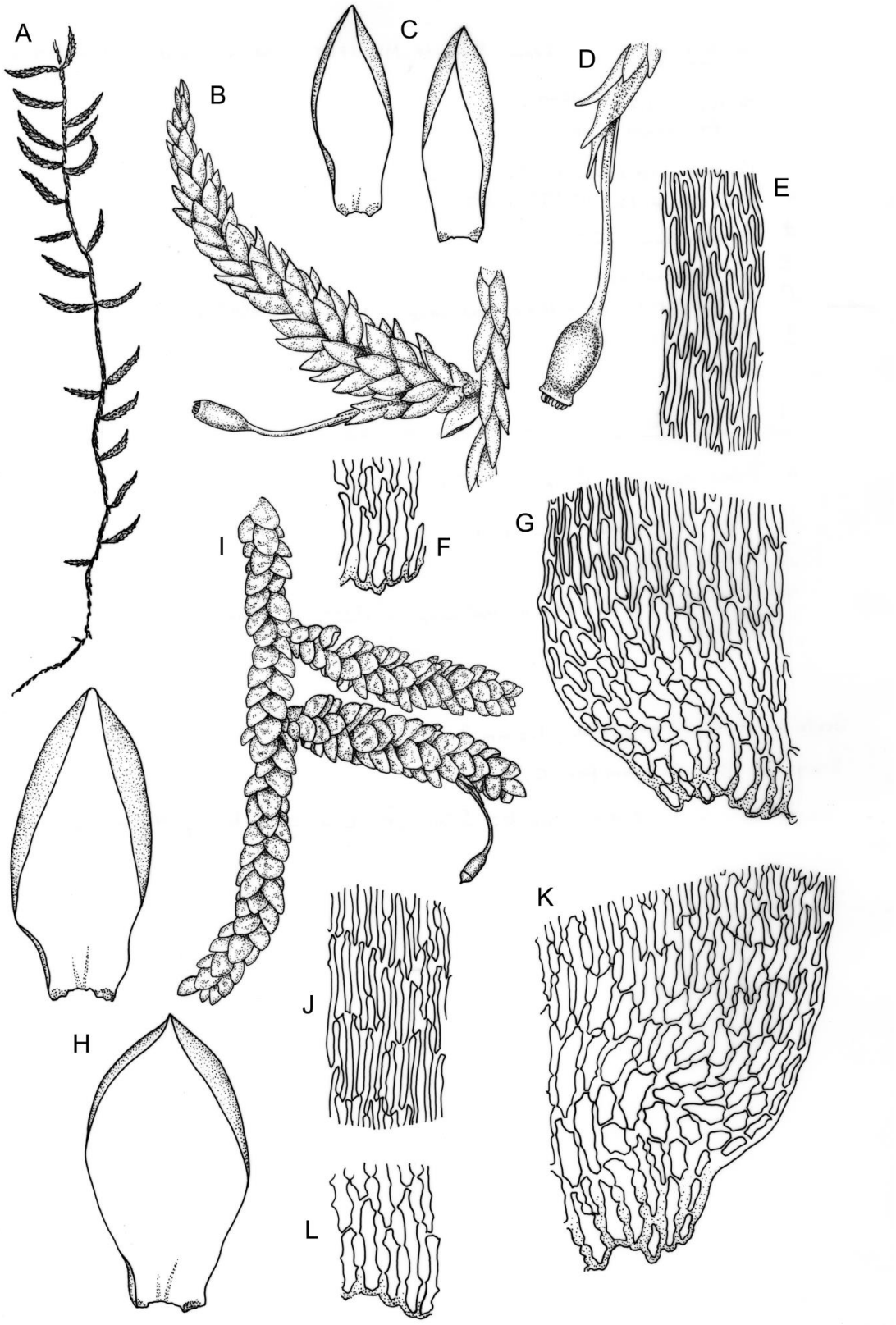
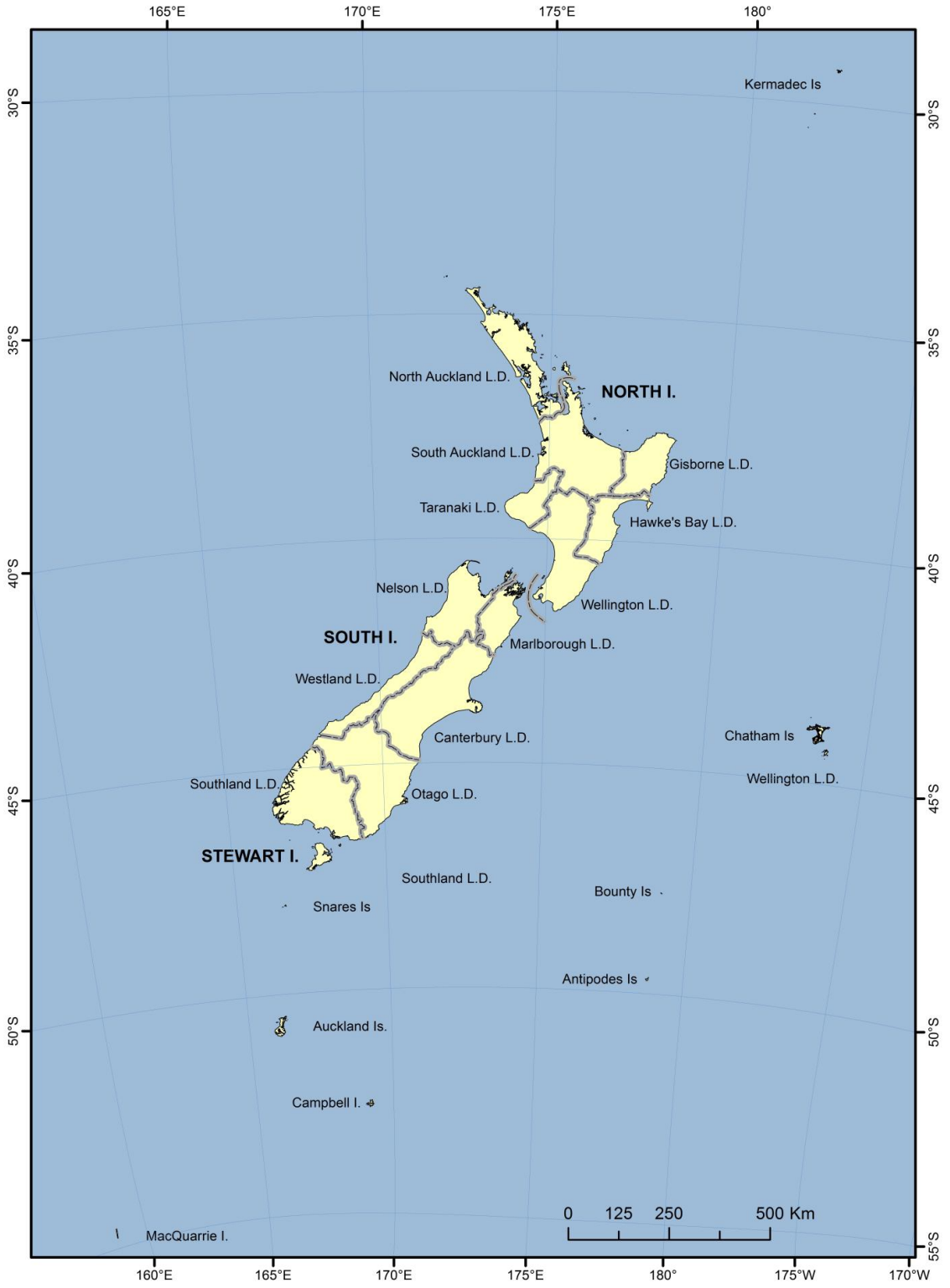
