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The genus *Acromastigum* in Australia

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Abstract

Twelve species of *Acromastigum* (Lepidoziaceae) are recognised for Australia including three new species from Tasmania, *Acromastigum prismaticale* sp. nov., *A. interstisiale* sp. nov. and *A. fumosum* sp. nov. The new species *A. interstisiale* also occurs in New Zealand on the Denniston Plateau. *Acromastigum tenax* is a new record for Australia from the Wet Tropics Bioregion, and *Acromastigum divaricatum* is recorded for Tasmania and New Zealand. The enigmatic New Zealand endemic. *Acromastigum brachyphyllum* is synonymised with *A. anisostomum*, which is excluded from the Australian flora as all Australian records are based on misidentifications, primarily of *A. interstisiale* but also of *A. mooreanum* and *A. fumosum*. *Acromastigum furcatifolium* and *A. fumosum* are geographically restricted and sparsely distributed, the former on sandstone in rainforest in the Blue Mountains west of Sydney, the latter on peat in rainforest and shrublands in Tasmania. *Acromastigum exiguum* and *A. marginatum* are retained as separate species distributed either side of the Tasman Sea. Descriptions, illustrations and associated observations for Australian species of *Acromastigum* are presented, as is a key including Australian and New Zealand species.

Introduction

The Lepidoziineae is a sharply defined group of families (Phycolepidoziaceae, Lepidoziaceae and Calypogeiaceae), isolated by the position and almost universal reduction in size of the sexual branches, the general development of microphyllous stolons or flagella and the two phase development observed in the epidermal cells of the capsule (Schuster 1969).

As early as 1845, Gottsche and Lindenberg recognised some elements of *Acromastigum* when they divided the genus *Mastigobryum* Nees into three sections, one of which, Section B, corresponded in a general way with *Acromastigum*. Spruce (1885) made no formal proposal, but expressed the opinion that three of the species in Section B might justifiably be separated as a distinct genus.

Mastiogobryum was further divided by Stephani (1885–1886) into 11 sections, one of which, the *Inaequilatera* included Spruce's 3 taxa plus another eight species. Schiffner (1893) followed Stephani's example and recognised the *Inaequilatera* as a section in the genus *Bazzania* (the correct generic name for *Mastigobryum*, Carrington 1870). In 1908 Stephani revised his earlier classification and divided the 11 sections of *Mastigobryum* into 4 subgenera (*Intergrifolia, Bidentata, Inaequilatera* and *Tridentata*). Stephani thought generic separation unwarranted, but in 1934 Evans separated the subgenus *Inaequilatera* as the genus *Acromastigum* on the basis of branching differences i.e. postical branches arise terminally, replacing half of the underleaf, rather than

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being intercalary or axillary as in *Bazzania*. Though Evans cited other differences in the axial organs, for him the presence of the *Acromastigum*-type branching alone was sufficient justification for separating the *Inequilaterae* from *Bazzania/Mastigobryum*.

Evans (1934) recognised a total of 28 *Acromastigum* species divided into four sections on the basis of vegetative characters: sections *Squarrosa*, *Subcomplicata* (each with one species), *Exilia* (3 species) and *Inequilatera* (23 species). A number of new taxa have since been recognised and partly in response Schuster (1968, 1997) altered the organisation of the genus at a subgeneric and sectional level by recognising 3 subgenera, *Acromastigum* (with two sections, *Triandrophyllopsis* (R.M.Schust.) R.M.Schust. and *Acromastigum* which is the equivalent of Evans' *Squarrosa*), *Subcomplicatae* (Evans' section *Subcomplicata*) and *Inequilaterae* (Schiffn.) Grolle (with 3 sections, *Lepidomastigum* R.M.Schust., *Exilia* and *Inaequilatera*, the latter 2 being equivalent to Evans' sections of the same name).

All but two of the Australian *Acromastigum* species belong to the section *Inaequilatera*, which is circumscribed by cortical cells usually in 7 longitudinal rows; bifid incubously inserted leaves and trifid underleaves. *Acromastigum* and *A. verticale* are allied to *A. intergrifolium* of Sect. *Acromastigum*, circumscribed by cortical cells in more than 7 longitudinal rows; leaves undivided or bidentate, transversely attached; underleaves undivided.

Some of Evan's species concepts have caused confusion and concern in this region and additional collecting (particularly in Tasmania) has revealed the need for a revision of the group in Australia. Since Evan's monograph there has also been further work on the New Guinean species (Grolle 1978, Piippo 1991), New Caledonia (Hürlimann 1983, Kitagawa 1985, Schuster 1997) and New Zealand (Hodgson 1954, Schuster 1963, Engel and Merrill 1994) that is of relevance to *Acromastigum* in Australia. Molecular phylogenetic investigation of the Lepidoziaceae (Heslewood and Brown 2007) resolved *Lepidozia furcatifolia* Steph. within *Acromastigum* and this transfer was formalised by Brown et al. (2012). The aim of this study is to document and describe Australian *Acromastigum* species on the basis of morphological data. Selected specimens examined are summarised according to the regional classification of Anonymous 1975 Queensland); Anderson 1961, Jacobs and Pickard 1981 (New South Wales); Conn 1993 (Victoria); and Orchard 1988 (Tasmania).

Taxonomic Treatment

Acromastigum Evans

Plants small to moderate in size, in large tufts or in low mats amongst other bryophytes, varying from bright green to chestnut-brown, usually c. 1 mm wide. Stems rigid, with branching of 3 types; terminal *Frullania*-type: giving rise to apparent dichotomies (the dorsal half of the lateral leaf is usually situated in the fork of the 'dichotomy'); terminal *Acromastigum*-type: giving rise to ventral, flagelliform branches (the incomplete and undivided underleaf is situated basally, to one side of the branch); intercalary branches from the ventral merophyte giving rise to sexual branches (branch is located in the axis of an otherwise normally shaped underleaf) - intercalary branches may also give rise to normal leafy shoots, especially when the apex of the plant has been damaged; branches usually arising from one side of the axis, homodromous, branch shoots usually subequal to parent shoot in vigour, widely spreading (rarely more than 90° to each other); ventral flagelliform shoots with reduced leaves common, flagelliform shoots sometimes becoming leafy especially beyond point of attachment to substrate. Stem anatomy simple, cells showing some differentiation into cortical and medullar layers; cortical cells in one layer, larger in diameter than medullar cells and forming an hyalodermis, usually in 4 dorsilateral and 3 ventral longitudinal rows (derived from the 2 lateral rows of segments and the ventral row respectively; Evans 1934); cell walls ± uniformly thickened or with the outer tangential walls distinctly thickened; medullar cells much smaller, walls thinner than in cortical cells but distinctly thick walled in certain species. Rhizoids usually sparse on leafy branches, from bases of underleaves, more frequent at bases of reduced leaves and underleaves of flagella but rarely common, simple or branched at the tips, also developing from the basal cells of fertilised female branches. Leaves usually clearly incubously inserted and oriented, more or less transversely inserted in some species, alternate or rarely subopposite, the line of insertion straight to rarely acroscopically curved at its upper end; imbricate or somewhat distant, often slightly convex with deflexed apex bidentate, bifid (or rarely entire), ventral lobe usually somewhat larger; leaf margins entire, minutely crenulate or with multicellular teeth; scale-like leaves of the flagelliform branches smaller than the underleaves, transversely attached, usually bifid (or simple). Cells of leaves usually regularly quadrate to hexagonal, subisodiametric; cells toward base of leaf usually distinctly larger than dorsal ones, sometimes vittate, vitta extending upward from the base, close to the ventral margin, merging into adjacent tissues, often very indistinct; with bounding walls ± strongly thickened; thickenings also developed in the vertical walls, sometimes forming distinct trigones, separated by ± evident pits, trigones frequently coalescing;

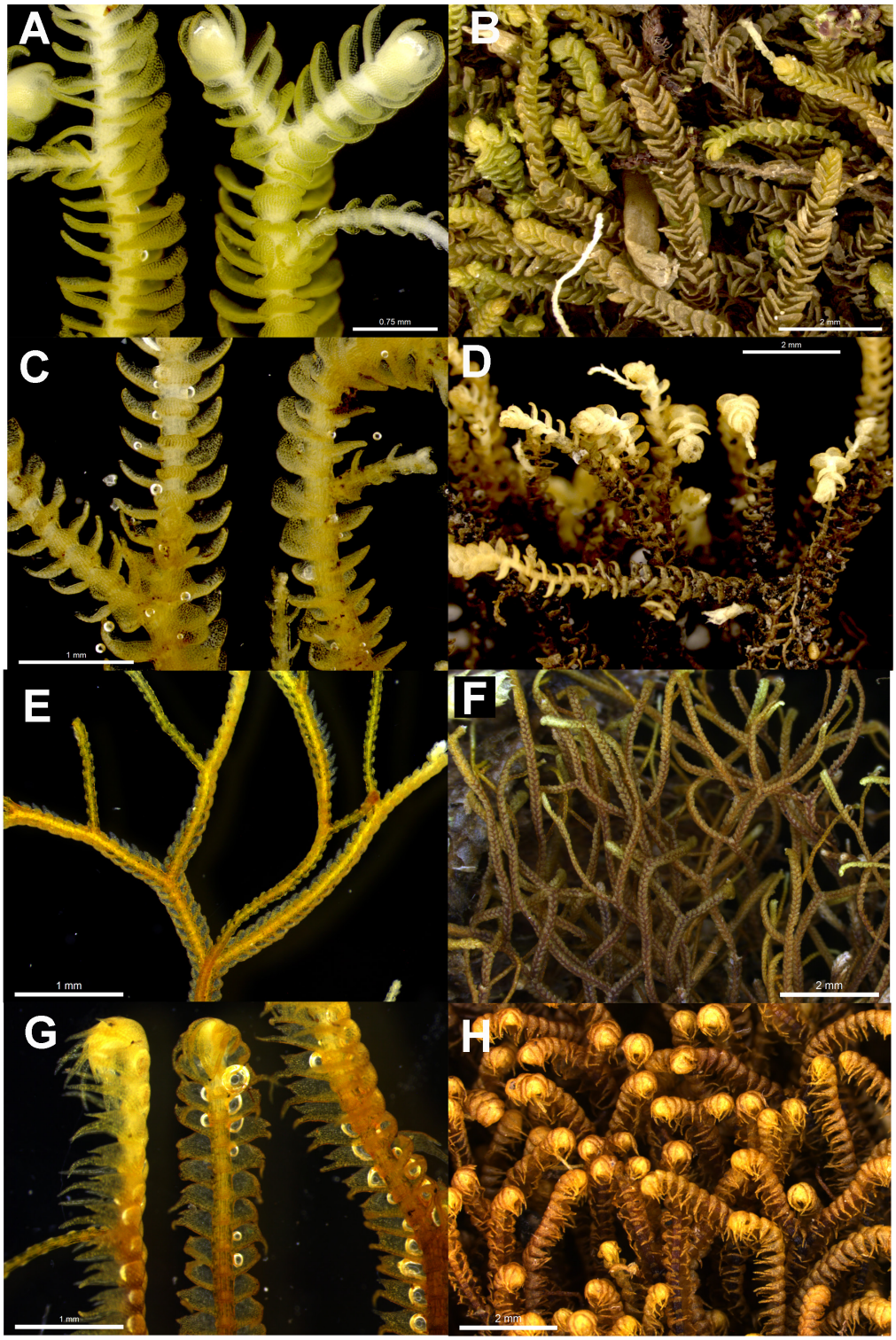


Fig. 1. Hydrated shoots in ventral view and dried specimens in dorsal view (except *A. mooreanum*) for Australasian *Acromastigum*. **A**, **B,** *A. cavifolium* (HO310141); **C**, **D,** *A. verticale* (HO571177); **E**, **F,** *A. tenax* (*Brown 12/321*); **G**, **H,** *A. mooreanum* (HO409665).

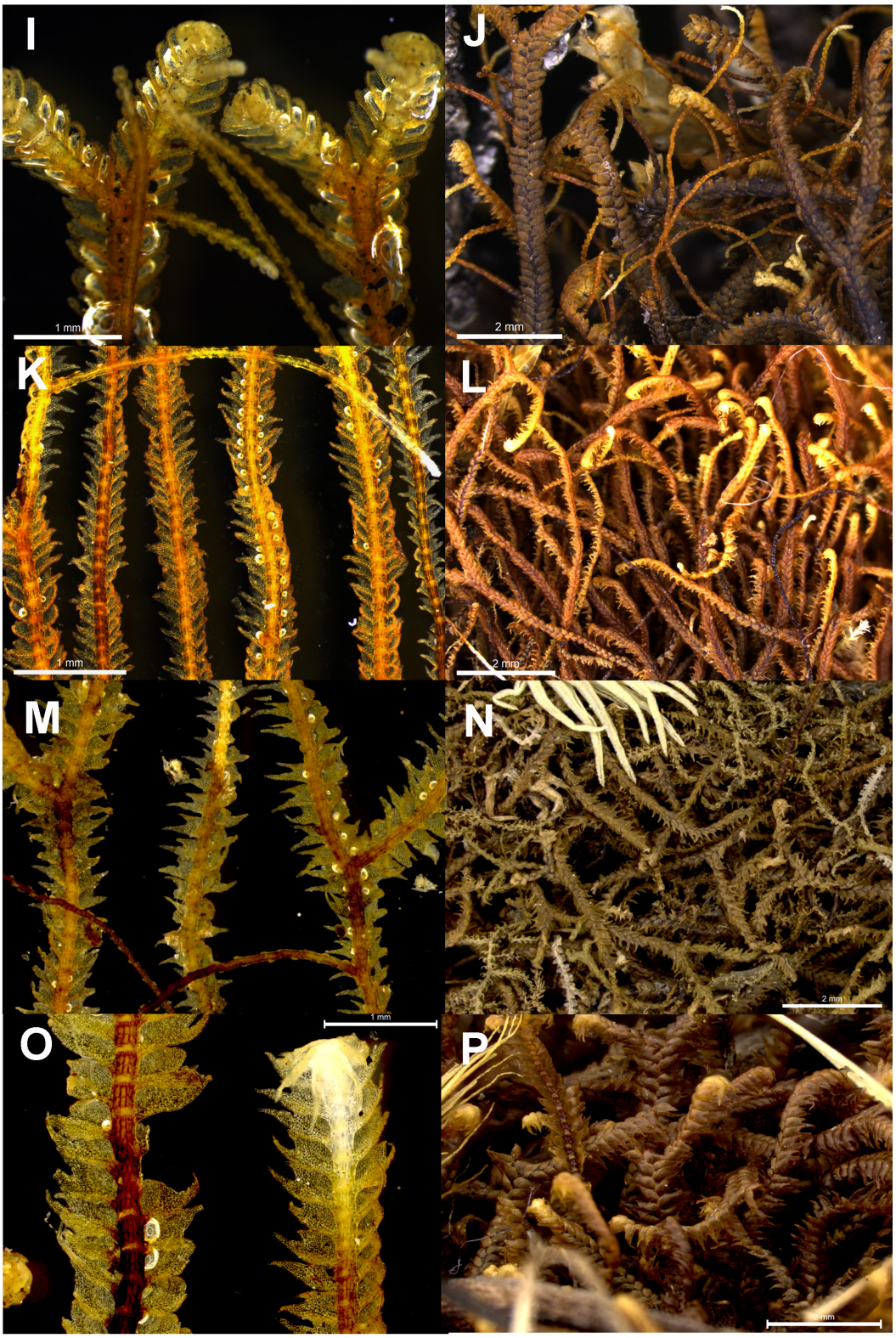


Fig. 1. cont. Hydrated shoots in ventral view and dried specimens in dorsal view; **I**, **J**, *A. anisostomum* (NSW745732); **K**, **L**, *A. interstisiale* (HO571028); **M**, **N**, *A. furcatifolium* (NSW299597); **O, P**, *A. fumosum* (HO443755).

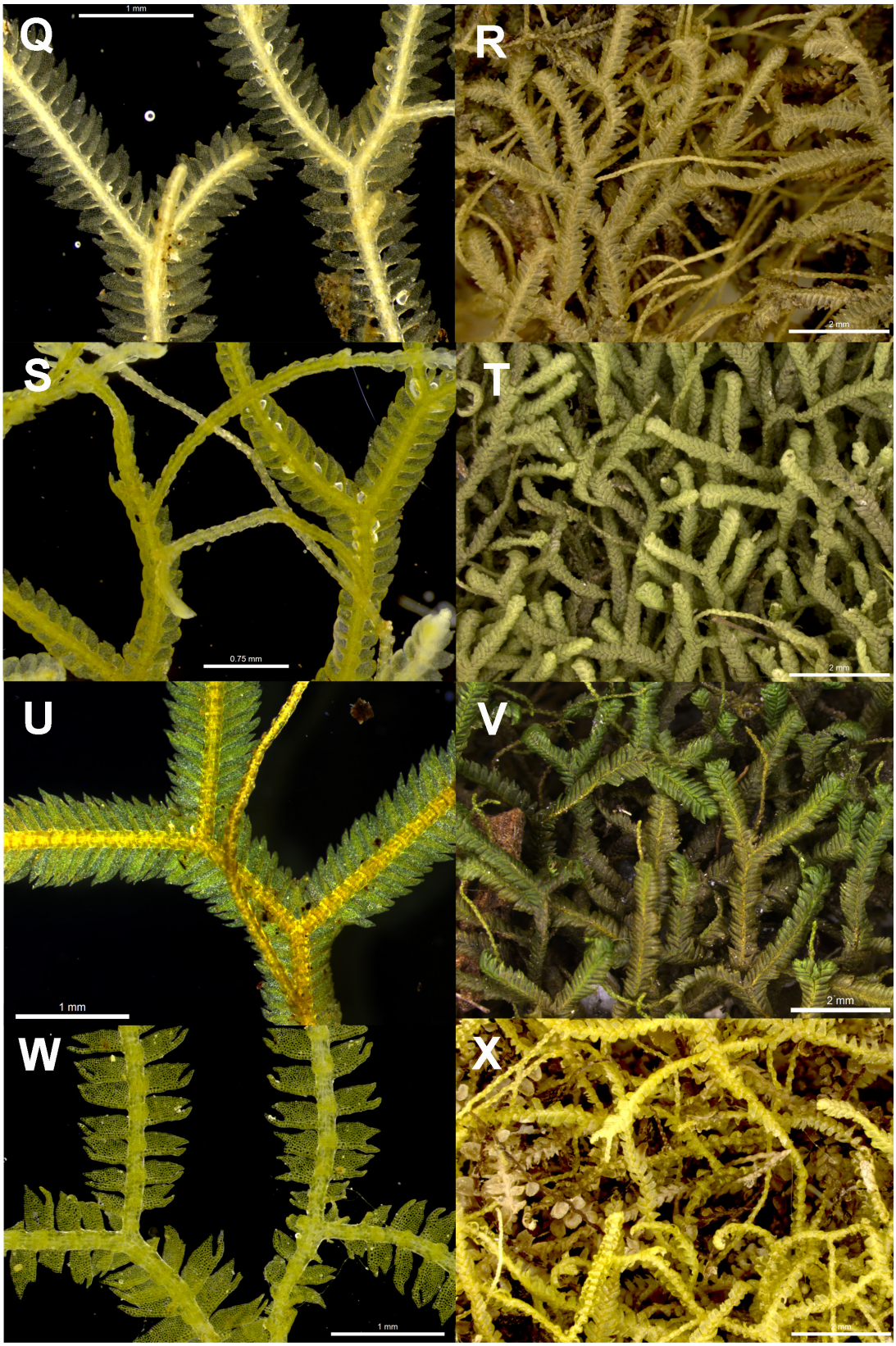


Fig. 1. cont. Hydrated shoots in ventral view and dried specimens in dorsal view; **Q, R**, *A. marginatum* (NSW745727); **S, T**, *A. exiguum* (NSW761322); **U, V**, *A. echinatiforme* (NSW896971); **W, X,** *A. cunninghamii* (NSW745790).

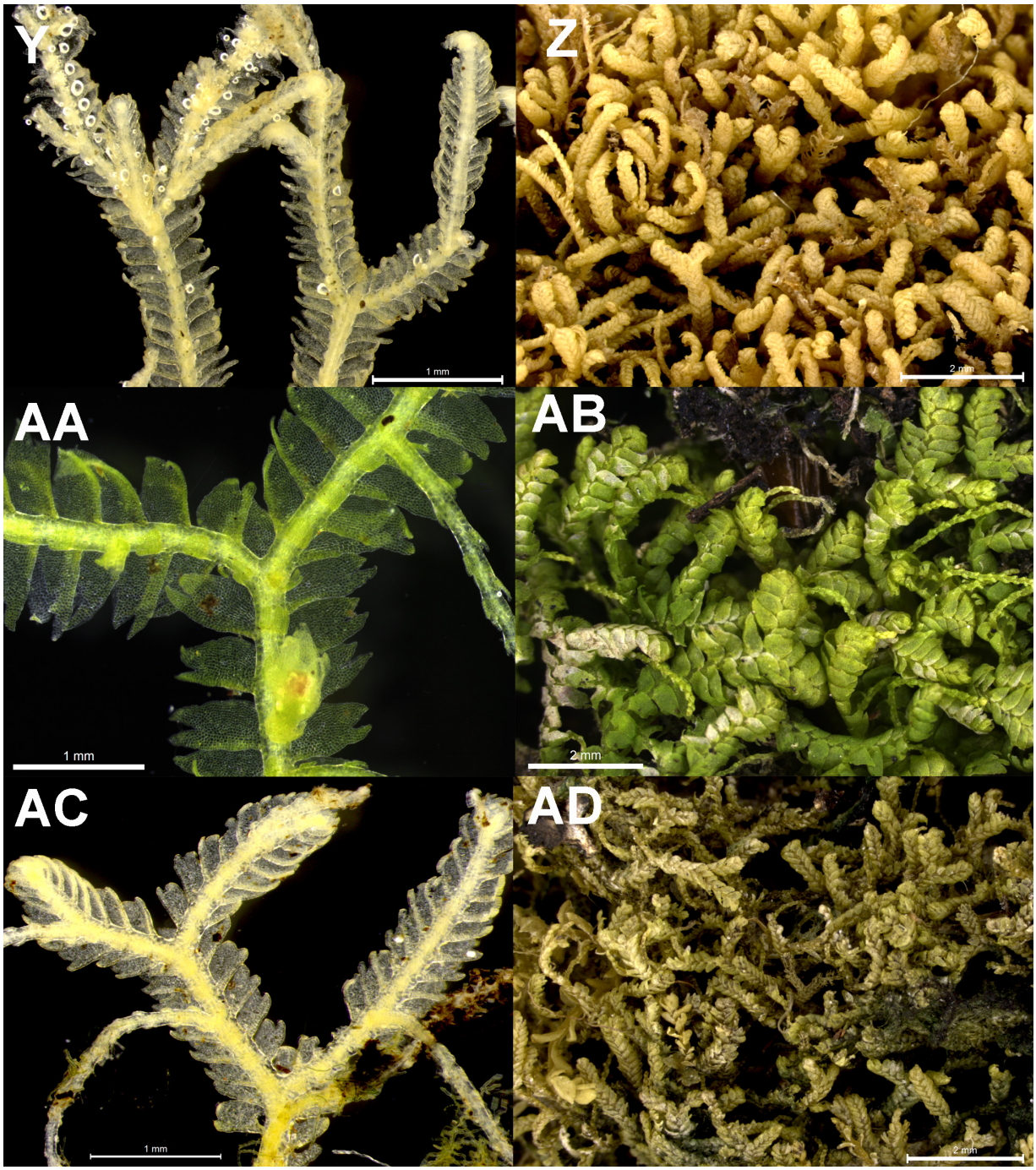


Fig. 1. cont. Hydrated shoots in ventral view and dried specimens in dorsal view; **Y, Z**, *A. prismaticale* (NSW365325); **AA**, **AB,** *A. colensoanum* (NSW262574); **AC, AD,** *A. divaricatum* (HO501795).

outer cell walls uniformly thickened or sometimes more strongly thickened in the middle, thus forming a projecting tubercle; cuticle smooth to minutely verruculose or striolate-verruculose. Underleaves large, transversely inserted, distant to slightly imbricate, apex 3-lobed or rounded to truncate or slightly emarginate; hyaline papillae present at apices of lobes, degenerating with age. Asexual reproduction by means of caducous leaves and underleaves in some species.

Dioicous, often sterile and rarely with sporophytes. Sexual branches ventral-intercalary, short, from the axis of underleaves, lacking vegetative leaves, not proliferating or with innovations. Androecia small, compact, spicate; bracts and bracteoles delicate, cell walls thin or only slightly thickened; bracts saccate, with strongly arched keel, connivent margins, apex bifid or bidentate; bracteole convex but not saccate, apex bifid or undivided (according to the condition found in the vegetative leaves). Gynoecia with bracts and bracteoles similar, imbricate, the innermost largest; bracts broadly ovate to lanceolate-ovate, apex variously laciniate or laciniate-ciliate (less so on outer bracts), with two main laciniae or divisions present in species with bifid leaves; cell walls slightly thickened (less so than in vegetative leaves). Perianth elongate, subfusiform-trigonous, terete below and cylindrical, trigonous above, gradually narrowed toward the mouth, unistratose above but often pluristratose below; mouth 3-lobed, the lobes variously laciniate or laciniate-ciliate, contracted; perigynium lacking. Sporophytes with seta usually consisting of c. 8 large epidermal cell rows and a medulla of smaller, more numerous rows of cells (c. 16). Capsule oblong-ovoid; walls usually 4–6-stratose; epidermal layer of relatively large rectangulate cells with longitudinal walls bearing coarse nodular, radial thickenings; innermost layer with transverse semiannular bands restricted to the inner tangential walls (or extending across inner tangential and both radial walls). Elaters slender, elongate, bispiral. Spores unicellular, green.

Type: *Acromastigum integrifolium* (Aust.) Evans

The genus *Acromastigum* is sister to the cosmopolitan and species-rich genus *Bazzania* S.F. Gray corr. Carr. (Cooper et al. 2011). The genus differs from *Bazzania* chiefly in the presence of *Acromastigum*-type branching and in morphological features of the stem i.e. the cortical cells in *Bazzania* are somewhat larger than the medullar ones but do not form a distinct hyalodermis and the number of longitudinal rows is indefinite but always more than seven. The species of *Bazzania* with tridentate leaves have no analogues in *Acromastigum*, and in species of *Bazzania* with bilobed leaves the lobes tend to be subequal in size. The scale-like leaves on the flagelliform branches are rarely bifid in *Bazzania* whereas this is the normal condition in *Acromastigum*.

Key to *Acromastigum* species of Australia and New Zealand

Diagnostic images for all species are presented in Figure 1. Species descriptions follow the order of presentation in the key. Scanning Electron Micrographs (SEMs) of leaf cell surfaces are presented in Figure 2 as a guide to surface ornamentation described in the key. In this figure some cell walls have been deformed during the alcohol-dehydration used to prepare samples. This may have obscured ornamentation that seems visible under light microscope, particularly on the dorsal surface of *A. interstisiale*. However, the SEMs do illustrate that the leaf surface of *Acromastigum* are often associated with various fungi, bacteria, diatoms, and other protists. This should be borne in mind when examining leaf surfaces for ornamentation. Species that occur in New Zealand but not Australia (e.g. *A. cunninghamii*) are also included to facilitate their recognition should they be collected in Australia.

1. Shoots isophyllous or subisophyllous. Leaves obscurely bilobed or unlobed 2
1. Shoots anisophyllous. Leaves bilobed, sometimes lobing indistinct (as in *A. exiguum* and *A. marginatum*) 3
2. Shoots creeping over substrate, isophyllous, leaves and underleaves unlobed and symmetric, plants epiphytic or lithophytic ..... *A. cavifolium* (Figs 1A, B)
2. Shoots erect, subisophyllous, leaves and underleaves obscurely bilobed and asymmetric, plants terrestrial, typically in wet sites ..... *A. verticale* (Figs 1C, D)
3. Plants tiny, orange-green to golden shoots c. 0.3 mm wide, leaves inconspicuous, imbricate and appressed to stem. Stem relatively large, c. 1/3 the shoot width. Underleaves unlobed to obscurely trilobed with lobes up to two cells high and two or three cells wide at base ..... *A. tenax* (Figs 1E, F)
3. Plants larger generally 0.5-1.9 mm wide though sometimes more, pale green, mid-green, yellow green, glaucous, or golden brown to brown often with a black pigmented stem, leaves conspicuous, remote to imbricate, widely spreading to appressed. Stem not so relatively large, usually less than a quarter of the shoot width. Underleaves distinctly or obscurely trilobed (as in *A. furcatifolium* and *A. interstisiale*), lobes more than two cells high and two or more cells wide at base 4

4. Plants brown pigmented. Stems brown or black. Branching infrequent and pseudodichotomous or not in which case the parent shoot is initially outwardly displaced by the branch but recovers its original trajectory. Antical leaf-lobe shorter than postical 5

4. Plants yellow or green pigmentated (brownish in older shoot sectors of *A. echinatiforme* but stems *yellow* in this species). Stems yellow green or green, not brown pigmented or black. Branching frequent. Branching frequent and pseudodichotomous. Antical leaf lobe more or less equal in length to postical (though shorter in *A. exiguum, A. marginatum* and *A. prismaticale*) 9

5. Leaves obliquely spreading. Postical half of insertion almost transverse. Leaves imbricate, closely set and overlapping. Mature stem sectors black 6

5. Leaves laterally spreading. Postical half of insertion longitudinal. Leaves contiguous to imbricate, but not close set and overlapping. Mature stem sectors dark brown 7

6. Dorsal leaf margin ampliate. Ventral lobe scythe-like, up to 1 mm long, curved outward in dry plants. Vitta conspicuous, separated from ventral leaf margin by 1 cell row, extending into ventral leaf lobe which is 2 or 3 cells wide at base ..... *A. mooreanum* (Figs 1 G, H)

6 Dorsal leaf margin not ampliate. Ventral lobe acuminate to obtuse, much shorter than 1 mm, not curved outward in dry plants. Vitta separated from leaf margin by 2-3 cells, extending into ventral leaf lobe or not, ventral leaf more than 2 cells wide at base ..... *A. anisostomum* (Figs 1 I, J)

7. Cell walls in vitta with trigones consistently bulging, separation between vitta and adjacent smaller cells sharp. Leaf disc 5-8 tiers of cells high to sinus apex (along vitta). Ornamentation on leaf surface (viewed with light microscope) of dense but indistinct papillae ..... *A. interstisiale* (Figs 1 K, L)

7. Cell walls in vitta with trigones bulging or not, vitta and adjacent smaller cells not sharply differentiated. Leaf disc 6-10 tiers of cells high to sinus apex (along vitta). Ornamentation on leaf surface (viewed with light microscope) indistinct, or if distinct (as in *A. furcatifolium*) the leaf-lobes widely spreading 8

8. Shoots to 0.7 mm wide. Leaf lobes widely divergent, sinus gaping. Leaf disc 6-8 tiers of cells high to sinus apex ..... *A. furcatifolium* (Figs 1 M, N)

8. Shoots to 2.0 mm wide. Leaf lobes spreading or convergent, not widely divergent. Leaf disc 9-10 tiers of cells high to sinus apex ..... *A. fumosum* (Figs 1 O, P)

9. Leaves ovate, postical margin with continuously curved outline, weakly bifid or entire 10

9. Leaves quadrate to rectangular, postical margin straight or irregular, bifid 11

10. Marginal cell wall of leaf much thicker than internal walls, up to (5)-7-12 μm wide, continuous around leaf margin ..... *A. marginatum* (Figs 1 Q, R)

10. Marginal cell wall not thicker than internal walls, up to 1-3-(5) μm wide ..... *A. exiguum* (Figs 1 S, T)

11. Underleaf width equal to or less than stem; plants with or without a distinct vitta; south eastern Rainforests in New South Wales, and Victoria; and Tasmania and New Zealand 12

11. Underleaves wider than stem; plants without a distinct vitta; Wet Tropics Bioregion Rainforests, Queensland ..... *A. echinatiforme* (Figs 1 U, V)

12. Vitta distinct, extending into ventral leaf lobe 13

12. Vitta indistinct or absent, not extending into the ventral leaf lobe 14

13. Leaves remote to contiguous, plane, spreading. Postical lobe displaced toward antical lobe in plane with disc, sinus frequently narrow, leaf resembling a flat crab claw ..... *A. cunninghamii* (Figs 1 W, X)

13. Leaves imbricate, concave, obliquely patent. Postical lobe curved ventrally, not in plane with disc, sinus wide, leaf not really resembling a crab claw ..... *A. prismaticale* (Figs 1 Y, Z)

14. Shoots up to 1.8 mm in width. Stems typically with more than seven rows of cortical cells .... *A. colensoanum* (Figs 1 AA, AB)

14. Shoots typically 0.7 mm in width. Stems with seven rows of cortical cells .... *A. divaricatum* (Figs 1 AC, AD)

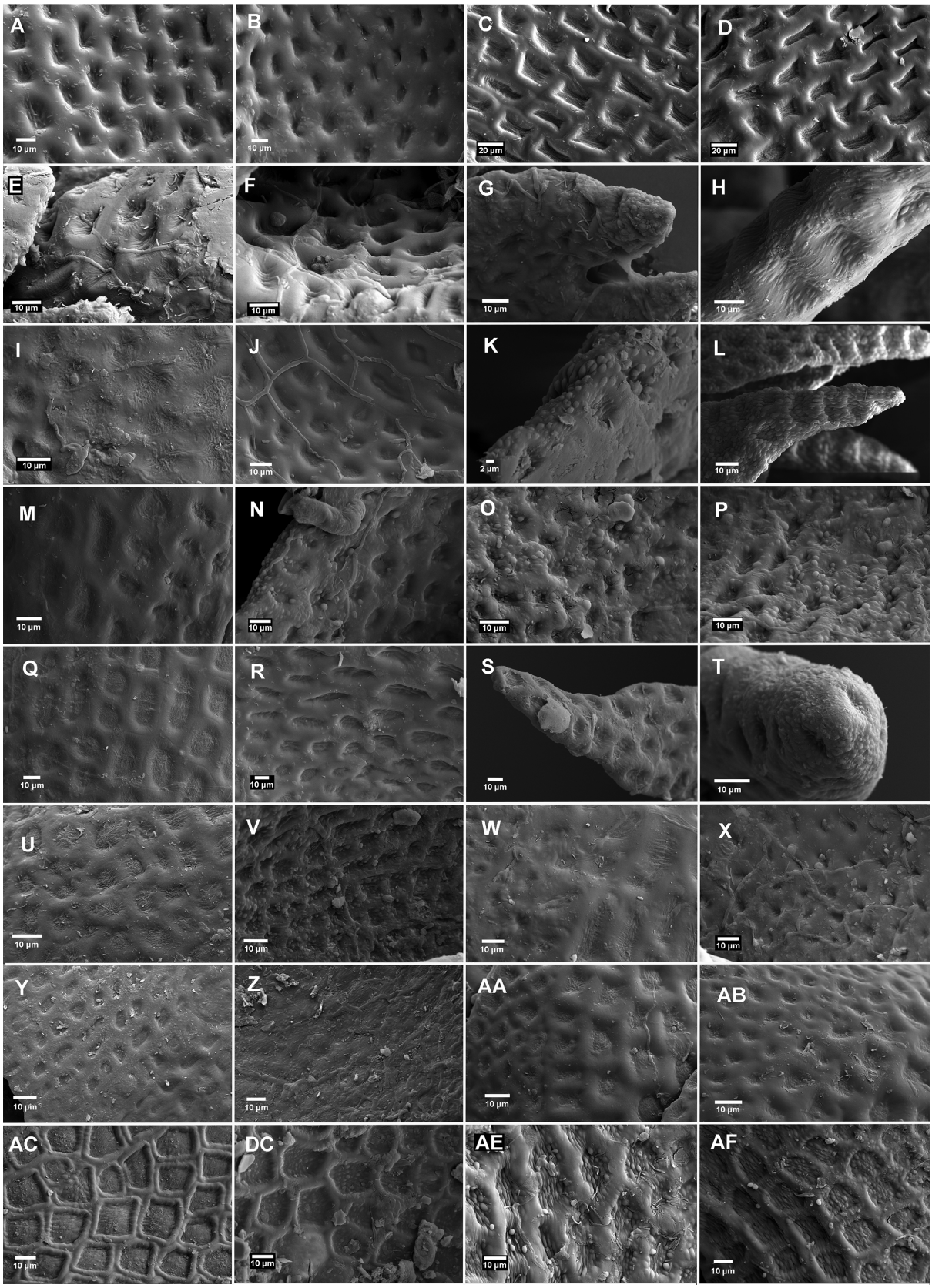


Fig. 2. Scanning Electron Microscope images of leaf surfaces for Australasian *Acromastigum*. *A. cavifolium* (HO310141) **A,** dorsal; **B,** ventral. *A. verticale* (HO571177) **C,** dorsal; **D,** ventral. *A. tenax* (*Brown 12/321*) **E,** dorsal; **F,** ventral; **G,** apex. *A. mooreanum* (HO409665) **H,** apex; **I**, dorsal; **J**, ventral. *A. interstisiale* (HO571028) **K,** apex; **M,** dorsal; **N,** ventral. *A. furcatifolium* (NSW299597) **L**, apex; **O**, dorsal; **P**, ventral. *A. fumosum* (HO443755) **Q**, dorsal; **R**, ventral; **S**, apex. *A. anisostomum* (NSW745732) **T**, apex; **W,** dorsal; **X,** ventral. *A. exiguum* (NSW761322) **U,** dorsal; **V**, ventral; *A. echinatiforme* (NSW896971) **Y,** dorsal; **Z,** ventral. *A. prismaticale* (NSW365325) **AA,** dorsal; **AB,** ventral. *A. colensoanum* (NSW262574) **AC,** dorsal; **DC,** ventral; *A. divaricatum* (HO501795) **AE,** dorsal; **AF,** ventral.

Acromastigum cavifolium R.M.Schust. *Journal of the Hattori Botanical Laboratory* 26: 257 (1963). Fig. 3.

Type: New Zealand, Stewart Island, crest of Tin Range, 5-6 miles NE of Port Pegasus, 14 Jan 1962, *R.M. Schuster 53119* (holotype: F; isotype: JE)

Acromastigum integrifolium sensu E.A.Hodgs. *Transactions of the Royal Society of New Zealand* 82: 18 (1954), non *A. integrifolium* (Austin) A.Evans

Usually in small tufts or patches, shoot tips bright yellow-green, older sectors tinged brown; erect to slightly arching; shoots 1.0–1.5 mm wide. Stems slender, filiform, wiry, mostly to 35 mm long by 325–380 μm in diam., c. 7 or 8 cells in diam.; cortical cells c. 1.5–2.5 × as long as wide, 80–130 μm long, 45–60 μm wide, 35–55 μm diam. and in 13-15 rows rather than the normal 7; medullar cells more elongate, c. 2.5–5.5 × as long as wide, 105–180 μm long, 30–45 μm wide, 14–30 μm in diam. (tapering somewhat at either end); both cortical and medullar cells thick walled, outer tangential surface of cortical cells usually thicker i.e. to 8 μm thick. Branches lateral, rather infrequent and distant, diverging at an angle of 50–70°; flagella sporadic (and occasionally intercalary). Rhizoids scarce. Leaves inserted on a nearly straight line, imbricate, slightly convex, usually rather widely spreading to squarrose (especially when dry), entire, ovate, ± symmetrical, 560–730 μm long × 500–585 μm wide, widest just above the slightly narrowed base; central region of leaf with slightly larger cells, forming an indistinct band 4 or 5 cells wide at base, tapering to 1 or 2 cells at apex; apex subacute to almost rounded. Cells of mid-leaf 40–75 × 25–40 μm, becoming smaller towards the margins, intermediate cells 25–50 × 25–35 μm, marginal cells 15–25 × 20–45 μm, subquadrate at margin to rectangular; trigones strong, often bulging and coalescing, margin of leaf thick walled; oil-bodies not observed; cuticle smooth. Underleaves imbricate, insertion transverse but sometimes the lateral margins slightly decurrent, somewhat spreading to almost squarrose, large (c. ¾ size of lateral leaves), 1.2–1.7 × as wide as stem, suborbicular, 270–545 μm long, 335–465 μm wide, not auriculate at base; apex truncate, subentire to emarginate, sinuses vestigal, lobes rounded. Asexual reproduction not observed. Androecial branches slightly stalked (c. 100 μm), sometimes developed in abundance; bracts very slightly bifid (<1/20) or entire, deeply saccate, rounded to bluntly acute, 1-androus, c. 440–490 μm long, 400–545 μm wide; bracteoles slightly emarginate (with papilla), ovate, 295–360 μm long, 280–360 μm wide. Gynoecia produced on short branches. Bracts and bracteoles similar, in several series, innermost largest, larger ones usually bisbifid, central sinus acute (30–40°) and split 1/3–1/2 length of bract, secondary lobes much smaller (<1/10 length of bract), ovate, margins with scattered 1- or 2-celled laciniae and papillae; cells rectangular to almost isodiametric, length:width ratio 1.2–4.8, corners rounded by small trigones; oil-bodies in scattered patches towards apex, 1–3 per cell, ± botryoidal, 2–5 μm diam., clear. Perianth c. 4 mm long when fully developed, slenderly ovoid-cylindrical, narrowed at mouth, 1-stratose throughout, cells rectangular to elongate-rectangular, length:width ratio 1.2–5.5, thick-walled, trigones present in mid and basal regions, tangential walls thickened in upper regions and up to 10 μm thick; oil-bodies present, particularly in mid-region of perianth, 1–4 per cell, spherical, 4–5 μm diam., clear. Sporophyte; seta with 12–14 rows of large, hyaline epidermal cells filled with numerous tiny oil-bodies (which may give the cells a dark appearance in transverse section) surrounding 15–18 rows of smaller interior cells; capsule inner layer with nodular thickenings and occasionally semiannular bands; epidermal layer similar. Spores 13–16 μm diam.

Variation: Individuals of *Acromastigum cavifolium* exhibit some variation in shoot stature and the size of associated leaves and underleaves. The only inter-individual variation observed during this study was in plant colour, which varies from golden-brown to green; apparently in association with sun exposure.

Distribution and ecology: *A. cavifolium* is found in Australia (Tasmania) and New Zealand (North and South Islands) and, like most *Acromastigum* species, is widespread but infrequently collected. Jarman describes Tasmanian *A. cavifolium* as an understorey epiphyte (Jarman and Fuhrer 1995) but the species has also been collected from damp soil and humus in seepage zones receiving a moderate amount of light (NSW285475); a microsite more typical of *A. verticale*.

In New Zealand *A. cavifolium* is almost always encountered as an epiphyte in cool hyperhumid forests where it inhabits bark of a wide range of species, including *Agathis australis*, *Manoao colensoi, Olearia colensoii* and beech species including *Nothofagus cliffortioides* and *N. menziesii*. It can be found growing with an equally diverse array of bryophytes including *Brevianthus flavus*, *Lepicolea attenuata*, *Radula multiamentula, Acrochila biserialis, Acroscyphella phoenicorhiza,* and species of *Chiloscyphus*, *Trichocolea*, *Telaranea*, *Lepidozia*, *Bazzania*, as well as with the fern *Hymenophyllum armstrongii*.