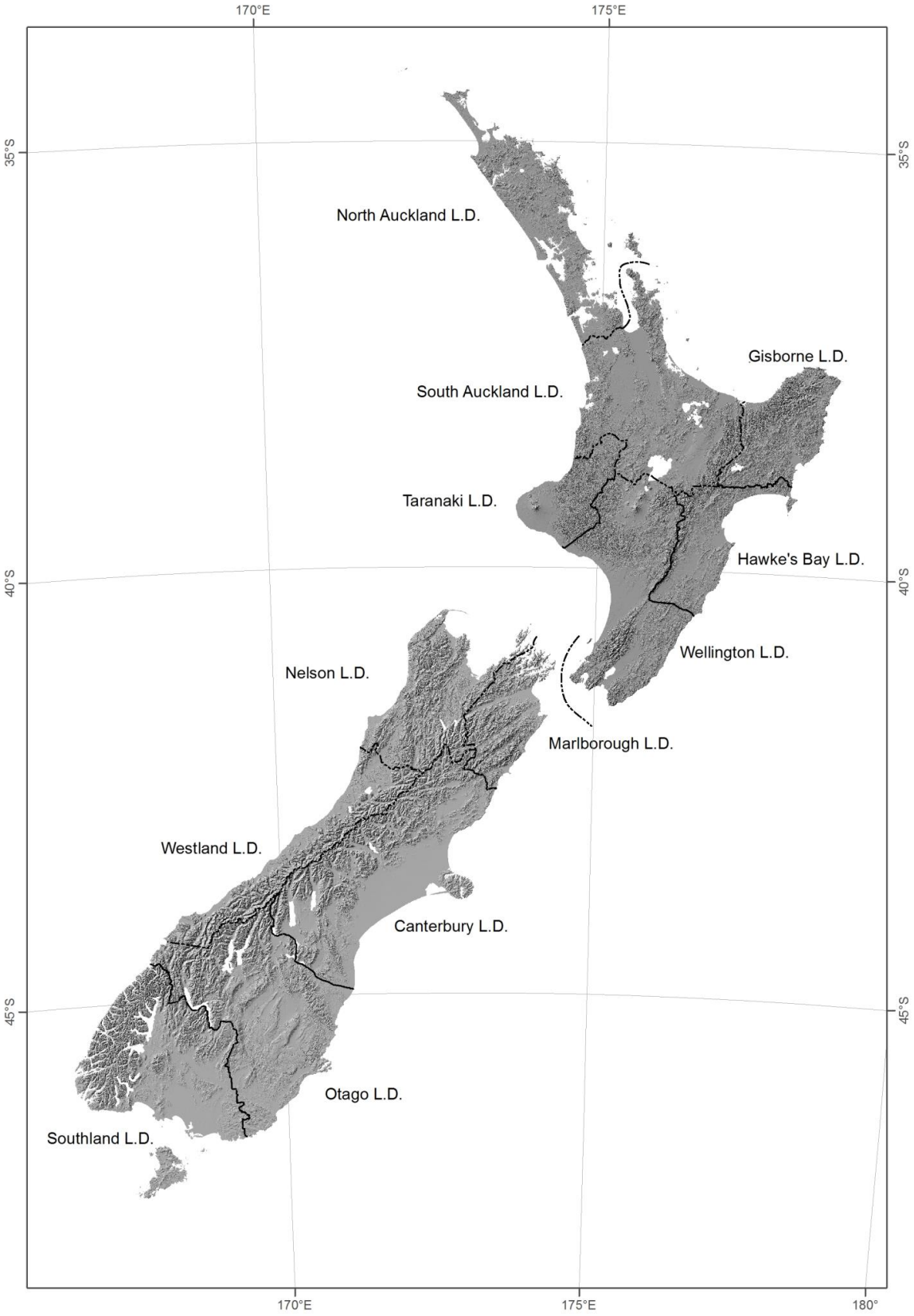