Recognition: The isophyllous shoots with nearly entire, triangular, concave leaves and underleaves in combination with the production of ventral flagelliform branches are distinctive within the Australasian bryophyte flora. *Acromastigum cavifolium* could only be confused with *A. verticale*, but the two species differ in microhabitat, shoot orientation, and leaf and underleaf shape. Generally *Acromastigum cavifolium* is an epiphyte or lithophyte whose isophyllous shoots grow horizontally along the substrate. *Acromastigum verticale*

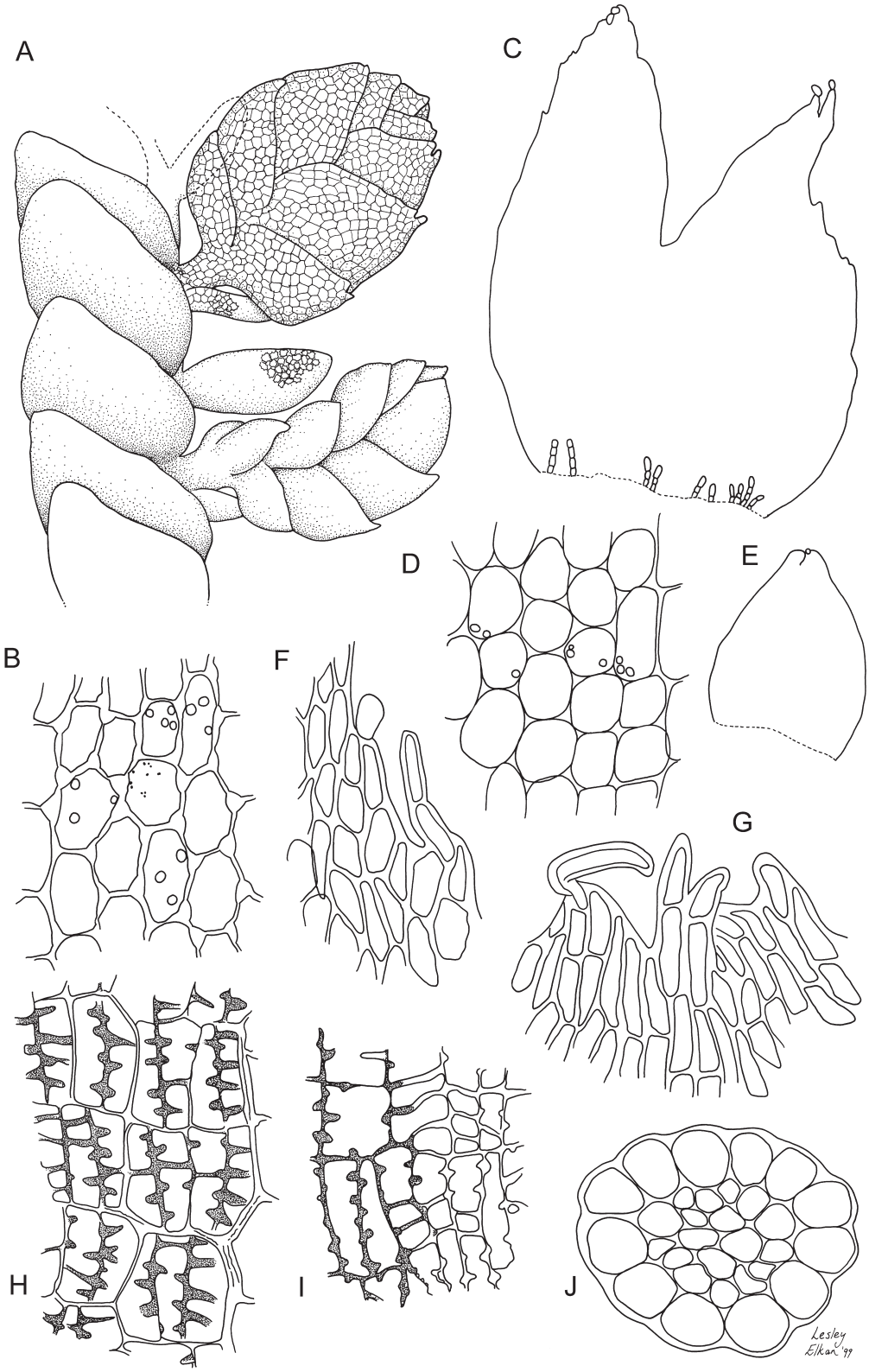


Fig. 3. *Acromastigum cavifolium*. **A,** shoot showing male branches. **B,** Basal leaf-cells. **C,** Female bract. **D,** Marginal leaf cells. **E,** Female bracteole. **F,** Apex of female bract lobe. **G,** Cellular detail of perianth mouth. **H,** Capsule epidermal layer. **I,** Capsule inner layer. **J**, Seta transverse section. Scale (approximate) **A,** 300 μm; B, D, F–H, I, J: 50 μm; **C**, **E,** 120 μm. From *Jarman 89/13* (HO).

is a terrestrial whose subisophyllous shoots grow erect from the substrate. Other characters by which the two species can be separated are presented in the key above.

Representative specimens examined: Australia: Tasmania, Central Highlands (Orchard): Mt. Kate, 41°37'S 145°58'E, 1120 m, 15 Apr 1996, *A. Moscal 28233A* (HO571027); South West: Anthony Road, 41°50.5'S 145°37'E, 550 m, 13 Nov 1992, *J. Jarman s.n.* (HO547163); Track of road to White Spur Dam, 41°53'S 145°31'E, 600 m, 24 Jan 1992, *J. Jarman s.n.* (HO310141); Scotts Peak Road, 42°49'S 146°23'E, 590 m, 19 Oct 2013, *J. Jarman s.n.* (HO571170); Mt Sprent, 42°47'S 145°58'E, 850 m, 5 Feb 1987, *J. Jarman s.n.* (HO571182); Schnell's Ridge, south of Mt Anne, 43°02'S 146°25'E, 14 Jan 1978, *A.V. Ratkowsky H834* (HO49566).

New Zealand: North Island: Auckland: Coromandel Ranges, Mt Moehau, E from trig, 36°32'17"S 175°24'59"E, 640 m, 3 Nov 1980, *E.K. Cameron s.n.* (AK323763); Coromandel Ranges, ridge SW of Mt Rowe along track to Mt Rowe, 37°2'16"S 175°40'19"E, 720 m, 26 Jun 2007, *M.A.M. Renner 2833* (AK300167); South Island, Western Nelson: Stockton mine area, Webb Stream, a tributary of Waimangaroa River, 41°40'12"S 171°52'53"E, 700 m, 5 Dec 2006, *J.E. Braggins 06/243A* (AK301604); J.E. Braggins 06/246A (AK301817); Upper Deep Stream, 41°42'33"S 171°50'23"E, 913 m, 6 Dec 2006, *J.E. Braggins 06/277A* (AK302280); Westland: Craigieburn, Craigieburn Road East, 42°14'S 171°38'E, 190 m, 28 Mar 2001, *M.A.M. Renner 200* (AK286367).

Acromastigum verticale (Steph.) E.A.Hodgs. *Transactions of the Royal Society of New Zealand* 82: 18 (1954). Fig. 4

Bazzania verticalis Steph. *Hedwigia* 32: 214 (1893).

Mastigobryum verticale Steph. *Species Hepaticarum* 3: 449. (1908).

Type: New Zealand**,** Great Barrier Island, without date, *Kirk 373* (G).

Usually in small tufts or patches or growing intermixed with other bryophytes, colouring probably similar to that of *A. cavifolium*, dried plants light golden brown to dark brown in older shoots; mature leafy shoots 0.9–1.6 mm wide. Stems slender, filiform, wiry, mostly to 20 mm long × 280–380 μm in diam., c. 7–9 cells in diam.; cortical cells c. 0.9–2.4 × as long as wide, 45–140 μm long, 45–60 μm wide, 33–75 μm in diam. and in 12 or 13 rows; medullar cells more elongate, c. 2.5–8.0 × as long as wide, 95–205 μm long, 25–45 μm wide, 20–40 μm diam. (ends usually slightly tapered to almost square); both cortical and medullar cells thick walled, outer tangential surface of cortical cells usually thicker i.e. 6–8 μm thick. Branches infrequent, postical or occasionally lateral (diverging at an angle of 50–70°); flagella sporadic to frequent (1–2 mm apart) and occasionally intercalary. Rhizoids scarce. Leaves inserted by a nearly straight line, imbricate, slightly convex to almost cucullate, usually rather widely spreading to squarrose (especially when dry) and not appearing particularly imbricate, entire or sometimes with a minute blunt tooth near apex, ovate, almost symmetrical to slightly falcate, often slightly obpyriform, 680–985 μm long × 405–775 μm wide, widest just above the slightly to distinctly auriculate base; central 4–6 rows of cells somewhat larger, reducing in size towards margins, tapering to 1–2 cells at apex; apex bluntly acute, often minutely toothed. Cells of central region 40–75 × 25–35 μm, intermediate cells 30–45 × 25–45 μm, marginal cells 15–30 × 25–40 μm, subquadrate to rectangular at margins to elongate hexagonal centrally; trigones strong, often bulging and sometimes coalescing, margin of leaf thick walled (to 8 μm); oil-bodies not observed; cuticle smooth. Underleaves imbricate, insertion transverse but lateral margins sometimes very slightly decurrent, spreading to almost squarrose (thus not appearing imbricate), large (c. ½–¾ size of lateral leaves), suborbicular to widely ovate, 335–600 μm long, 400–665 μm wide, subcordate at base; apex emarginate with sinus vestigal and lobes rounded or more rarely entire and rounded. Asexual reproduction not observed. Androecial branches sessile, each stem apparently only producing one per season (with 4 to 5 pairs of androecia); bracts very slightly bifid to simply lobed or toothed, saccate, bluntly acute, 1-androus, c. 350–400 μm long, 335–440 μm wide; bracteoles very slightly emarginate to rounded (with papillae), ovate to elliptic, 150–200 μm long, 145–160 μm wide.

Gynoecia produced on postical branches, sporadic. Bracts and bracteoles similar, in several series, innermost largest, largest ones usually bifid (with toothing that suggests may be bisbifid in some specimens), central sinus acute and split c. 1/10 length of bract, ovate to elliptic, with occasional 1-several celled teeth in upper portion of bract and papillae; cells ± rectangular to elongate-rectangular (some cells with tapered end walls), length:width ratio 1.5–7.3, scattered cells with moderately distinct trigones but most with walls only marginally thicker in corners: oil-bodies not known. Perianth c. 4 mm long when fully developed, slenderly ovoid-cylindrical, narrowed at mouth, 1-stratose throughout, cells ± elongate-rectangular, length:width ratio 1.7–3.5, thin-walled basally to thick-walled apically, small trigones present in mid and basal regions, inner tangential walls slightly thicker than radial walls and outer tangential distinctly thicker (to 10 μm thick); oil-bodies not known.

Sporophyte seta with 8 rows of large, hyaline epidermal cells (probably filled with numerous tiny oil-bodies) surrounding 16 rows of smaller interior cells; capsule walls 2 to 3 stratose. Inner layer of capsule with nodular thickenings and occasionally semiannular bands. Elaters c. 12 μm diam. Spores c. 12–14 μm diam.

Variation: No significant variation among individuals was noted.

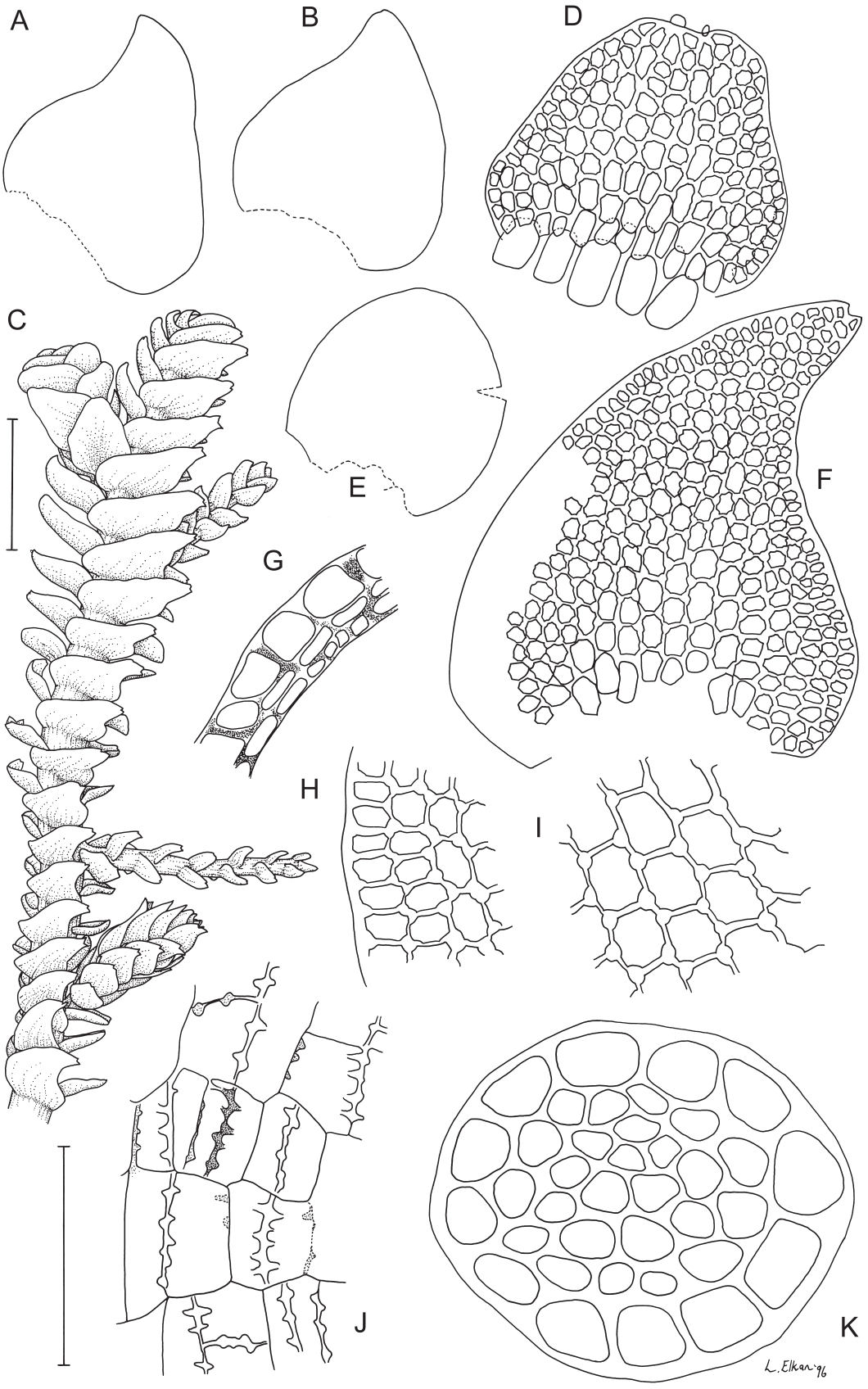


Fig. 4. *Acromastigum verticale*. **A–B,** Leaf outlines. **C,** Oblique view of shoot. **D,** Underleaf cellular detail. **E,** Underleaf outline. **F,** Leaf cellular detail. **G,** Transverse section of capsule wall. **H,** Leaf marginal cells. **I,** Leaf medial cells. **J**, Capsule epidermal layer. **K,** Stem transverse section. Scale (approximate) **A**, **B**, **E,** 800 μm; **C**, 2000 μm (larger); **D**, **F,** 500 μm; **G–K**, 100 μm.

Distribution and ecology: Australia (Tasmania) and New Zealand (South Island). On stream banks, on soil and rock within streams, and in moist depressions, typically in exposed situations associated with alpine scrub and shrublands.

Recognition: *Acromastigum verticale* can be recognised by the combination of erect growth habit, subisophyllous shoots with inconspicuously lobed leaves having an asymmetrical outline, and occupancy of terrestrial microsites. For additional characters differentiating *A. verticale* from the similar *A. cavifolium*, see couplet 2 in the key above.

Representative specimens examined: Australia: Tasmania: South West: Mt Sprent, 42°47'S 145°58'E, 600 m, 31 Jan 1987, *J. Jarman s.n.* (HO571177).

New Zealand: South Island: Western Nelson: Stockton Mine Area, A.J. Stream, tributary of Mangatini Stream, east of Burma Road, c. 2 km N of Mt Stockton, 41°38'S 171°55'E, 420 m, 5 Dec 2006, *J.E. Braggins 06/260C* (AK301930); *J.E. Braggins 06/267B* (AK301958); Rakiura (Stewart Island): near Pegasus Creek, 0.8–2.4 miles above junction with Pegasus Harbour, 15-70 m, 9–11 Jan 1962, *R.M. Schuster 59669* (F).

Acromastigum tenax (Steph.) A.Evans *Annales Bryologici***,** supplement 3: 41 (1934). Fig. 5.

Mastigobryum tenax Steph. *Species Hepaticarum* 6: 483 (1924).

Type: New Caledonia. "Lerat legit" (syntypes: G00043635, G00282570, G00282571, G00282572, PC0101826, PC0150628). Lectotypification of this species is required.

Forming small to moderate colonies, plants golden-green with lighter tips (drying bronze green); loosely adherent to substrate, attached primarily by geotropic stolons which grow into the substrate matrix; mature leafy shoots to 0.4 mm wide. Stems slender, 100–120 μm and c. 4 or 5 cells in diam.; cortical cells 1–2 × as long as wide, 25–60 μm long, 24–30 μm wide, c. 20–30 μm tangentially, free external wall heavily thickened up to 13 mm thick, radial walls moderately thick-walled with c. 3 μm thick, walls yellow-brown pigmented; medullar cells smaller diameter than cortical, walls yellow brown pigmented. Lateral *Frullania*-type branches, frequent, diverging at an angle of c. 80°; ventral *Acromastigum*-type branches produced at equal frequency, typically one per shoot between lateral branches. Rhizoids scarce. Leaves 140–180 μm long × 100–130 μm wide, broadly elliptic to slightly ovate, clearly incubously inserted on an oblique line to centre of stem, imbricate, convex, equally bilobed, lobes triangular, ventral lobe 50–70 μm long, 45–60 μm (3 or 4 cells) wide at base; dorsal lobe 45–70 μm long,

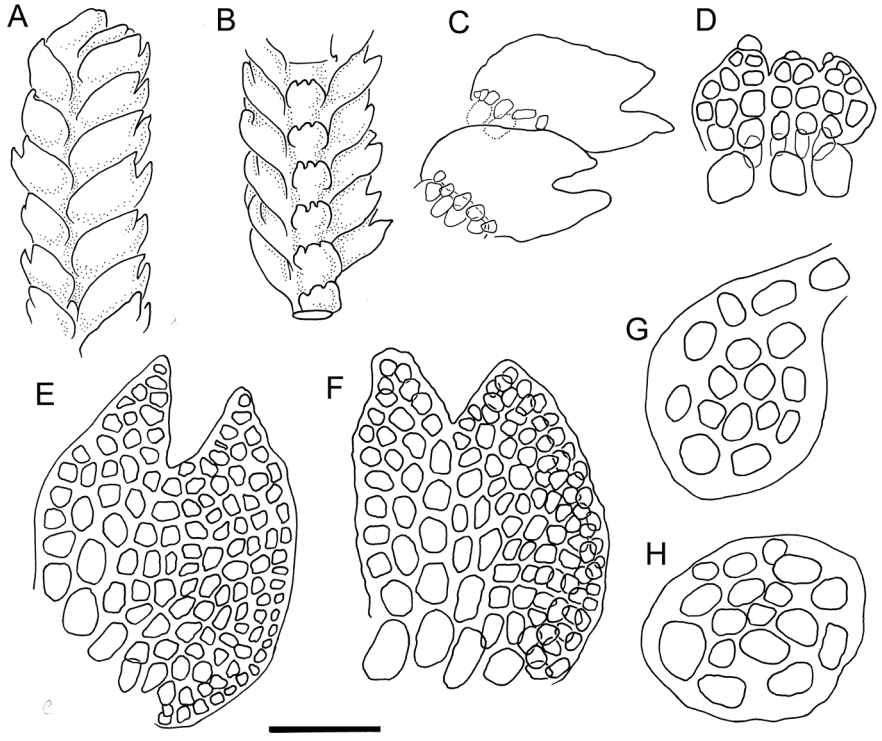


Fig. 5. *Acromastigum tenax*. **A,** Shoot dorsal view (scale bar 600 μm). **B,** Shoot ventral view. **C,** Two leaf outlines. **D,** Underleaf cellular detail. **E–F,** Two leaves showing cellular detail. **G–H,** Stem transverse sections. Scale (approximate) **A**, **B,** 250 μm; **C,** 100 μm; **D–H,** 50 μm. From *E.A. Brown 12/321*(NSW).

45–60 μm (4–6 cells) wide, apices obtuse, postical lobe apex sometimes rounded, sinus V-shaped, lobes swept forward toward shoot apex; Vitta indistinct, consisting of three irregular tiers of larger cells in the postical half of the leaf, running from the base into the postical lobe, cells progressively smaller from base to lobe apex, to 30 × 20 μm wide at base. Cells of antical half of leaf progressively smaller toward margin, where 4–8 × 4–8 μm, median cells 8–12 × 8–12 μm, subquadrate to rectangular, walls c. 2 μm thick including free external margin; oil-bodies not known; cuticle papillose, particularly toward lobe apices. Underleaves scarcely distant; insertion transverse, appressed, small (c. 0.25 size of lateral leaves), equal to or narrower than stem width; depressed ovate, 50–60 μm long, 80–105 μm wide, 3-lobed to entire, sinuses shallow and indistinct; apices of lobes truncate to rounded or sometimes slightly emarginate; lobes up to 2 cells long and 2 or 3 cells wide. Asexual reproduction not observed as Gynoecia and androecia not observed.

Variation: The degree to which underleaves are lobed is variable within and between individuals of *A. tenax*. The Australian specimen usually has distinctly three-lobed underleaves, whose lobes are 2 cell tiers high, and two or three wide at the base. However, it also produces underleaves whose lobing is indistinct, and rarely underleaves that are truncate with only two shallow indentations. In New Caledonian specimens examined, distinctly trifid underleaves are rare, most being unlobed or having indentations. Similar variation was observed by Evans in the type: 'The most typically developed underleaves… have two narrow and acute sinus at the apex, separating three low crenations less than two cells high, which are obtuse, rounded, or subtruncate. These crenations, which represent the divisions of species with trifid underleaves, are tipped with two cells side by side or more rarely a single cell' Evans (1934, p.43). Evans also noted that 'Underleaves of *A. tenax* are of unusual interest because they serve to bridge the gap between the trifid underleaves of typical *Inaequilatera* and the undivided underleaves of *Exilia*' (Evans 1934 p. 45). At the time of its publication *A. tenax* was known only from the type material. Additional specimens from New Caledonia and Australia extend the spectrum of variation in underleaf morphology exhibited by the species to include tri-lobed underleaves.

Distribution and ecology: New Caledonia and Australia. In Australia currently known from a single gathering made in the Wet Tropics Bioregion of north-east Queensland, at around 1000 m elevation.

Recognition: *Acromastigum tenax* is, within the Australian flora, readily recognised by its small size, small closely appressed and imbricate subequally lobed leaves, golden-brown colour, entire to shallowly lobed underleaves, and the relatively robust stems c. one third the shoot width. The underleaves are subrectangular to almost reniform, convex, and variously lobed, from distinctly trilobed with lobes two tiers high to entire. The vitta is indistinct, of three irregular tiers of larger cells in the postical leaf base.

Remarks: *Acromastigum tenax* was distinguished from *A. aurescens* by its undivided underleaves, as opposed to trifid underleaves by Evans (1934). However, only a single specimen of *A. tenax* was known to Evans at the time of his study. Subsequent collections from New Caledonia show a greater diversity of underleaf morphology than he was able to document, and undivided as well as distinctly trifid underleaves may be found within single plants, for example NSW611516. The underleaf character in Evans' key is, therefore, insufficient for separating *A. aurescens* and *A. tenax*. Other characters associated with underleaf shape, leaf shape, imbrication and orientation all provide better circumscription of two morphological groups. On the basis of these characters, Australian plants fit *A. tenax*.

Determinations by Kitagawa on syntype specimens suggest the 'original' material of *A. tenax* is a mixed gathering of *A. tenax* and *A. adaptatum*; lectotypification of *A. tenax* is therefore required.

Representative specimens examined: Australia: Queensland: Cook: track to Devils Thumb, 16°23'S 145°17'E, 1120 m, 28 Mar 2012, *E.A. Brown 12/321, V.C. Linis & M.A.M. Renner* (NSW).

New Caledonia: Province Sud: Creek Pernod, valley to SW of creek, southern most of three unburnt valleys, 22°12'27''S 166°50'24''E, 4 Nov 2003, *E.A. Brown 03/155, D.M. Crayn & C.J. Quinn* (F, NOU, NSW611516).

Acromastigum mooreanum (Steph.) E.A.Hodgs. *Transactions of the Royal Society of New Zealand* 82: 19 (1954) Fig. 6.

Bazzania mooreana Steph. *Hedwigia* 33: 1 (1894).

Mastigobryum mooreanum Steph. *Species Hepaticarum* 3: 539 (1909).

Type: Australia: Tasmania: South West: Jones Walk, North Sprent River, 600 feet, 1893, *J.B. Moore s.n.,* comm. F von Muller No. 65 (holotype: G00043634!).

Usually forming extensive colonies or occasionally in smaller tufts, plants golden brown; ± erect with apices slightly curled to somewhat arching; mature leafy shoots 1.2–1.5 mm wide (c. 2 mm when leaves flattened). Stems slender, filiform, wiry, mostly to 50 (–65) mm long (living area c. 10–15 mm) × 215–240 μm in diam., c. 6 or 7 cells

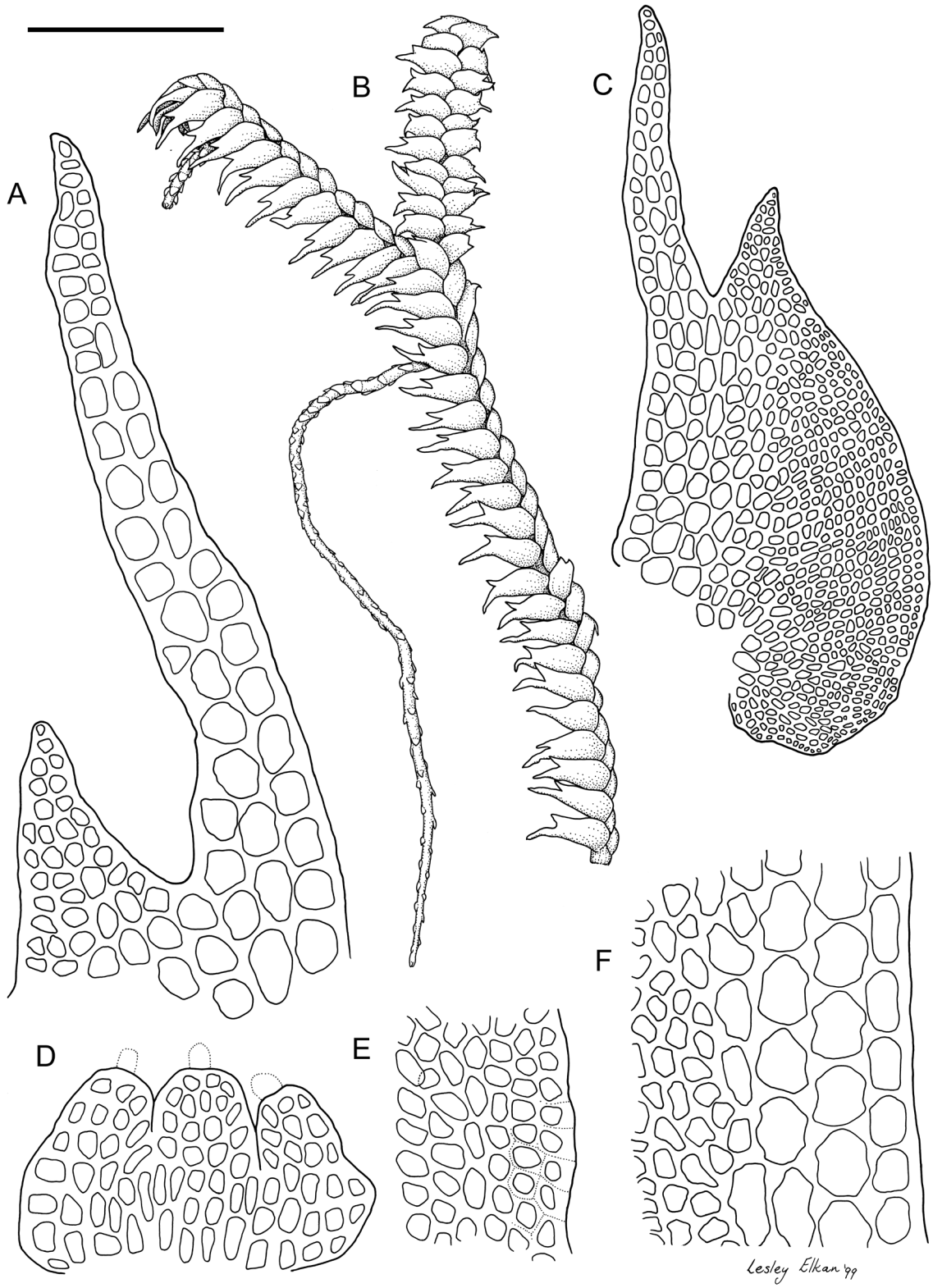


Fig. 6. *Acromastigum mooreanum*. **A,** Leaf apex. **B,** Oblique view of shoot. **C,** Leaf cellular detail. **D,** Underleaf cellular detail. **E,** Cells of antical leaf margin. **F,** Cells of postical leaf margin. Scale unknown. Scale (approximate) **A**, **D**, **E**, **F,** 100 μm; **B,** 2000 μm; **C,** 250 μm. From NSW285482.

in diam.; cortical cells c. 1.4–3.2 × as long as wide, 70–210 µm long, 50–75 µm wide, 20–50 µm diam.; medullar cells more elongate, c. 2–8(–13) × as long as wide, 130–240 µm long, 20–35 µm wide, 20–35 µm diam. (end walls squared to slightly tapered); cortical cells with brown pigmented walls and much thicker walled than medullar cells, with radial walls usually 4–6(–11) µm and outer tangential 10(–26) µm Branches lateral or occasionally postical, infrequent or more usually every 4–7 mm near tips, diverging at an angle of 45–90°; flagella scattered, 1 to often numerous (0.7–2.5 mm apart usually) per stem. Rhizoids scarce. Leaves inserted by an oblique line to centre of stem, imbricate, strongly convex and falcate, dorsally appressed to stem with the apices deflexed (often strongly so), 2-lobed (ventral always longer), (720–)880–1260 µm long × (290–)345–465 µm wide, widest just above the slightly narrowed base, dorsal base often slightly auriculate and ventral straight; distinct vitta present along ventral margin, 3 to 4 cells wide at base, cells reducing in size towards apex but larger cells usually extending into ventral lobe, marginal row of cells typically smaller but still forming part of vitta; ventral lobe (260–)380–580 µm long, 80–115 µm (3 cells, rarely 2 or 4) wide at base; dorsal lobe (65–)160–195 µm long, (55–)80–130 µm (4 to7 cells) wide at base; lobes acute. Cells of leaf largest in 'vitta'and becoming smaller towards the dorsal margin; vittate cells 25–70 × 25–45 µm, usually elongate hexagonal, trigones often obscuring shape and coalescing so cells have unevenly thickened walls; median cells 10–40 × 10–30 µm, radially or tangentially rectangular to ± isodiametric, c. 2 µm thick; marginal cells 10–20 × 10–25 µm, subquadrate, walls c. 2 µm thick, to 5 µm on margin; oil-bodies present in vitta, 1–6 per cell, globular to rarely ellipsoidal, granular, 1–10 µm long, 1–7 µm wide, rarely 1 or 2 present in scattered median cells; cuticle minutely papillate to striate towards apex of lobes. Underleaves distant, insertion ± transverse, appressed, small (c. 1/10 size of lateral leaves), as wide as or slightly narrower than stem, very widely depressed ovate, 100–145 µm long, 180–250 µm wide, not auriculate at base but often with marginal lobes or irregularities; 3-lobed, sinuses to c. 2/3 way; apices of lobes truncate, subentire to emarginate. Asexual reproduction not observed. Androecia, gynoecia and sporophytes not observed.

Variation: Individuals vary in shoot stature and size of associated leaves. Although the species is fairly consistent in morphology across its geographic range, specimens from 'hard' sites can bear smaller leaves whose postical lobe is not fully developed. These plants have a strong resemblance to *A. anisostomum*, and do not appear different from typical individuals of that species save two features: 1) the separation of the vitta from the postical leaf margin by a single row of smaller cells and 2) the narrower postical lobes than is typical of *A. anisostomum*.

Distribution and ecology: Australia (Tasmania) and New Zealand (South Island), common in cool hyperhumid environments in both countries, including forests and alpine zones. *Acromastigum mooreanum* is typically terrestrial, and may form large near-pure hummocks on raised microsites on the forest floor and at the base of large trees. It may also occur as a terrestrial in alpine habitats, in microsites such as seepages over soil and wet rock near streams. Occassionally *A. mooreanum* is an epiphyte, and has been collected on the trunks of *Nothofagus cunninghamii* with *Bazzania*, *Schistochila pseudociliata* and *Acrobolbus cinerescens*.

Identification: *Acromastigum mooreanum* is a distinctive species recognisable by its relatively large size (shoots up to 1.5 mm wide with leaves in natural conformation), with ventrally secund leaves whose postical lobe then spreads laterally *outward* below the stem. The postical lobe is lanceolate, almost scythe-like, and is comprised almost entirely of vitta cells. The vitta in the leaf disc is separated from the leaf margin by a single row of smaller cells only. The antical leaf margin is ampliate, and stems on mature shoot sectors are black.

Acromastigum mooreanum could be confused with *A. anisostomum* (here excluded from the Australian flora). In *A. mooreanum* the vitta is separated from the ventral margin by one row of smaller cells versus 2 or 3 cells in *A. anisostomum*. The vitta is 3 or 4 cells wide basally and narrows to two rows wide and continues into the ventral lobe, which is lanceolate in shape, often up to 1 mm long, and 2 or 3 cells wide at its base, versus 4 or 5 cells wide at the base of the leaf and narrows and becomes indistinct at or near the sinus between the postical and antical lobe, rarely if ever extending into the postical lobe in *A. anisostomum*. In *A. anisostomum* the postical lobe is triangular and up to seven cells wide at the base. *Acromastigum mooreanum* has been confused with *A. interstisiale*, for differences see the recognition section of the latter.

Remarks: Specimens collected by Whitelegge from Lane Cove and Balls Head Bay in the Sydney region are unusual because *A. mooreanum* is otherwise known in Australia only from Tasmania. Another species, *Lejeunea subelobata*, common in Tasmania was also recorded from Balls Head Bay in Sydney by Whitelegge (Renner 2013). These two geographic outliers, gathered by the same collector, are probably best explained as mislabellings of Tasmanian material.

Representative specimens examined: Australia: Tasmania: Central Highlands: Cradle Mt., 41°41'S 145°57'E, Dec 1915, *L. Rodway* (HO87430, HO88177, HO88179); West Coast: Highway B28, east of Mt Murchison, Quinn Creek, 41°50'S 145°37'E, 600 m, 20 Feb 1998, *J.E. Braggins 98/065D* (AK255757; HO); Anthony Road, track to Lake Selina, 41°52'29''S 145°36'42''E, 510 m, 4 Dec 1996, *L.H. Cave 069* (HO320171); Sorell River, 42°32'S 145°29'E, Feb 1900, *T.B. Moore* (HO87434); South West: Jacks Track forest trail, Strathgordon, c. 100 m from entrance to Lake Pedder Motel, 42°46'02''S 146°02'36''E, 7 Feb 1995, *E.A. Brown 95/13 & B.M.*

Wiecek (NSW365314); Road to Hartz Mountain, just outside boundary of National Park, 43°12'15'' S 146°47'15'' E, 520 m, 11 Dec 1990, *E.A. Brown 90/131a* (NSW277087); Clear Hill, 42°41'S 146°16'E, 1050 m, 12 Jan 2000, *J. Jarman s.n.* (HO501725); South West: Southwest Conservation Area, tributary of the Serpentine River, north of the Mount Sprent track, c. 1 km directly east-southeast of Serpentine Dam, 42 46 52 S 145 58 14 E, 620 m, 16 Jan 1994, *E.A. Brown 94/94 & K.L. Radford* (NSW285482); Mt Wedge, 42°51'S 146°18'E, 5 Mar 1978, *A.V. Ratkowsky H845* (HO49568); Jubilee Range, 42°52'S 146°32'E, 920 m, 7 Jan 1985, *A. Moscal 9180B* (HO570990); Howards Range, 41°54'S, 145°31'E, 590 m, 24 Jan 1992, *J. Jarman s.n.* (HO310142); Lake Skinner track, 42°57'S 146°41'E, 5 Feb 1978, *A.V. Ratkowsky H839* (HO49565); Lawson Range, 42°58'S 145°41'E, 480 m, 25 Jan 1986, A. Moscal 11935 (HO443753); Southwest National Park, Mt Norold, summit, 43°15'S 146°15'E, 970 m, 24 Feb 1994, *J. Jarman s.n.* (HO571168); Mt Hartz track, 43°15'S 146°46'E, Dec 1914, *L. Rodway* (HO87429; Adamson's Peak Track, 43°20'S 146°52'E, 19 Feb 1978, *A.V. Ratkowsky H841* (HO409664); South Cape Range, 43°33'S 146°39'E, 17 Mar 1983, *S.J. Jarman 929* (HO74708; Catamaran, Recherche, 43°34'S 146°53'E, 14 Jan 1911, *W.A. Weymouth 1216* (HO87431).

New Zealand: South Island: Western Nelson:Mt Augustus, 830 m, 15 Apr 2005, *D. Glenny 9430*, NSW745732; Stockton Mine Area, Ford Creek west of Burma Road, 41°40'12''S 171°52'53''E, 700 m, 4 Dec 2006, *J.E. Braggins 06/237C* (AK300456); Rakiura (Stewart Island): Rakiura National Park, Rocky Mountain summit, 46°51'42''S 167°56'48''E, 490 m, 26 Feb 2003, J.J. Engel 24326, *M.J. von Konrat & J.E. Braggins* (F1173766, NSW749366); Rocky Mountain, 46°52'S 167°57'E, 500 m, 9 Apr 2001, *M.A.M.Renner 01/163*, AK255205; Rakeahua River, Mt Rakeahua, track to summit N of Rakeahua River, 46°56'24''S 167°52'30''E, 500 m, 1 Mar 2003, *J.J. Engel 24502*, *M.J. von Konrat & J.E. Braggins* (NSW749373); Port Pegasus, 47°1'S 163°3'E, L. Cockayne 8283 (AK18693 as *A. anisostomum* det. A.W. Evans).

Acromastigum interstisiale E.A.Br. & M.A.M.Renner sp. nov. Figs 7, 8.

Diagnosis: Similar to *A. furcatifolium* but differs by its leaf margins lacking irregular obtuse projections and the leaf lobes not widely diverging to form a gaping sinus. Similar to *A. anisostomum* and *A. mooreanum*, but differs from both in its densely but obscurely papillose leaf surface; further distinguished from *A. anisostomum* by the relatively deeply divided leaves, where both antical and postical lobes are triangular and acuminate; and from *A. mooreanum* by the ventral lobe being 4-6 cells wide at the base (not 2-3) and spreading from the stem in plane with the leaf disc, not ventrally secund and scythe-like; and by the dorsal lobe margin not being ampliate.

Type: Australia: Tasmania: South West: near start of Pedder Track, lower slopes of Sentinel Range, near road to Strathgordon, near rocky outcrops c. halfway up, 42°52'15''S 146°12'22''E, 7 Feb 1995, *E.A. Brown 95/04 & B.M. Weicek* (holotype: NSW365295; isotypes: AK, CANB, HO).

Often forming extensive colonies or in smaller tufts, plants golden brown; ± erect with apices slightly curled to somewhat arching; mature leafy shoots 0.6–0.8 mm wide (c. 1.2 mm when leaves flattened). Stems slender, filiform, wiry, mostly to 25(–45) mm long × 240-250 µm diam., c. 6 or 7 cells in diam.; cortical cells c. 1.2–2.6 × longer than wide, 55–175µm long, 40–70 µm wide, 30–65 µm diam.; medullar cells more elongate, c. 7 × as long as wide, 175–210 µm long, 25–30 µm wide, 15–30 µm diam. (end walls squared to slightly tapered); cortical cells with brown pigmented walls and much thicker walled than medullar cells with radial walls to 12 µm and outer tangential to 28 µm (<5 µm in places). Branches lateral or occasionally postical, infrequent or more usually every 2–3 mm near tips, diverging at an angle of 60–70°; flagella scattered, 1 to several per stem. Rhizoids scarce. Leaves inserted by an oblique line to centre of stem, distant (particularly near base of plant) to somewhat imbricate, strongly convex and falcate, dorsally appressed to stem with the apices deflexed (often strongly so), 2-lobed (ventral always longer), 455–600 µm long × 325–345 µm wide, widest just above the slightly narrowed base, dorsal base often slightly auriculate and ventral often bulging slightly; vitta present 1 to 2(or 3) cells in from ventral margin, 4–6 cells wide at base and usually indistinguishable at sinus; ventral lobe 175–275 µm long, 85–105 µm (4 cells) wide at base; dorsal lobe 100–115 µm long, 80–100 µm (4 to 6 cells) wide at base; lobes acute. Cells of leaf largest in vitta and becoming smaller towards the margins; vittate cells 35–55 × 30–45 µm, quadrate, trigones bulging; median cells 20–35 × 10–25 µm; marginal cells 10–20 × 10–15 µm, subquadrate, thick walled, often 4 or 5 cells deep at dorsal base; oil-bodies not seen; cuticle densely papillose, to 6 µm thick at margins. Underleaves distant, insertion ± transverse, appressed, small (c. ⅕ size of lateral leaves), as wide as or slightly narrower than stem, very widely ovate, 95–155 µm long, 160–240 µm wide, not auriculate at base but often with marginal lobes or irregularities; 3-lobed, sinuses to c. ½ way; apices of lobes truncate, subentire to emarginate. Asexual reproduction not observed.

Androecial branches tiny, inconspicuous, rarely more than 1 or 2 per stem; bracts bifid ⅖–½ length, 1-androus, deeply saccate, c. 200–290 µm long and 185–295 µm wide, lobes acute; bracteoles ovate, c. 90–150 µm long and 55–90 µm wide, acute to ± truncate (with papilla). Gynoecia uncommon. Bracts and

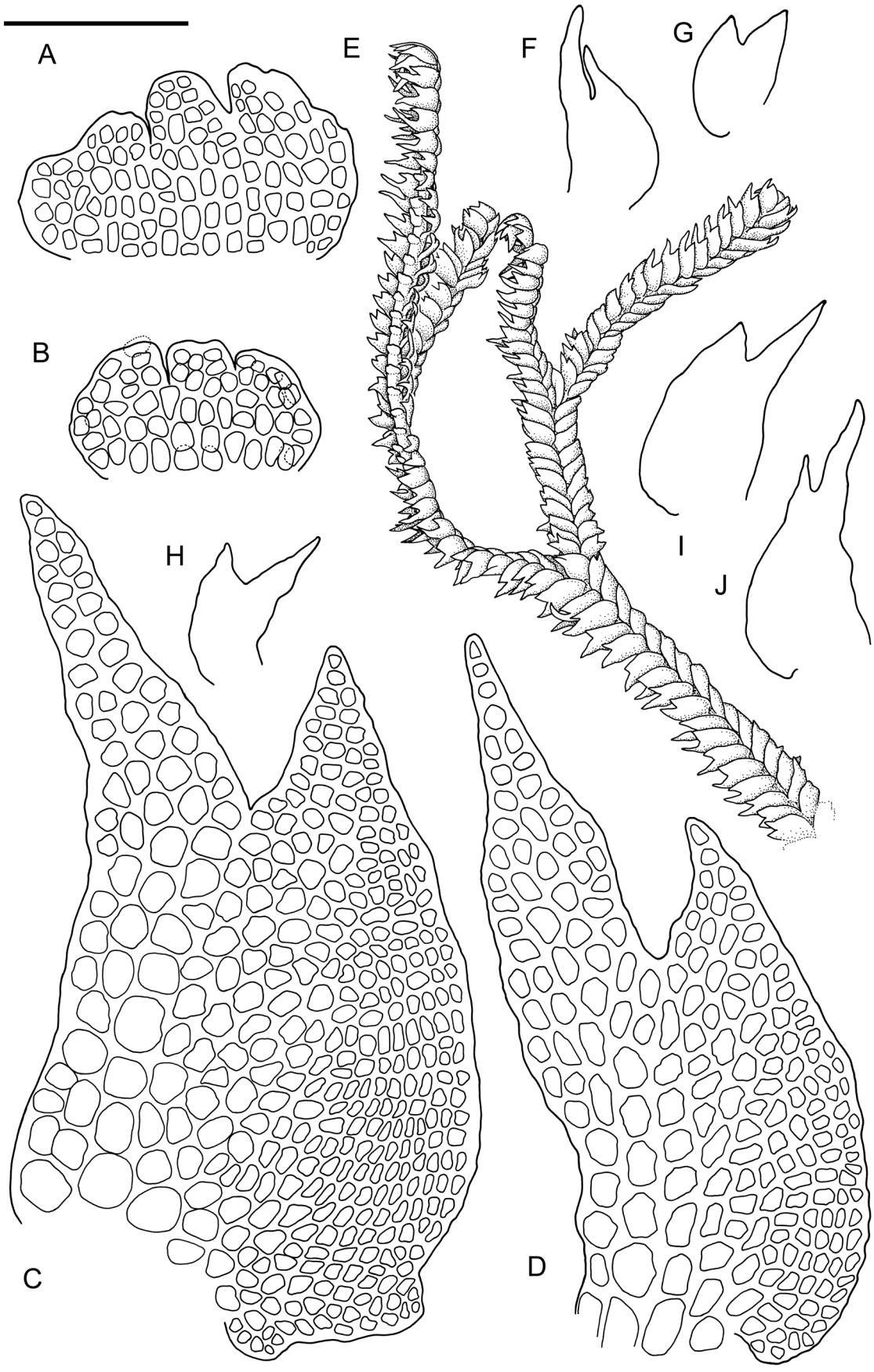


Fig. 7. *Acromastigum interstisiale*. **A–B,** Underleaves cellular detail. **C–D,** Leaves cellular detail. **E,** Lateral-oblique view of shoot. **F–J,** Leaf outlines. Scale (approximate) **A–D,** 100 µm; **E,** 2000 µm; **F–J**, 500 µm. From *E.A.Brown 90/216, Ratkowsky 78/33, Maxal 24205*.