Plate 7: ***Weymouthia*. A–G: *W. mollis***. A, habit. B, branch detail with capsule. C, branch leaves. D, perichaetium with capsule. E, mid laminal cells. F, basal laminal cells. G, alar cells. **H–L: *W. cochlearifolia***. H, branch leaves. I, branch detail with capsule. J, mid laminal cells. K, alar cells. L, basal laminal cells. *W. mollis* drawn from *T.W.N. Beckett s.n.*, May 1889, CHR 624130, and *J. Child 1740*, CHR 432785. *W. cochlearifolia* drawn from *T.W.N. Beckett s.n.*, May 1889, CHR 623822.



Map 1: Map of New Zealand and offshore islands showing Land District boundaries



Map 2: Map of main islands of New Zealand showing Land District boundaries

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Map 1	A.D. Wilton	© Landcare Research 2014
Map 2	A.D. Wilton	© Landcare Research 2014

Flora of New Zealand: PDF publications

The electronic Flora of New Zealand (**eFloraNZ**) project provides dynamic, continually updated, online taxonomic information about the New Zealand flora. The collaborators in the project are Manaaki Whenua – Landcare Research now part of the Bioeconomy Science Institute of New Zealand, the Museum of New Zealand Te Papa Tongarewa, and the National Institute of Water and Atmospheric Research (NIWA) now part of Earth Sciences New Zealand.

The eFloraNZ presents new systematic research and brings together information from the Bioeconomy Science Institute's network of databases and online resources. New taxonomic treatments are published as fascicles in PDF format and provide the basis for other eFloraNZ products, including the web profiles.

eFloraNz has separate sets of PDF publications for mosses, ferns and lycophytes, and seed plants.

For each eFloraNZ set the PDF files are made available as dated and numbered fascicles. With the advent of new discoveries and research the fascicles may be revised, with the new fascicle being treated as a separate version under the same number. However, superseded accounts will remain available on the eFlora website.

Moss Set (ISBN 978-0-478-34747-0)

The Moss Set covers indigenous and exotic mosses within the New Zealand Botanical Region.

Orignally, authors Allan Fife and Jessica Beever intend**ed** to publish *Flora of New Zealand Mosses* as a book. However, it was decided to make completed family treatments available through the eFloraNZ project.

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