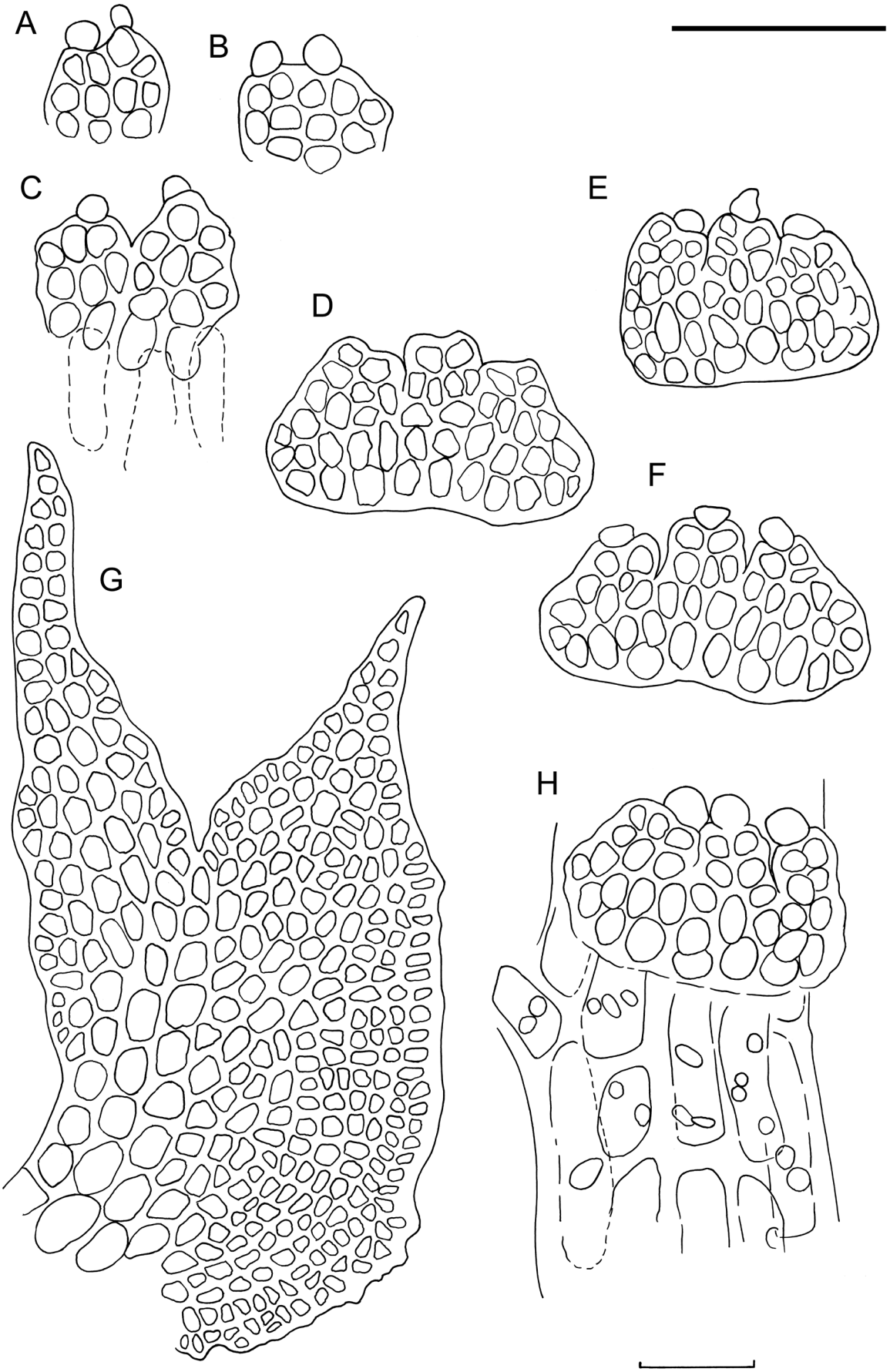


Fig. 8. *Acromastigum interstisiale.* **A–B,** Underleaves from stolon. **C,** Leaf from stolon. **D–F,** Underleaves from normal shoot cellular detail. **G,** Leaf cellular detail. **H,** Underleaf *in situ* cellular detail. Scale (approximate) **A–H,** 100 μm. From *E.A.Brown 90/216, Ratkowsky 78/33, Maxal 24205*.

bracteoles dissimilar, in several series, innermost largest. Bracts bifid, central sinus 0.6–0.7 length of bract, broadly ovate, margins smooth or with occasional papillae or cell protruding slightly; cells ± rectangular to isodiametric, 1.1–2 × longer than wide, moderately thick-walled, lacking trigones; oil-bodies unknown. Bracteoles entire, ovate to acuminate, otherwise similar to bracts. Perianth c. 3 mm long when fully developed, slenderly ovoid-cylindrical, narrowed at mouth and strongly plicate and not strongly 3-lobed, 1-stratose throughout, cells elongate or often ± isodiametric near mouth, 0.9–3.3 × longer than wide, thick-walled (radial walls c. 3 μm and tangential often more, to 10 μm on outer tangential).

Etymology: of small narrow spaces, in reference to its occupancy of the narrow morphological space between *A. anisostomum*, *A. fumosum*, A. *furcatifolium*, and *A. mooreanum*.

Distribution and ecology: Australia (Tasmania) and New Zealand (South Island). Widespread in montane forests and subalpine shrublands in the wetter parts of Tasmania, particularly in the west and south (Fig. 9). It appears to be the most common species of *Acromastigum* in subalpine and alpine South West National Park. In New Zealand *A. interstisiale* occurs on the Stockton Plateau. *Acromastigum interstisiale* grows in a range of predominantly terrestrial microhabitats, including on the ground beneath shrubs (such as *Leptospermum*) and trees (such as *Lepidothamnus* (New Zealand only), *Banksia* (Australia only)) in forest up to 10 m tall; on exposed rock and stream side banks and boulders; on banks in forest and shrubland; and on rock overhangs.

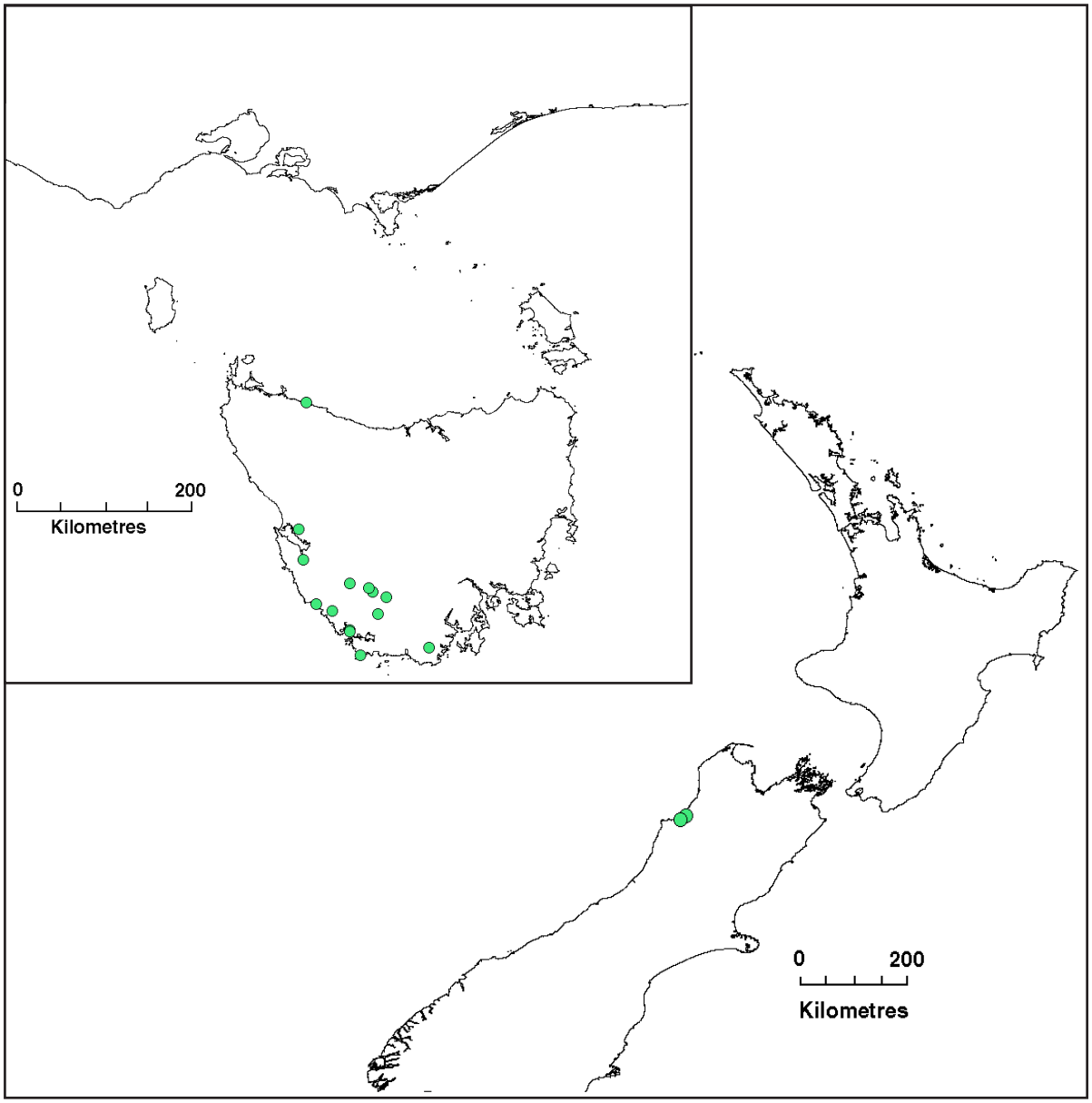


Fig. 9. Distribution of *Acromastigum interstisiale* in Tasmania, Australia (top left), and in South Island, New Zealand.

It grows in association with a wide range of bryophyte and fern species, and may occur admixed with *A. mooreanum* and *A. fumosum* in Tasmania, and with *A. anisostomum*, *A. marginatum*, and *A. mooreanum* in New Zealand.

Recognition: *Acromastigum interstisiale* has been confused with *A. anisostomum* and *A. mooreanum* in Australia, and with *Acromastigum brachyphyllum* (synonymised with *A. anisostomum* in this treatment), *A. anisostomum* and *A. mooreanum* in New Zealand. *Acromastigum interstisiale* differs from *A. anisostomum* in its deeply lobed leaves, whose postical lobe is broadly triangular, and in the cell surfaces covered by dense but indistinct ornamentation. *Acromastigum interstisiale* differs from *A. mooreanum* by postical leaf lobe being 4 to 6 cells wide at the base, and more than 2 cells wide for around half its length, and by the smaller vitta cells in the leaf disc and postical lobe, by the postical lobe not being scythe shaped and reflexed laterally outward when dehydrated, and by the leaf lobe cell surfaces being covered by dense but indistinct ornamentation. *Acromastigum interstisiale* differs from *A. furcatifolium* by its leaf margins lacking irregular obtuse projections, particularly on the postical margin, by the sinus narrowing gradually and having an acute apex, rather than widening between the lobes and having an obtuse apex.

Remarks: Specimens of *A. interstisiale* have been identified as *A. anisostomum*, *A. brachyphyllum* (in New Zealand) or *A. mooreanum*. Rodway (1917) and Evans (1934) were both of the opinion that *A. mooreanum* represented a robust form of *A. anisostomum*, and this confusion appears partly due to the existence of the third unrecognised and undescribed species presented here as *A. interstisiale*. Evans discussed variation within *A. anisostomum* and differences between it and *A. mooreanum* at length, and concluded that although the differences might seem significant they are 'bridged over' by some specimens. Evans' objections to the separation of *A. anisostomum* and *A. mooreanum* were based on continuity between the two species manifest in Cockayne's specimens collected on Stewart Island, within which Evans found the number of cells separating the vitta from the leaf margin varied, and hence he concluded that no consistent differences in leaf lobe width or shape existed. Evans therefore felt justified to follow Rodway in regarding *A. mooreanum* as a synonym of *A. anisostomum*. He made this clear in literature and in a letter to E. A. Hodgson, where he wrote "my first acquaintance with *Bazzania mooreana* came from a specimen collected in Tasmania. It certainly looked very different from the ordinary forms of *B. anisotoma* and I thought at first that Stephani was right in separating it as a distinct species. Cockaynes' [sic] specimens from Stewart Island however merge over the gap between the Tasmanian specimen and the usual form of *B. anisostoma*. I feel convinced therefore that Rodway was right when he interpreted *B. mooreana* as a form of *B. anisostoma*". This excerpt from a letter sent by Evans to Hodgson was included on a note within a specimen of *A. mooreanum* (det. *A. anisostomum*) from Stewart Island collected by Cockayne (AK18693), transcribed by Hodgson (M.A.M.Renner pers. obs.). Evans refers to Cockayne specimens, but we have seen only one specimen held in AK, which is *A. anisotomum*. We have not seen the specimens cited by Evans held in A and Y. However, from Evans' figures (1934 Fig. 10) it is likely that these specimens contain a mixture of *A. anisostomum*, *A. interstisiale* and *A. mooreanum*. Two of the leaf outlines illustrated (Evans 1934, Figs 10 C, B) are consistent with *A. anisostomum* as are the figures of cellular detail, while the third leaf outline (A) is consistent with *A. interstisiale*. Figure 11 in Evans (1934) accurately illustrates differences in leaf and lobe shape between *A. interstisiale* (the Oldfield collection from Tasmania) and *A. anisostomum* (the other two collections from New Zealand). That few specimens of these three species were available to Evans for study may have contributed to his missing the subtle differences in leaf and lobe shape, vitta, and cell surface ornamentation separating them. The similarity between *A. interstisiale* and both *A. furcatifolium* and *A. fumosum* is discussed further in the remarks under those species.

Representative specimens examined: Australia: Tasmania, North West: Cathedral Rocks, 40°53'S 145°31'E, 40 m, 21 Sep 1992, *A. Moscal 24205* (HO443744); West Coast: 3 km south Teepookana Bridge, 42°13'S 145°26'E, 220 m, 8 Nov 1990, *J. Jarman s.n.* (HO525959); Sorell River, 42°32'S 145°29'E, Feb 1900, *L. Rodway 212a* (HO87427 as *B. mooreana* det. Stephani); Sorrell River, 42°32'S 145°29'E, Feb 1900, *W.A. Weymouth & T.B. Moore* (HO88180 as *B. anisostoma* det. Stephani); South West: tributary of Serpentine River, north of the Mount Sprent track, c. 1 km directly ESE of Serpentine Dame, 42°46'52''S 145°58'14''E, 620 m, 16 Jan 1994, *E.A. Brown 94/96 & K.L. Radford* (NSW285485); Mt Cullen, 42°50'S 146°10'E, 366 m, 4 Mar 1978, *A.V. Ratkowsky H842* (HO409670); Mt Cullen, summit area, 42°50'S 146°10'E, 720 m, 13 Apr 1986, *A. Moscal 12881C* (HO443746); Southwest National Park, side of Celtic Hill, Scotts Peak Road, 42°55'39''S 146°21'00''E, 440 m, 13 Dec 1990, *E.A. Brown 90/216* (NSW277323); Elliot Hill, 43°00'S 145°37'E, 205 m, 17 Jan 1986, *A. Moscal 11788* (HO443752); Mt Gaffney, 43°04'S 145°47'E, 480 m, 14 Jan 1986, *A. Moscal 11700B* (HO443754); Arthur Plains, 43°06'S 146°16'E, 250 m, 15 Feb 1996, *A. Moscal 28039A* (HO571028); Coffin Bay, Port Davy, 43°16'S 145°58'E, 6 m, 5 Jan 1987, *A. Moscal 13804A* (HO443747); Coffin Bay, Port Davy, 43°17'S 145°58'E, 2 m, 11 Jan 1987, *A. Moscal 13886B* (HO443751); Moonlight Flats, 43°27'S 146°48'E, 3 Mar 1989, *J. Jarman s.n.* (HO501750); Wilson Bight, 43°32'S 146°05'E, 40 m, 13 Jan 1987, *A. Moscal 13952B* (HO443750).

New Zealand: South Island: Western Nelson: A.J. Stream, tributary of Mangatini Stream, east of Burma Road, c. 2 km N of Mt Stockton, 41°38'S 171°55'E, 420 m, 5 Dec 2006, *J.E. Braggins 06/267H* (AK301964); Stockton mine area, A.J. Stream north

side near junction with Mangatini Stream, 41°40'12''S 171°52'53''E, 510 m, 5 Dec 2006, *J.E. Braggins 06/265A* (AK300461); Ford Creek west of Burma Road, 41°40'12''S 171°52'53''E, 700 m, 4 Dec 2006, *J.E. Braggins 06/265B* (AK300462); Ford Creek west of Burma Road, 41°40'12''S 171°52'53''E, 700 m, 4 Dec 2006, *J.E. Braggins 06/237A* (AK300454); Ford Creek west of Burma Road, 41°40'12''S 171°52'53''E, 700 m, 4 Dec 2006, *J.E. Braggins 06/233C* (AK300453 p.p.); Ford Creek west of Burma Road, 41°40'12''S 171°52'53''E, 700 m, 4 Dec 2006, *J.E. Braggins 06/231B* (AK300450); Ford Creek west of Burma Road, 41°40'12''S 171°52'53''E, 700 m, 4 Dec 2006, *J.E. Braggins 06/231A (AK300449)*; Plover Stream SE of Burma Road, 41°40'12''S 171°52'53''E, 720 m, 5 Dec 2006, *J.E. Braggins 06/254A* (AK300457); Plover Stream SE of Burma Road, 41°40'12''S 171°52'53''E, 720 m, 5 Dec 2006, *J.E. Braggins 06/256A* (AK300459); c. 0.5 km below Denniston under power pylons above road, 41°44'S 171°47'S, 530 m, 2 Dec 1998, *J.E. Braggins 98/502C* (AK254180).

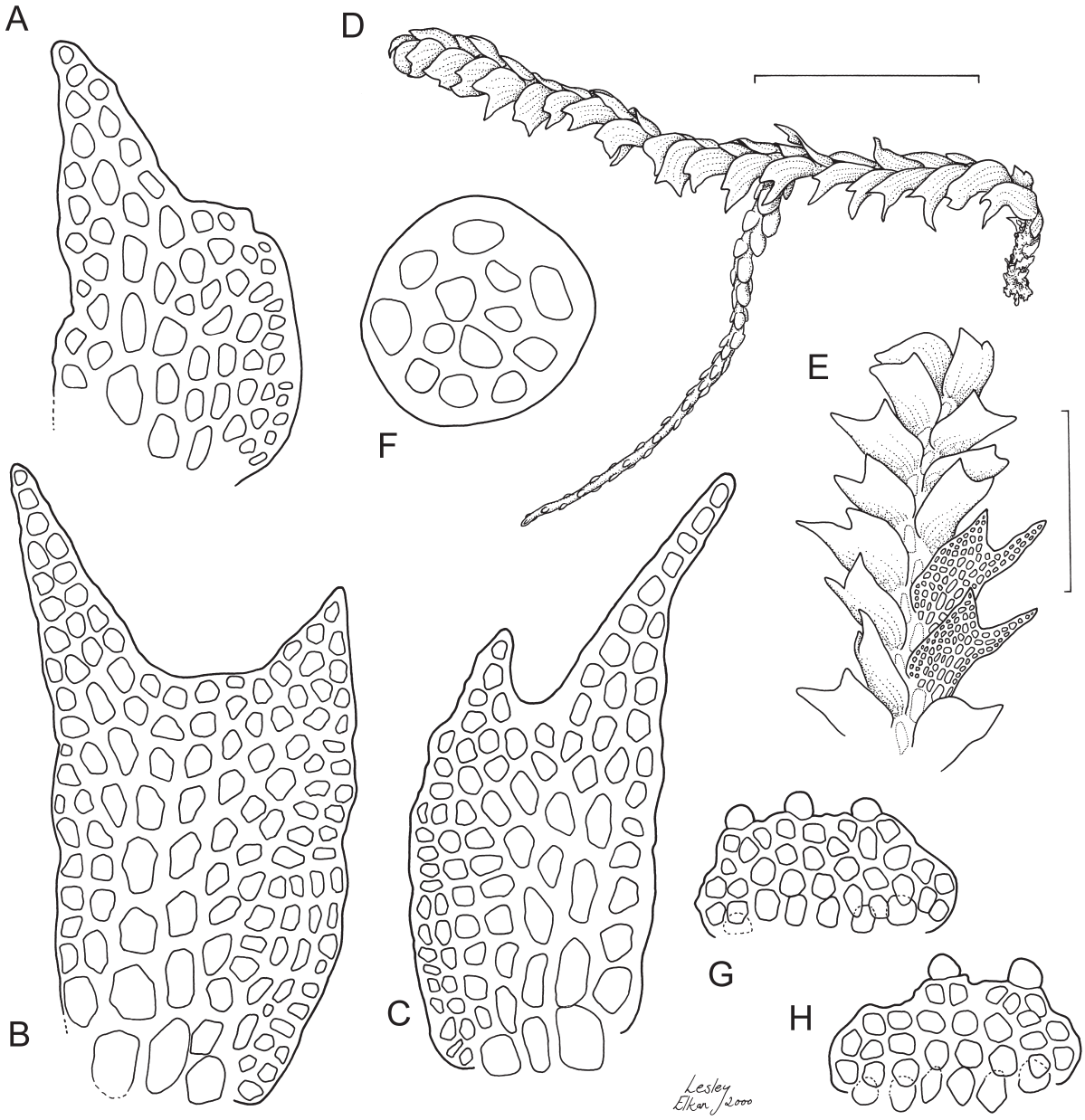


Fig. 10. *Acromastigum furcatifolium*. **A–C,** Leaves showing cellular detail. **D,** Lateral-oblique view of shoot. **D,** Dorsal view of shoot. **F,** Stem transverse section. **G–H,** Underleaves cellular detail. Scale (approximate) **A–C**, **F–H,** 100 μm; **D,** 2000 μm; **E,** 500 μm. From AKU63468, (?)NSW418729.

Acromastigum furcatifolium (Steph.) E.A.Br. *Phytotaxa* 65: 58 (2012), Fig. 10.

Lepidozia furcatifolia Steph. *Journal and Proceedings of the Royal Society of New South Wales* 48: 112 (1914).

Type: Australia**,** New South Wales: Central Tablelands: Horse Shoe [Horseshoe] Falls, Blackheath. (33°37'S, 150°19'E), 07 Jan 1911, *W.W. Watts 1027* (holotype: G *n.v.*; isotypes: NSW360433! NSW360434! NSW361394!)

Forming intertangled tufts of procumbent or somewhat arching stems, with brown pigmentation. Shoots 0.4–0.6 mm wide (when flattened), usually c. 5 mm long. Stems wiry, 95–135 μm in diam., 4 or 5 cells in diam., rounded in cross-section; cortical cells 1.9–2.9 × as long as wide, 35–110 μm long, 25–45 μm wide, 40–45 μm in diam., dorsal cells approximately twice as long and wide as ventral cells, in 7 or 8 rows; medullar cells more elongate, c. 3.4–5.4 × as long as wide, 105–130 μm long, 25–35 μm wide, 15–30 μm diam. (ends usually square to slightly tapered); cortical and medullar cells with walls 3–11 μm thick, outer tangential walls of cortical cells thicker (6–18 μm, usually c. 12 μm); oil-bodies unknown. Branches infrequent, postical; flagella uncommon, main stem sometimes becoming flagellate at the apex. Rhizoids rare, arising at base of ventral leaves near tip of stem. Lateral leaves inserted at an angle of c. 35° from the vertical, slightly to distinctly imbricate, ± flat or with apices slightly deflexed; 2-lobed (ventral usually narrower and longer but lobes sometimes of similar width, rarely of similar length), dorsal lobe occasionally not formed and replaced by a shoulder, angle between lobes rarely <90°and often up to 150°, 250–365 μm long × 130–170 μm wide, often ± parallel sided or varying from widest near base to widest just below sinus, dorsal base obtuse to rounded, ventral base straight to obtuse; vitta very indistinct, composed of 1 or 2 rows of larger cells petering out below the sinus or ventral lobe (and 1 or 2 rows in from ventral margin); ventral lobe 105–145 μm long, 60–75 μm (3 or 4 cells) wide at base; dorsal lobe 35–55 μm long, 30–55 μm (2–4 cells) wide at base; lobes acute, often bluntly so. Cells of leaf largest in vitta region and becoming smaller towards both margins; vittate cells 25–45 × 20–30 μm, median cells 15–25 × 15–20 μm, marginal cells 10–15 × 10–15 μm, cells ± rectangular to elongate hexagonal or trapezoid; moderately thick walled, especially in vitta, c. 2–3 μm thick, corners usually thickened but not forming distinct trigones; oil-bodies unknown; cuticle minutely striate/papillate (often more obvious in young leaves), 1c.2(–7) μm thick at margins. Underleaves distant, insertion ± transverse, small (c.0.15(–0.3) size of lateral leaves), ± as wide as stem, depressed broad ovate/subquadrate, 65–75 μm long, 130–140 μm wide, base obtuse; with 3 vestigal lobes (<1 cell deep) or irregularly crenate. Asexual reproduction not observed. Androecia, gynoecia and sporophytes not observed.

Variation: Individuals exhibit variation in leaf size, the degree to which the dorsal leaf lobe is developed, and in how divergent the leaf-lobes are.

Distribution and ecology: *Acromastigum furcatifolium* is endemic to the upper Blue Mountains west of Sydney, where it grows on inverted or indented surfaces in humid microsites within sandstone cliffs often but not exclusively in association with waterfalls and sandstone covered with a thin layer of peat. It has been repeatedly collected from Adelina Falls, but also occurs at Mermaids Glenn, Wentworth Falls, and along the National Pass. *Acromastigum furcatifolium* forms more or less pure patches, and at National Pass it was collected on the top of a lacuna occupied by various ferns and the orchid *Rimacola elliptica*.

Recognition: *Acromastigum furcatifolium* is distinctive in the golden-brown colour of shoots, the obliquely patent leaves, and the gaping sinus between claw-like leaf-lobes that are almost equal in size. It could only be confused with *Acromastigum interstisiale* from Tasmania and New Zealand, some individuals of which occasionally bear leaves having a wide sinus. However, *A. furcatifolium* differs in the nearly transverse orientation of the leaves and the irregular outline of the leaf lobe particularly the postical margin which is often angular or 'kneed' in one or two places on the leaf disc. The papillate ornamentation on the leaf cell surfaces is indistinct under light microscope, except on the leaf lobes, where discrete papillae may be present at the base of the leaf lobes. This is in contrast to the continuous, densely ornamented leaf cell surfaces of *A. interstisiale* and the faintly striolate-papillose leaf cells of *A. mooreanum*.

Representative specimens examined: Australia: New South Wales: Central Tablelands: Blue Mountains National Park, Wentworth Falls, Blue Mountains, 29 Aug 1981, *J.E. Braggins s.n. (*AKU, NSW418729); Adelina Falls, cliff-face to east of falls, 4 May 1998, *E.A. Brown 98/04 & P.C. Jobson* (NSW422368); Lawson, Adelina Falls, 33°43'45''S 150°26'15''E, 660 m, 29 Mar 1989, *E.A. Brown 89/62* (NSW434073); Lawson, Adelina Falls, 33°43'45''S 150°26'15''E, 660 m, 29 Mar 1989, *R.G. Coveny 13006*, *E.A. Brown & P.D. Hind* (AK237145, NSW299597).

Acromastigum fumosum E.A.Br. & M.A.M.Renner sp. nov. Fig. 11.

Diagnosis: *Acromastigum fumosum* is the largest *Acromastigum* species in Australasia, having shoots up to 2.0 mm wide. It can be distinguished from *A. interstisiale* by its larger size and its leaf surfaces, which do not bear dense and obscure ornamentation, and the vitta cell walls being more or less evenly thickened and without distinct trigones. It can be distinguished from *A. mooreanum* by

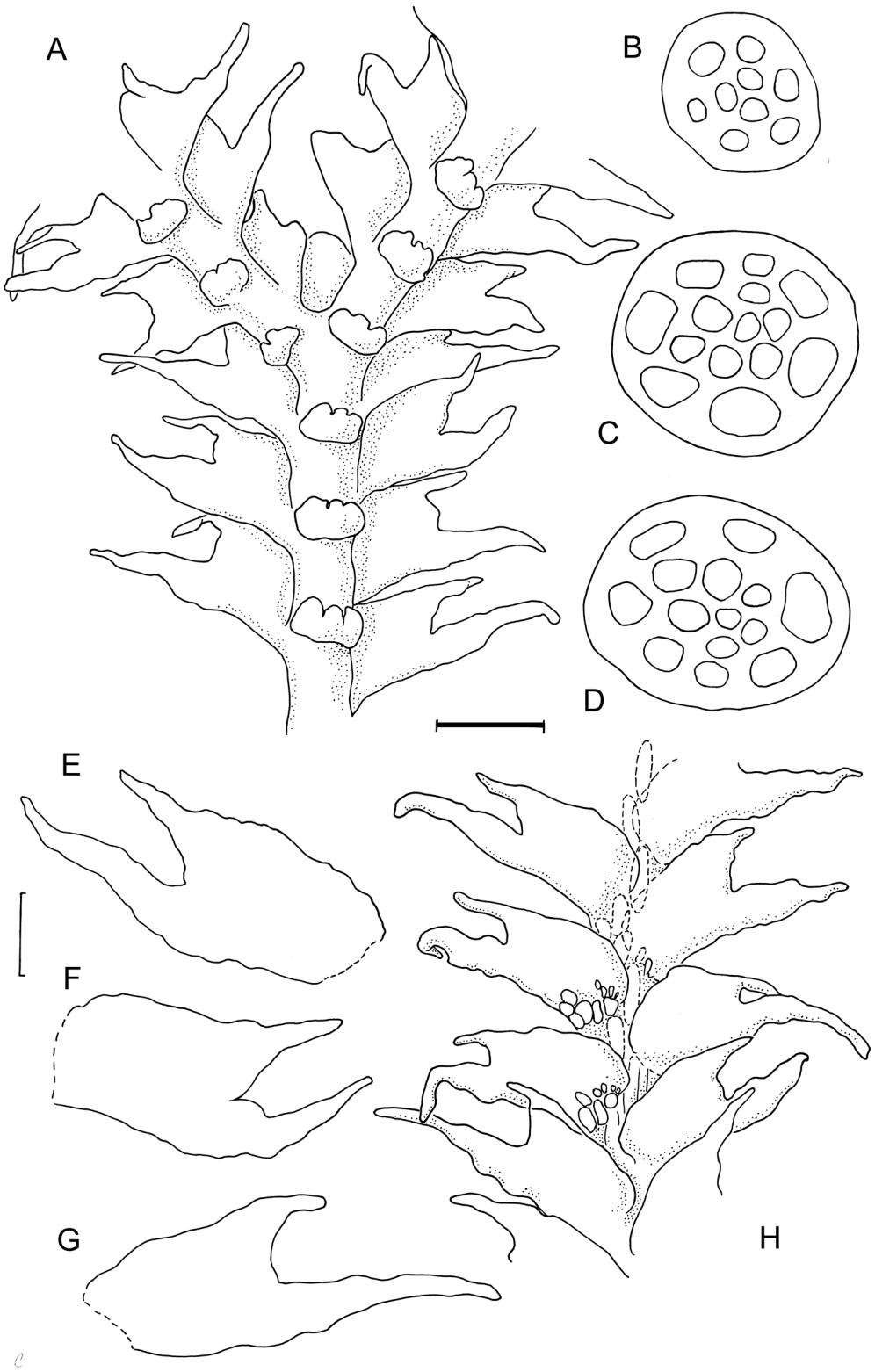


Fig. 11. *Acromastigum fumosum*. **A,** Ventral view of shoot. **B–D,** Stem transverse sections. **E–G,** Leaf outlines. **H,** Dorsal view of shoot. Scale (approximate): **A**, **H,** 600 μm. **B–D,** 60 μm. **E–G,** 240 μm From *Moscal 14127*.

the postical leaf-lobe being more than three cells wide at the base, and spreading in plane with the disc rather than ventrally secund and scythe shaped. *Acromastigum fumosum* differs from *A. furcatifolium* in its larger size, correspondingly larger leaves and the leaf lobes being divergent but not widely spreading, with the sinus apex being acute rather than obtuse, and underleaves typically distinctly 3-lobed.

Type: Australia**,** Tasmania**,** South West: Deadmans Bay, 43°32'S 146°29'E, 15 m, 19 Jan 1987, *A. Moscal 14127* (holotype: HO443755).

Forming intertangled tufts of prostrate or somewhat procumbent stems, with brown pigmentation. Shoots 1.0–2.0 mm wide, up to 30 mm long. Stems wiry, c. 200 µm in diam., 5 or 6 cells in diam., rounded in cross-section; cortical cells 2.0–3.5 × as long as wide, dorsal cells approximately twice as long and wide as ventral cells; medullar cells smaller than cortical, in 7 or 8 rows, stem cell walls heavily and continuously thickened and brown pigmented throughout; oil-bodies unknown. *Frullania*-type branches infrequent, pseudodichotomous; flagella uncommon. Rhizoids rare, arising at base of ventral leaves near tip of stem. Leaves obliquely inserted, imbricate, plane, or with apices slightly deflexed; 2-lobed, ventral narrower and longer than dorsal, dorsal lobe always formed, angle between lobes 30–90°; 750–1000 µm long × 500–600 µm wide, more or less parallel sided, dorsal base rounded, ventral base straight; vitta indistinct, composed of 3 or 4 rows of larger cells extending to the ventral lobe base near the sinus apex, 1 or 2 rows in from ventral margin; ventral lobe 400–600 µm long, 150–250 µm (4 to 6 cells) wide at base; dorsal lobe 200–450 µm long, 150–250 µm (4 or 5 cells) wide at base; lobes acute. Cells of leaf largest in vitta region and becoming smaller towards both margins; vittate cells 60–90 × 25–40 µm, median cells 20–30 × 15–25 µm, marginal cells 15–20 × 20–30 µm, cells ± rectangular to elongate hexagonal or trapezoid; moderately thick walled, especially in vitta, c. 2–3 µm thick, corners usually thickened but not forming distinct trigones; oil-bodies unknown; cuticle minutely striate/papillate (often more obvious in young leaves), (1–)c. 2(–7) µm thick at margins. Underleaves distant, insertion ± transverse, small c. 0.2–0.3 × size of lateral leaves), ± as wide as stem, depressed broad ovate/subquadrate, 110–140 µm long, 180–270 µm wide, base obtuse; with 3 lobes 2 or 3 cells deep. Asexual reproduction not observed. Androecia, gynoecia and sporophytes not observed.

Etymology: *fumosum* smoky, in reference to the plant colour.

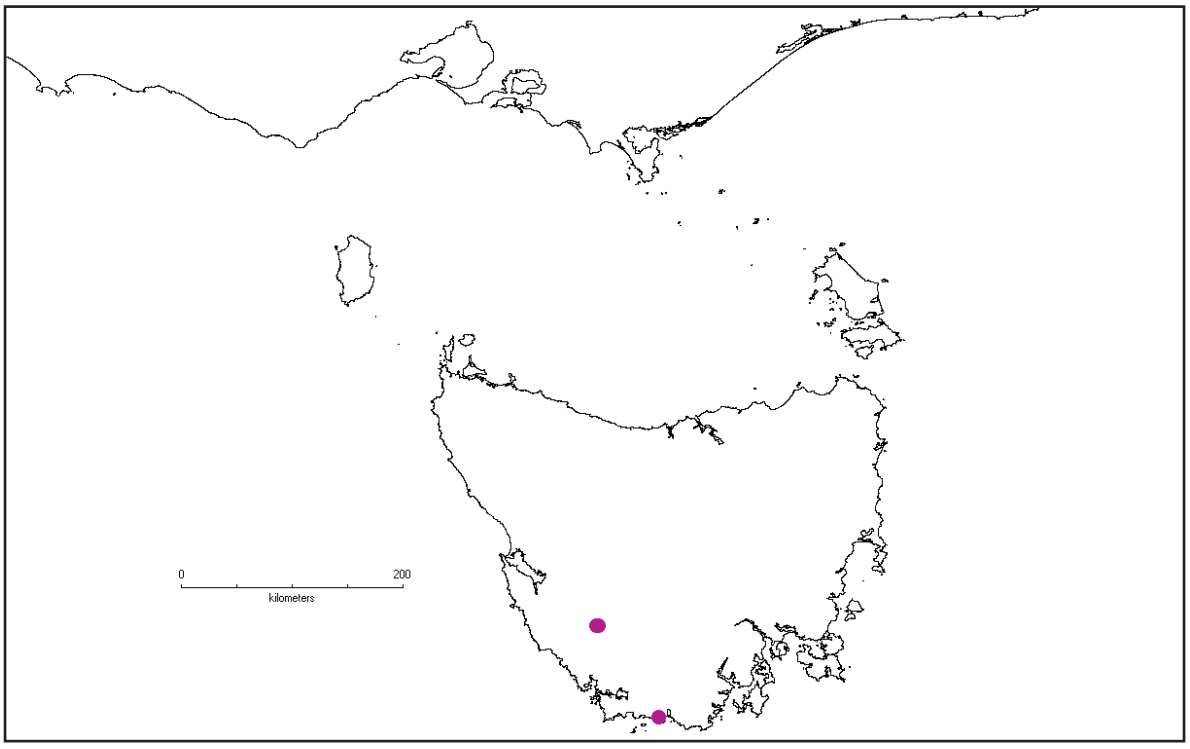


Fig. 12. Distribution of *Acromastigum fumosum* in Tasmania, Australia.

Distribution and Ecology: Endemic to Tasmania, where known from three collections from the South West, made between 15 and 600 m asl (Fig. 12). *Acromastigum fumosum* has been collected as a terrestrial in both forest and scrub, for instance with *Dicranoloma eucamptodontoides*, on shallow peat over skeletal soil in heath sedgeland. One gathering of *Acromastigum* from Mt Sprent in Tasmania contained *A.fumosum* mixed with *A. interstisiale*, and in another *A. fumosum* was mixed with *A. prismaticale*.

Recognition: *Acromastigum fumosum* differs from *A. furcatifolium* in its larger size, correspondingly larger leaves and the leaf lobes being divergent but not widely spreading, with the sinus apex being acute rather than obtuse. Cells of the leaves are also generally larger than in *A. furcatifolium. Acromastigum fumosum* can be distinguished from *A. interstisiale* by its larger size and leaf surfaces, not bearing dense and obscure ornamentation, and the vitta cell walls being more or less evenly thickened and without distinct trigones.

Remarks: *A. fumosum* presents as a remarkably robust *A. furcatifolium* without the widely divergent leaf lobes. It shares with *A. furcatifolium* the mostly obscure leaf surface ornamentation that is occasionally developed into prominent hemispherical papillae at the base of the leaf lobes, the vitta extending toward the leaf sinus and having mostly evenly thickened walls with concave trigones, and irregular leaf outline sometimes with obscure 'teeth' on the disc margins.

The correlated increase in plant stature and cell size relative to similar species may indicate a polyploid origin for *A. fumosum*.

Specimens examined: Australia: Tasmania: South West: National Park: Mt Sprent, 42°47'S 145°58'E, 600 m, 31 Jan 1987, *J. Jarman s.n.* (HO571178); slopes of Mt Sprent, 42°47'S 145°59'E, 350 m, 5 Feb 1987, *J. Jarman s.n.* (HO571176).

Acromastigum exiguum (Steph.) A.Evans, *Annales Bryologici***,** Supplement 3: 75 (1934). Fig. 13.

Mastigobryum exiguum Steph. *Hedwigia* 25: 6 (1885), plate 2, figs 4–6.

Type: Australia**,** Victoria**,** *W. Bäuerlen s.n.* (syntypes: FH, G-24694).

Forming small to moderate colonies, plants dull green with lighter tips (drying an olive-brown-green); creeping with apices slightly curled; mature leafy shoots to 1.2 mm wide. Stems slender, mostly to 30 mm long, 135–175 μm and c. 4 or 5 cells in diam.; cortical cells 1.1–2.8 × as long as wide, 35–105 μm long, 20–60 μm wide, c. 20–35 μm tangentially, moderately thick-walled with radial walls c. 3 μm thick (up to 7 μm and outer tangential to 18 μm, lacking oil-bodies; medullar cells variable but usually more elongate, (2–)4–5(–7) × as long as wide , 55–155 μm long 15–65 μm wide, 15–25 μm tangentially (end walls squared to slightly tapered), thin-walled, usually with several to numerous minutely globular grey ovoid oil-bodies 7–14 × 3–5 μm. Branches lateral (rarely postical, see MUCV4734), frequent, diverging at an angle of 80–100°; flagella frequent, often 1 per mm but more usually 1 per 3 mm. Rhizoids scarce. Leaves inserted by an oblique line to centre of stem, imbricate, convex, dorsally appressed to stem with the apices very slightly deflexed (sometimes strongly so), typically very unevenly 2-lobed with dorsal lobe often little more than a tooth and occasionally completely absent, 305–430 μm long × 150–240 μm wide, unsymmetrically ovate, dorsal base obtuse, ventral base straight to obtuse; vitta very indistinct, consisting of an irregular group of larger cells in the basal part of the leaf 2 or 3 cells in from the ventral margin; ventral lobe 60–80 μm long, 60–85 μm (3–5 cells) wide at base; dorsal lobe 5–20 μm long, 15–40 μm (1 or 2, rarely 3 cells) wide; lobes acute to obtuse. Cells of leaf largest in vitta region and becoming smaller towards both margins; vittate cells 20–40(–50) × 10–20(–25) μm, median cells 10–30 × 10–25 μm, marginal cells 10–20 × 5–15 μm, cells rectangular to subquadrate, walls <2 μm thick except at the margin where the 'cuticle' is up to 7 μm; oil-bodies absent; cuticle minutely papillose throughout. Underleaves scarcely imbricate to distant; insertion ± transverse, appressed, small (c. 0.25 size of lateral leaves), normally slightly wider than stem (but sometimes as wide as or slightly narrower than stem); depressed ovate/suborbicular, often with a shoulder on either side c. ⅓ way up, 100–145 μm long, 140–205 μm wide, base ovate to cordate; 3-lobed, occasionally of unequal size, sinuses to c. ½ way; apices of lobes truncate to rounded or sometimes slightly emarginate; lobes 3–4(– 6) cells long (more usually 3 or 4 cells), (2 or)3–4(or 5) cells wide, frequently with outer lobes curving in towards the central one. Asexual reproduction not observed. Androecial branches not observed. Gynoecia 1 per stem, rare; shortly stalked. Bracts and bracteoles similar, in several series, innermost largest; usually bifid, central sinus c. 20–40° and split 0.4–0.6 length of bract, ovate, margins smooth apart from additional small lobes and teeth which typically occur on innermost bracts; cells rectangular to elongate hexagonal, length:width ratio 1–4.5(–7), thin walled to moderately thick walled (c. 2 μm) on outer bracts, lacking trigones; oil-bodies unknown. Perianth c. 4 mm long when fully developed, slenderly ovoid-cylindrical, narrowed at mouth and variously lobed, lobe margins with scattered cells protruding or bluntly toothed, 2- (or 3)-stratose basally, reducing to 1-stratose near mouth, cells rectangular to elongate-rectangular, length:width ratio 1.3–3.7 (c. 50–120 × 25–35 μm) becoming smaller and less regular in shape towards mouth

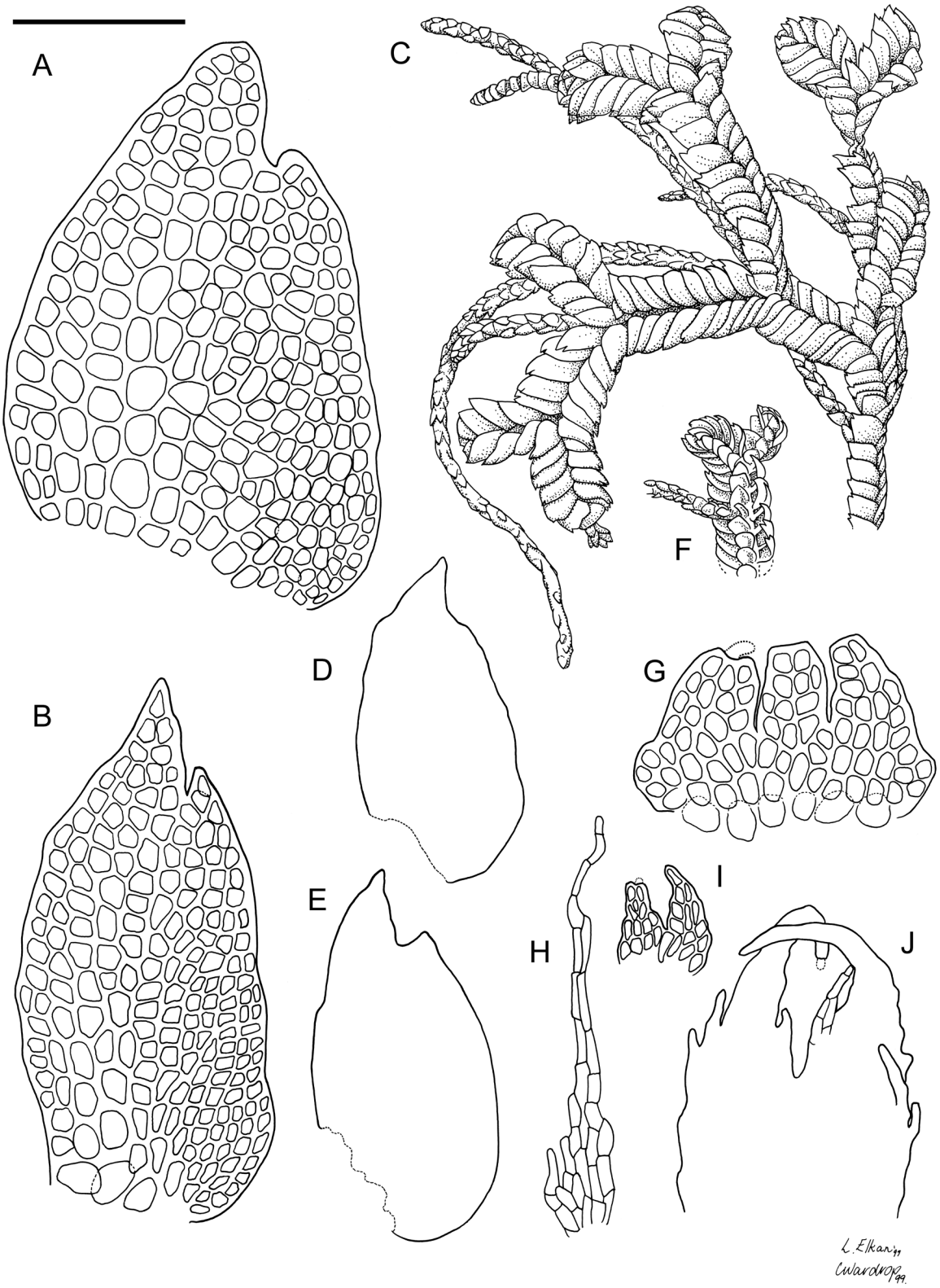


Fig. 13. *Acromastigum exiguum*. **A, B,** Leaves showing cellular detail. **C,** Dorsal-oblique view of shoot. **D, E,** Leaf outlines. **F,** Ventral view of shoot apex. **G,** Underleaf cellular detail. **H, I,** Leaf from stolon cellular detail. **J,** Female bract outline. Scale (approximate) **A**, **B**, **G**, **H**, **I**, 100 μm; **D**, **E**, **J**, 200 μm; **C**, **F,** 2000 μm. From S*elkirk & Edgcomb 493, Brown 89/55, Brown 89/191, Brown 89/158.*

(c. 18–50 × 13–20 μm), radial walls to c. 1 μm, lacking trigones, tangential walls 2–4 μm thick and having striate 'papillae'on lobes (very hard to observe); oil-bodies not observed in perianth. Sporophyte; seta with 8 rows of large, hyaline epidermal cells filled with botryoidal clusters of tiny oil-bodies (which may give the cells a dark appearance in transverse section) surrounding 11 rows of smaller interior cells; capsule walls 4 (or 3)-stratose, inner layer of capsule with thickenings on radial and transverse walls and bands of thickening on the inner tangential walls (often uneven and sometimes absent from a few walls). Elaters c. 10 μm diam, band width 3 μm and spiral periodicity c. 22–24 μm. Spores (13–)14–16(–18) μm diam.

Variation: *Acromastigum exiguum* exhibits variation in size, in degree of leaf concavity, and in shoot 'flatness', in how obvious papillae on the leaf surface are, in width of free external wall on the leaf, and in the depth of the sinus between the leaf lobes. In some specimens (e.g. NSW622377) plants are composed of narrow shoots, concave leaves that hug the stem and have a thick external marginal wall, a shallow sinus between leaf lobes, often with antical lobe redundant, and papillae obscure.

Distribution and ecology: Recorded from eastern New South Wales, particularly around Sydney, and from New Caledonia (Kitagawa 1985). Typically found on lightly shaded stream margins, on soil overlying sandstone boulders and bedrock.

Recognition: *Acromastigum exiguum* is distinctive in its milky green or even glaucous colour when fresh; the shallowly bilobed, concave, closely overlapping leaves, the semi-circular postical lobe margin; the indistinct or absent vitta, and the uniformly thickened leaf-lobe cell walls. Sometimes the antical leaf-lobe is abbreviated as in *A. marginatum*, but the semi-circular outline of the postical lobe margin is consistent.

Acromastigum exiguum differs from the New Zealand species *A. marginatum* E.A.Hodgs. in a number of features, although the suggestion has been made that they might be conspecific (Kitagawa 1985). The cell walls of the lateral leaves in *A. marginatum* are thicker than those of *A. exiguum* (often c. 3.5 μm versus rarely more than 1 μm in *A. exiguum*) and they form a distinctive wide marginal border which is not developed in *A. exiguum* to the same extent [(5)–7–12 μm versus 1–3–(5) μm] in *A. exiguum*. The leaves of *A. exiguum* are consistently bilobed, but the few specimens of *A. marginatum* that have been examined have a slightly better developed dorsal lobe, or where the lobe fails to develop, there is a much more prominent shoulder on the dorsal margin than is found in *A. exiguum*.

Representative specimens examined, Australia: New South Wales: Central Coast: Laughtondale Gully Road, north side, 3.2 km E of junction with Great Northern Road, Maroota, 32°25'S 151°00'E, 22 Aug 1991, *R.G. Coveny 15507, P.G. Kodela & L. McDougall* (NSW796572); Watagan Range, Boarding House Dam, off Watagan Forest Road, 33°00'S 151°24'E, 1 Oct 1989, *E.A. Brown 89/191* (NSW427755); Wollemi National Park, Floyd's Scrub, NW tributary of Wheeney Creek, c 3 km ESE of Mountain Lagoon, 33°27'24''S 150°40'10''E, 9 Jan 2008, *R.G. Coveny 19284, W.A. Cherry & P.D. Hind* (NSW7611322); Gully above station, Stanwell Park, 34°13'S 150°58'E, May 1905, W.W. Watts 851 (NSW260053); Brogers Creek, at Flying Fox Pass, c 1.9 km W of Barren Grounds Field Lodge, 34°40'39''S 150°41'29''E, 15 Mar 1992, *E.A. Brown s.n.* (NSW296162); Barren Grounds Nature Reserve, Lamonds Creek between the Natural Stone Bridge and Wonga Falls, 34°41'30''S 150°43'10''E, 570 m, 22 Apr 1992, *R.G. Coveny 16081 & P.D. Hind* (NSW262593); Somersby Falls, N of Sydney, 23 Aug 1981, *G.A.M. Scott s.n.* (MUCV 4734); Royal National Park, Sydney, 18 Jun 1972, *G.A.M. Scott s.n.* (MUCV1470); Brogers Creek, 7 km SE of Robertson, 11 Jul 1961, *I. Beeton B45*, (CBG052345, MUCV 3581); Central Tablelands: Bowens creek, c 100 m S of bridge, 33°29'54''S 150°28'34''E, 8 Mar 2004, *E.A. Brown 04/09, M. Heslewood & H. McPherson* (NSW700366); Blue Mountains National Park, Bilpin Gorge walk (Waratah Track) at the E end of Valley Ridges Rd, c 4.7 km ENE from summit of Mt Tomah, 33°32'S 150°28'E, 600 m, 23 Sep 2001, *V. Stajsic 2779 & N. Klazenga* (MEL2136376, NSW622377); Pierces Pass, c. 1.5 km by track from Bells Line of Road and c. 8 km SSW of Mt Wilson, 33°34'S 150°20'E, 800 m, 23 Sep 2001, *V. Stajsic 2794 & N. Klazenga* (MEL2137131, NSW622375); Coachwood Glen, Megalong Valley, 33°40'S 150°16'E, 13 Mar 1989, *E.A. Brown 89/34* (NSW427753); Blue Mountains National Park Dantes Glen walking track, c. 1 km NW of Lawson township, 33°42'S 150°25'E, 650 m, 22 Sep 2001, *V. Stajsic 2735 & N. Klazenga* (MEL2136332, NSW622376); Cataract Falls, Lawson, 33°44'S 150°26'E, 630 m, 29 Mar 1989, *R.G. Coveny 13023, E.A. Brown & P.D. Hind* (NSW299629).

Acromastigum echinatiforme (De Not.) A.Evans, *Annales Bryologici,* Supplement 3: 64 (1934). Fig. 14.

Mastigobryum echinatiforme De Not. *Memorie della Reale Accademia delle Scienze di Torino* II. 28: 302 (1874), plate 30.

Type: Malaysia**,** Sarawak, Mount Linga, 1867, *O. Beccari 56* (FI *n.v.*).

Bazzania echinatiformis (De Not.) Trevis, *Memorie del Reale Istituto Lombardo de Scienze e Lettere. Serie 3, Classe di Scienze Matematiche e Naturali* 4: 414 (1877).

Forming dense mats composed of procumbent to suberect arching stems, yellow-green to pure green and lacking brown pigments (young growth creamy pale brown when dried). Shoots 0.6–0.8(–1) mm wide (when

flattened), usually 10–16 mm long. Stems somewhat lax, 110–145 μm and 5 or 6 cells in diam., often slightly dorsi-ventrally flattened; cortical cells 1.2–2 × as long as wide, 43–66 μm long, 34–40 μm wide, 30–45 μm diam., typically in 7 rows; medullar cells more elongate, c. 6–8 × as long as wide, 120–160 μm long, 15–25 μm wide, 19–25 μm diam., (ends usually square to slightly angled); cortical cells with thick walls, outer and inner tangential walls (2)-6–12 μm thick, radial walls narrower (1–6 μm); medullar cells thinner walled, typically 1–3 μm thick; oil-bodies unknown. Branches frequent, arising at intervals of 1.5–5 mm, lateral or occassionally postical when the apex is damaged and usually diverging at an angle of 40–60(–90)°; flagella frequent, 1.5–3 mm apart, flagella leaves bifid with one lobe frequently smaller, c. ⅓ size of underleaves; rhizoids scarce, usually arising from flagella leaves when present. Leaves inserted at an angle of 60° from the vertical, imbricate, flat to dorsally appressed to stem with the apices deflexed, 2-lobed (ventral slightly narrower and longer than the dorsal but sometimes slightly wider, 425–505 μm long × 170–210 μm wide, widest just above the narrowed base, dorsal base usually somewhat auriculate, ventral margin often straight or bulging slightly at ventral lobe; vitta present but not well defined, 4 or 5 cells wide and 1 or 2 cells in from ventral margin; ventral lobe

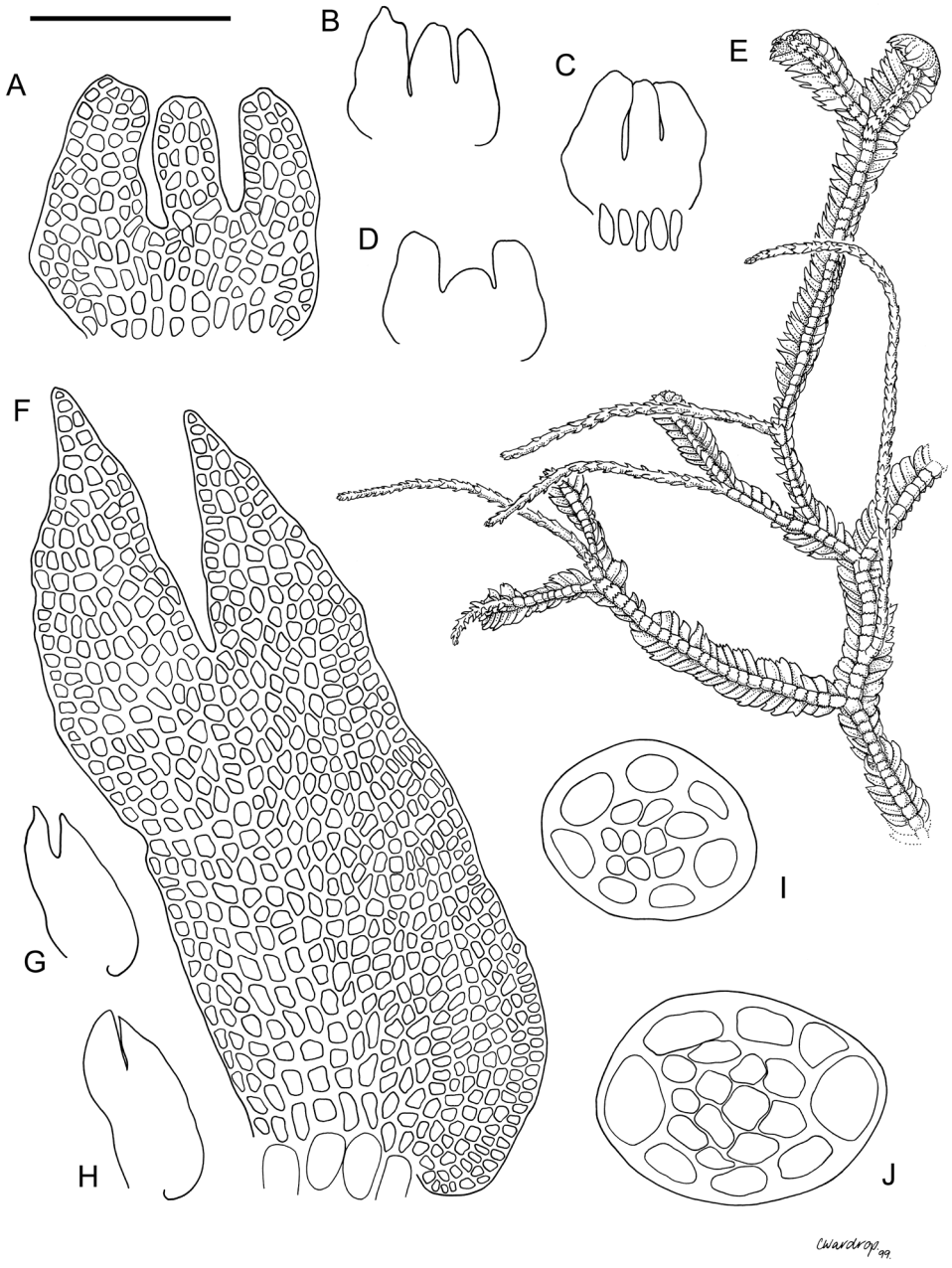


Fig. 14. *Acromastigum echinatiforme*. **A,** Underleaf cellular detail. **B–D,** Underleaf outlines. **E,** Ventral view of shoot system. **F,** Leaf cellular detail. **G**, **H,** Leaf outlines. **I**, **J**, Stem transverse sections. Scale (approximate) **A**, **F**, **I**, **J**, 250 μm; **B–D,** 500 μm; **E,** 4000 μm; **G**, **H,** 1000 μm. From *E.A. Brown 94/500* and *Hicks 11661*.

155–190 µm long, 75–105 µm (7–9 cells) wide at base; dorsal lobe 120–145 µm long, 80–110 µm (8–11 cells) wide at base; lobes acute. Cells of leaves decreasing in size from vitta towards dorsal margin, with ventral 1 or 2 rows smaller than those of the vitta; vitta 15–35 × 13–20 µm, central 13–22 × 9–13 µm and dorsal margin 9–10 × 8–12 µm; thin walled throughout (slightly thicker in vitta); oil-bodies unknown; cuticle smooth except towards tips of lobes where it is distinctly but minutely papillate. Underleaves slightly imbricate, insertion ±transverse, ±flat, large (c. 0.3–0.45 size of lateral leaves), typically slightly wider than stem, occasionally subquadrate but usually with lateral margins curved outwards, 140–165 µm long, 175–215 µm wide, rounded to rarely auriculate at base, marginal irregularities frequent; 3-(4)-lobed, sinuses to c. 0.4–0.5 way; lobes 7–10(–12) cells long, (3–)4–6(–9) cells wide, often with one lobe larger or smaller than the others; apices of lobes rounded to truncate or emarginate. Asexual reproduction occasionally by caducous leaves.

Variation: There are significant differences between Australian and Malesian populations of *A. echinatiforme*. The general morphology shows strong affinities and the underleaves are almost identical in both regions (not unusual in a number of taxa), however the lateral leaves of Australian plants are larger by about 20% — typically 16–20 cells high at the sinus vs 9–12, leaf 18 cells wide at maximum girth vs 9–12(–16); the cortical cells of the stem have a larger lumen with the walls a little less thickened; and the vitta tends to be better developed in Malesian plants.

Distribution and ecology: In Australia *A. echinatiforme* is a common lithophyte or trunk epiphyte in montane rainforest within the Wet Tropics Bioregion of north-east Queensland, typically occurring above 600 m asl.

Recognition: Mid-green to brown-green plants with rectangular, spreading almost isolobous leaves, the lobes convergent and slightly forward-swept, underleaves deeply trifid, lobes rectangular, vitta indistinct.

Remarks: Material in Queensland was initially attributed to *Acromastigum echinatiforme* by Marie Hicks who collected it in the 1980's. The type of *A. echinatiforme* is held in Becarri's herbarium and was not available for loan.

Representative specimens examined: Australia, Australia: Queensland**:** Cook: Good Shepard Rock, slope of Mount Demi near Mossman, 16°30'S 145°19'E, 17 Jul 1983, *M.L. Hicks 11661* (NSW434075); Mount Lewis State Forest, Mount Lewis Road, third creek beyond locked gate, 16°30'16'' S 145°16'08'' E, 1200 m, 14 Aug 1995, *E.A. Brown 95/108, B.M. Wiecek & K.L. Radford* (NSW390610); Mount Lewis, 23 Jun 1983, *M.L. Hicks 11363* (TENN); State Forest 143, Mount Lewis Road c 30.5 km from intersection with Mossman-Mount Mollow Road, 50 m up small stream, 16°30'50''S 145°16'10''E, 16 Jul 1994, *E.A. Brown 94/500, R.G. Coveny & B. Tan* (NSW297109); Main Coast Range, 19 km NNW of Mount Molloy, 1200 m, 16°31'S, 145°16'E, 30 Jun 1984, *H. Streimann 30310* (CANB8408816); *H. Streimann 30308* (CANB8408814); Mt Bellenden Ker National Park, Mt Bellenden Ker, just below radio transmitter pylon, between track and stream, 17°15'55''S 145°51'15''E, 1500 m, 7 Aug 1995, *E.A. Brown 95/179, B.M. Wiecek & K.L. Radford* (BRI, NSW390438); Mount Bellenden Ker, south peak, 23 km SSE of Gordonvale, 1550 m, 17°18'S, 145°52'E, 03 Mar 1983, *H. Streimann 27433* (CANB8305398); Bellenden Ker Range, Russell River catchment, Wooroonooran National Park, track to Choorichillum from end of Gourka Road, between NW summit and Choorichillum, 17°23'45''S 145°48'56''E, 1460 m, 30 Mar 2012, *M.A.M.Renner 6432, V.C. Linis & E.A. Brown* (NSW896971); North Kennedy: Cardwell Range, Douglas Creek, Bridge No. 10, on forestry road to Blencoe Falls, 700 m upstream from bridge, 18°12'46''S 145°48'30''E, 730 m, 30 Jul 1995, *E.A. Brown 95/74, B.M. Wiecek & K.L. Radford*, (NSW390333); 31 Jul 1995, *E.A. Brown 95/108, B.M. Wiecek & K.L. Radford*, (NSW390367).

Acromastigum prismaticale E.A.Br. & M.A.M.Renner sp. nov. Fig. 15.

Diagnosis: *A. prismaticale* is distinctive in its yellow-green colour, frequent pseudodichotomous branching, and the postical leaf lobe being long and narrow, two cells broad for nearly its entire length, and composed entirely of vitta cells. *Acromastigum prismaticale* shares this distinctive postical leaf-lobe with *A. cunninghamii* but can be distinguished from the latter by its imbricate leaves, and the postical lobe being ventrally secund and divergent from the antical lobe.

Type: Australia: Tasmania: Central Highlands: Mt Kate, 41°38'S 145°58'E, 920 m, 19 Jan 1997, *A. Moscal 28912* (holotype: HO443756).

Forming moderately extensive colonies, plants dull green (drying light green); creeping with apices slightly curled; mature leafy shoots 0.4–0.8 mm wide (c. 0.7–0.9 mm when leaves flattened). Stems slender, filiform, mostly to 15 mm long, 110–165 µm and c. 4(–6) cells in diam.; cortical cells 1.1–2.2 × as long as wide, 35–60 µm long, 25–35 µm wide, c. 40–45 µm diam.; medullar cells more elongate, c. 7 × as long as wide, 135–140 µm long, 15–20 µm wide, 20–25 µm diam. (end walls squared to slightly tapered), probably full of oil bodies; cortical cells thick-walled, radial walls to 10 µm and outer tangential to 18 µm. Branches lateral, frequent, diverging at an angle of 75–90°; flagella frequent, often 1 per mm. Rhizoids scarce. Leaves inserted by an oblique line to centre of stem, imbricate, slightly convex and often somewhat falcate, dorsally appressed to stem with the apices deflexed (strongly so when dry), 2-lobed (ventral slightly longer), 340–430 µm long

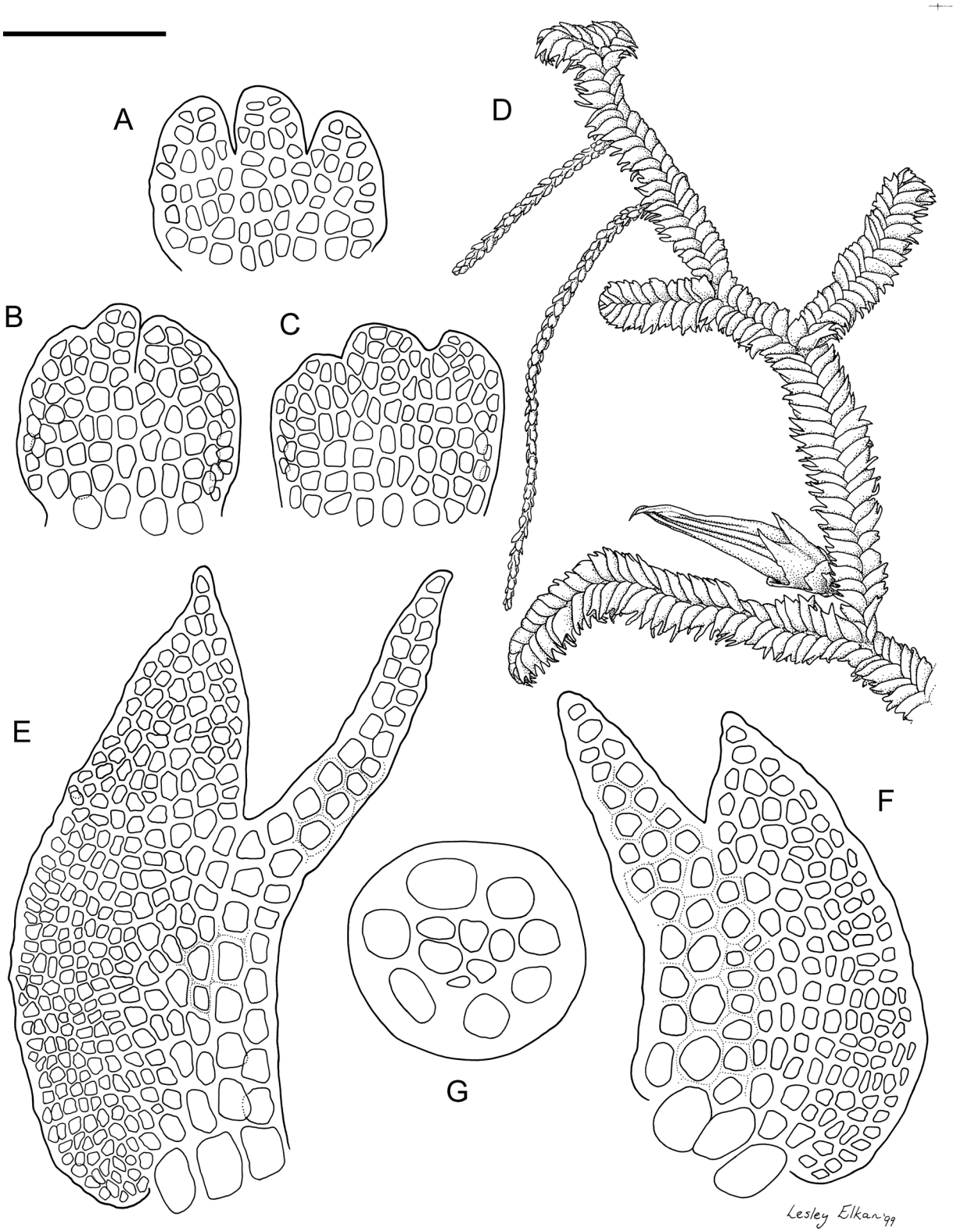
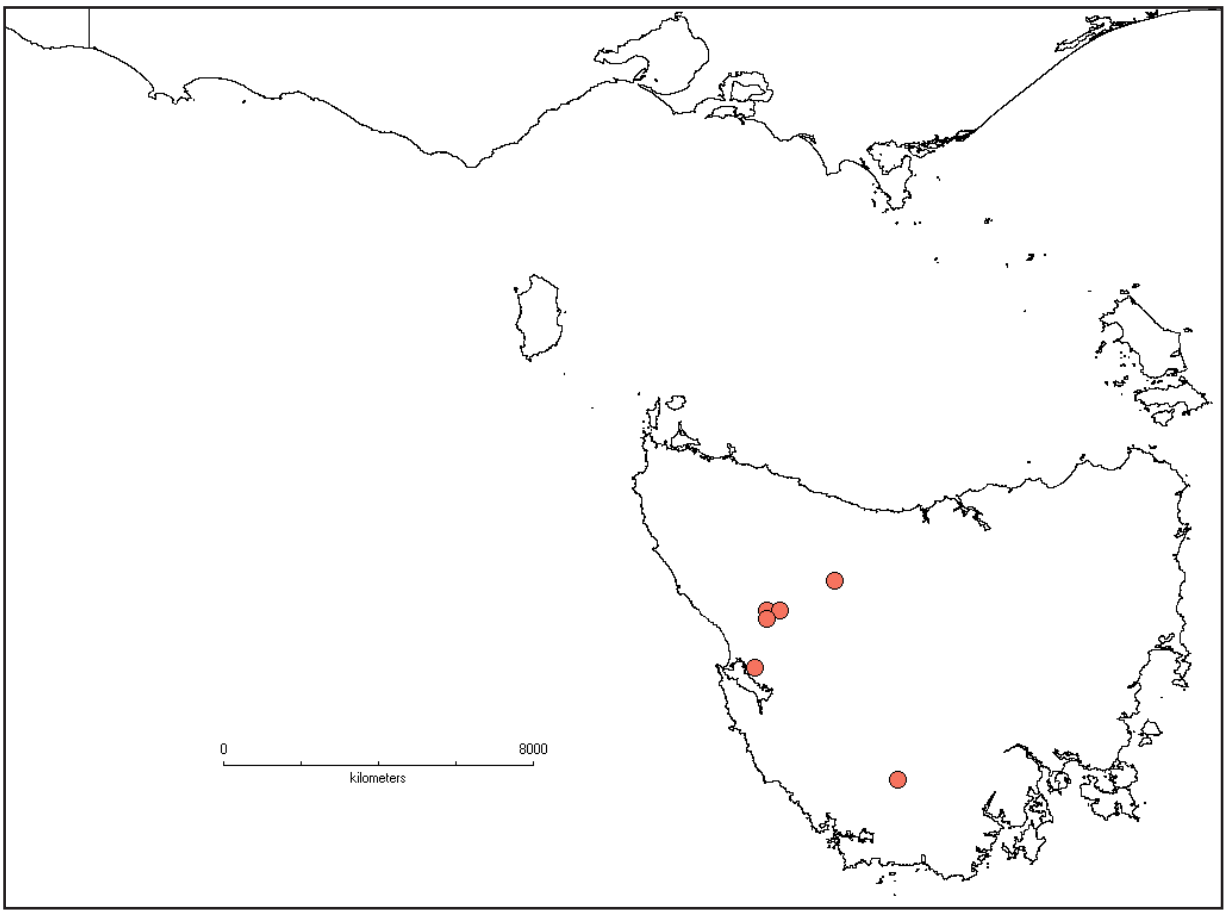


Fig. 15. *Acromastigum prismaticale*. **A–C,** Underleaf cellular detail. **D,** Dorsal view of shoot. **E, F,** Leaf cellular detail, **E,** showing typical leaf, **F,** an atypical small leaf. **G,** Transverse section of stem. Scale (approximate) **A–C, E–G,** 100 μm; **D,** 2000 μm. From *Jarman 83/2, 88/22 and 89/2*.

× 130–195 µm wide, widest just above the slightly narrowed base to c. ½ way up the leaf, dorsal base obtuse to auriculate, ventral base straight or with a bulge; vitta present on ventral margin, continuing into ventral lobe, 2(or 3) cells wide; ventral lobe 125–240 µm long, 40–55 µm wide, 2(or 3) cells wide at base; dorsal lobe 95–165 µm long, 75–120 µm (5–10 cells) wide; lobes acute. Cells of leaf largest in vitta and becoming smaller towards the dorsal margin; vittate cells 15–40 × 15–25 µm, ± rectangular, thick-walled, lacking trigones but often with a small triangular mark where cell walls join; median cells 15–25 × 15–20 µm; marginal cells 5–15 × 5–15 µm, subquadrate to occasionally almost triangular, moderately thick-walled, often to 7 µm; oil-bodies not observed; cuticle smooth to very lightly striate/papillate on both surfaces of ventral lobe and leaf, to 7 µm thick at margins. Underleaves slightly imbricate to distant; insertion ± transverse, appressed, small (c. size of lateral leaves), as wide as or slightly wider than stem, ± oblong to slightly obovate or elliptic, 120–150 µm long, 135–185 µm wide, straight or slightly narrowed at base; 3-lobed or more commonly 2-lobed with irregular margins suggesting a third lobe, sinuses to c. 1/5; apices of lobes truncate to rounded or sometimes slightly emarginate; lobes up to 4 cells long (more usually 2 cells), 4(or 5) cells wide. Asexual reproduction not observed.

Androecial branches not observed.

Gynoecia postical, 1 to several per stem; shortly stalked, occasionally 2 gynoecia produced on a branch. Bracts and bracteoles dissimilar, in several series, innermost largest. Bracts usually bifid, sometimes with several lobes (two of which are usually better developed), central sinus 0.2–0.4 length of bract, broadly ovate, margins smooth or with occasional papillae, cells protruding slightly or with several celled teeth; cells elongate-hexagonal or polygonal to rhombic, length:width ratio 1.3–3.1, moderately thick-walled (to 2 µm or to 4 µm in places on outer bracts), lacking trigones; oil-bodies unknown. Bracteoles emarginate to bifid (less extensively developed than in bracts), to 1/3 split, widely elliptic to obovate, otherwise similar to bracts. Perianth c. 2.5 mm long when fully developed, slenderly ovoid-cylindrical, narrowed at mouth and strongly plicate, lacerate to ¼ length, 1-stratose throughout, cells ± hexagonal throughout, length:width ratio 1.3–6.1, thick-walled (radial and inner tangential walls c. 2 µm, outer tangential 4–6 µm); oil-bodies unknown. Sporophyte not observed.



Fig, 16. Distribution *Acromastigum prismaticale* in Tasmania, Australia.

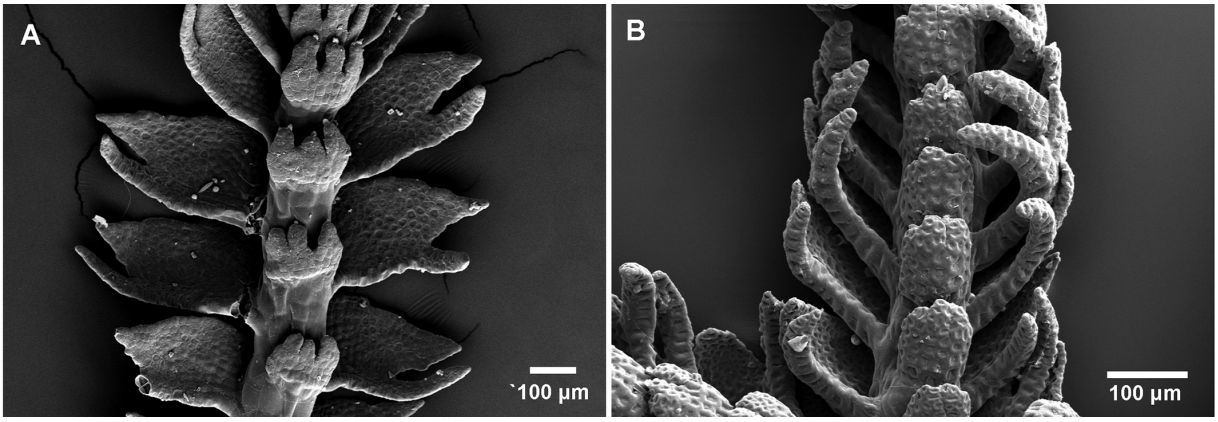


Fig. 17. Scanning electron microscope images of the ventral view of *Acromastigum cunninghamii* (**A**) and *A. prismaticale* (**B**) in ventral view. A. from NSW749450, B. from HO443756

Etymology: In reference to cells of the postical leaf lobe resembling, and occasionally behaving as, prisms.

Variation: No significant variation among individuals was noted during the course of this study.

Distribution and ecology: Aparrently endemic to Tasmania (Fig. 16). *Acromastigum prismaticale* is typically encountered as an epiphytic on trunks of large canopy trees in montane forest, particularly *Arthrotaxis selaginoides* and *Nothofagus cunninghamii*, and it may form extensive pure turfs on both. It also grows on fallen and decaying logs of *Arthrotaxis* on the forest floor.

Recognition: *Acromastigum prismaticale* is distinctive in its postical leaf lobe being narrow (c. 2 cells broad) and composed of vitta cells. This distinctive character is shared only with *A. cunninghamii* and *A. mooreanum*. Confusion is really only possible with *A. cunninghamii*, as *A. mooreanum* is a much larger, browner plant with black-pigmented stem in mature sectors (Fig. 1). *Acromastigum prismaticale* can be distinguished from *A. cunninghamii* by the imbricate leaves whose postical lobe is ventrally secund and divergent from the antical lobe (Fig. 17); by the shallowly lobed underleaves; and by the absence of leaf surface ornamentation.

Representative specimens examined: Australia: Tasmania: Central Highlands: Road to White Spur Dam, 41°53'S 145°31'E, 600 m, 24 Jan 1992, *J. Jarman s.n.* (HO310155); West Coast: Highway B28, east of Mt Murchison, Quinn Creek, 41°50'S 145°37'E, 600 m, 20 Feb 1998, *J.E. Braggins 98/065A* (AK255745, HO553557); Mt Murchison Regional Reserve, Anthony Road, 41°50'S 145°36'E, 590 m, 9 May 1991, *J. Jarman s.n.* (HO562403); 3 km south of Teepookana Bridge, 42°13'S 145°26'E, 220 m, 7 Nov 1990, *J. Jarman s.n.* (HO525961); South West: South West National Park, below summit of Mt Eliza, 42°57'50''S 146°23'36''E, 8 Feb 1995, *E.A. Brown 95/22 & B.M. Weicek* (HO, NSW365325).

Acromastigum colensoanum (Mitt.) A.Evans, *Annales Bryologici,* Supplement 3: 79 (1934) Fig. 18.

Bazzania colensoanum (Mitt.) Kuntze, *Revisio Generum Plantarum* 2: 832 (1891).

Bazzania colensoi (Mitt.) Rodway, *Tasmanian Bryophyta* 2: 75 (1916).

Mastigobryum colensoanum Mitt. in Hook.f., *Botany of the Antarctic Voyage ... Flora Antarctica* 2: 147 (1855), plate 100, fig. 3.

Type: New Zealand**,** North Island**,** Tararua, without date, *W. Colenso s.n.* (NY).

Mastigobryum divaricatum Nees in Gottsche, Lindenb. & Nees var. ß *muellerianum* Gottsche, *Linnaea* 28: 556 (1857).

Type: Australia, Victoria, without date*, F. von Müller s.n.* (B).

Mastigobryum minutulum Colenso, *Transactions of the New Zealand Institute* 19: 288 (1887).

Type: New Zealand**,** North Island**,** vicinity of Norsewood, without date, *W. Colenso 1403* (Y!).

Typically forming dense tufts composed of procumbent to suberect arching stems, yellow-green to pure green, never with brownish pigmentation (sometimes so pale when dried as to be almost glaucous). Shoots 0.8–1.8 mm wide (when flattened), usually 10–20 mm long. Stems somewhat lax, (125) 200–330 µm in diam., 5 to 9 cells in diam. (usually 6) and often slightly dorsi-ventrally flattened; cortical cells 0.6–3.8 (usually c. 1.5) × as

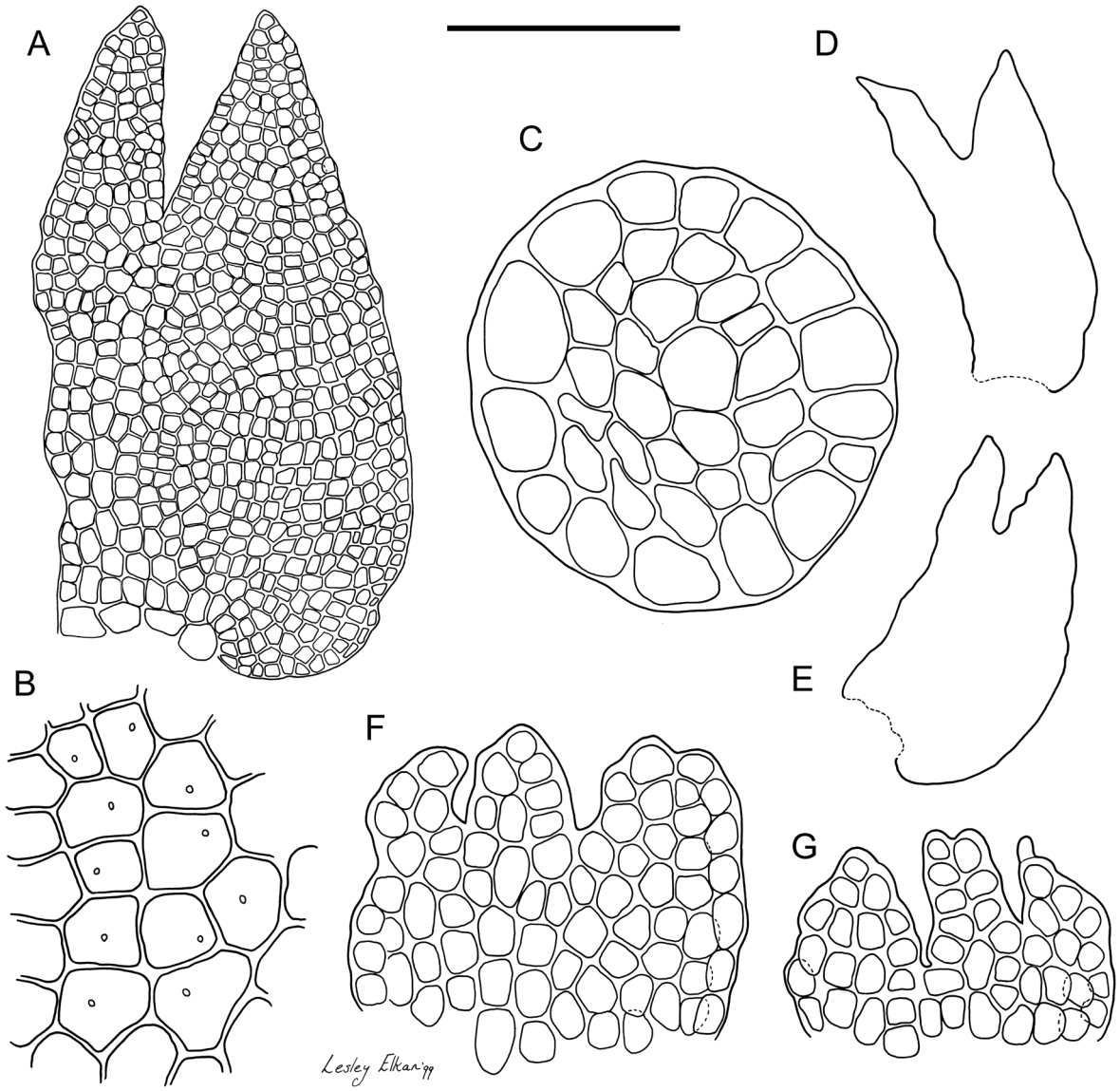


Fig. 18. *Acromastigum colensoanum*. **A,** Leaf cellular detail. **B,** Leaf medial cells. **C,** Stem transverse section. **D, E,** Leaf outlines. **F, G,** Underleaf cellular detail. Scale (approximate) **A**, **F**, **G,** 250 μm; **B**, **C,** 100 μm; **D**, **E,** 500 μm.

long as wide, (25–)55–125 μm long, 20–70 μm wide, 20–60 μm in diam., typically in 14 or 15 rows but sometimes only 7 or ranging from 15 to 21 in some populations; medullar cells more elongate, c. 2.5–8.9 × as long as wide, 70–135 μm long, 15–30 μm wide, 20–47 μm diam. (ends slightly tapered to square); cortical and medullar cells with walls 1–2 μm thick, outer tangential walls of cortical cells thicker (i.e. 6–8 μm) and radial walls of cortical cells frequently slightly thicker (i.e. 2–3 μm); oil-bodies absent or 1 per cell, then usually only in the subcortical medullar cells, botryoidal, 0 or 1 per cell, c. 25–30(–65) × 15–20 μm. Branches frequent, arising at intervals of 2–5 mm, lateral (usually diverging at an angle of 80–90°); flagella frequent. Rhizoids scarce, most frequently arising from flagella leaves. Leaves inserted at an angle of c. 20–40° from the vertical, imbricate or distant to slightly imbricate in smaller forms with 7 rows of cortical cells, flat to dorsally appressed to stem with the apices deflexed (often strongly so), 2-lobed (ventral distinctly narrower and usually shorter but sometimes slightly longer than the dorsal), (440–)535–875(–1265) μm long, (200–)230–465(–625) μm wide (as small as 318 × 149 μm in some leaves on type of *A. minutulum*), widest just above the narrowed base, dorsal base usually auriculate, ventral margin often straight or bulging slightly at ventral lobe; no vitta present but cells towards ventral margin sometimes very slightly larger than those elsewhere; ventral lobe 110–290 μm long, 70–160 μm (4–8 cells) wide at base; dorsal lobe 160–270 (–330) μm long, 125–245 μm (9–12 cells) wide at base; lobes acute. Cells of leaf fairly evenly sized throughout (perhaps slightly bigger towards the ventral margin and sometimes slightly smaller at the dorsal margin); frequently isodiametric to rectangular, 15–30 μm long, 8–25 μm wide; thin walled throughout (walls sometimes slightly

unevenly thickened or with tiny trigones, especially in lobes); oil-bodies usually not present in cells of leaves but occasionally with 1 globular oil body c. 1 μm diam. per cell, especially on fertile branches; cuticle smooth to quite distinctly but minutely papillate, especially on margins of lobes, 2(–6) μm thick at margins. Underleaves distant, insertion ± transverse, appressed, small (c. 0.15–0.25 size of lateral leaves), slightly narrower to slightly wider than stem, subquadrate or with lateral margins curving, 105–290 μm long, 145–295 μm wide, not auriculate at base and rarely with marginal irregularities; 3(or 4)-lobed with sinuses up to 0.3–0.5(–0.7) deep; lobes 2–4(–9) cells long, 2–4(–6) cells wide, often with one lobe larger or smaller than the others; apices of lobes rounded to truncate or emarginate, rarely acute. Asexual reproduction by caducous leaves, sporadic. Androecial branches small (4 to 6 pairs of androecia), inconspicuous, often with 4 or more per stem; bracts bifid 1/5–3/10 length, 1-androus, saccate and broadly ovate (sometimes barely so), c. 360–425 μm long and 340–370 μm wide, lobes acute; bracteoles ovate, c. 100–280 μm long and 160–220 μm wide, acute to emarginate (with papilla often present on emarginate lobes). Gynoecia produced in axils of underleaves, often several per stem to numerous, moderately common. Bracts and bracteoles similar, in several series, innermost largest, usually bifid with central sinus acute and split 1/2–2/3 length of bract but occasionally undivided or with 1 or 2 distinct teeth or laciniae, ovate, margins often smooth or sometimes with scattered protruding cells and papillae; cells rectangular (to almost isodiametric in cells at base of unfertilised gynoecia i.e. unexpanded), Length:width ratio 2–3.5, cell walls evenly thickened or marginally thicker in corners, sometimes with small trigones; oil-bodies distributed throughout, 1–3 per cell (but often with numerous tiny cellular inclusions which may be oil-bodies), ± globular, <1 μm diam., clear. Perianth c. 4.5 mm long when fully developed, slenderly ovoid-cylindrical, narrowed at mouth and variously lobed, lobes with margins varying from slightly to strongly toothed/laciniate, 2- or 3-stratose basally, reducing to 1-stratose near mouth, cells rectangular to elongate-rectangular or somewhat sinuose, Length:width ratio 2–5 (c. 45–120 × 15–35 μm), radial walls to c. 1 μm, ill-defined trigones scattered throughout, tangential walls up to 6 μm thick and having striate papillae in upper regions (very hard to observe); oil-bodies not observed in perianth. Sporophyte; seta with 8 or 9 rows of large, hyaline epidermal cells filled with botryoidal clusters of tiny oil-bodies (which may give the cells a dark appearance in transverse section) surrounding 21–23 rows of smaller interior cells; capsule walls 2 (or 3)-stratose. Inner layer of capsule with thickenings on radial walls and occasionally with a light deposit on the inner tangential wall in the corner(s) of the cell; epidermal layer. Elaters c. 12 μm diam, band width 4.5–5 μm and spiral periodicity c. 12–14 μm. Spores 12–16 μm diam.

Variation: Plant size varies between individuals. Some specimens (AK259070) are robust and have the outward appearance of a small *Bazzania* species, whereas the smallest forms are difficult to distinguish from the larger forms of *Acromastigum divaricatum*. The stem of *A. colensoanum* varies in stature and some small forms of this species may have only 7 rows of cortical cells. Individuals vary in leaf papillosity, those bearing more distinct papillae appear to carry this feature through into the bracts and perianth. Leaf shape and spacing also varies between individuals, the leaves in some New Zealand specimens (AK290018) are falcate, and the spacing varies from remote to imbricate. In Australia, mainland populations tend to have more triangular antical leaf lobes than Tasmanian individuals, which are more isolobous.

Distribution and ecology: In Australia *Acromastigum colensoanum* occurs as far north as the Lamington Plateau (Queensland) and from there south to Victoria and Tasmania along the Great Dividing Range. This species is also widespread in New Zealand and has been collected from one of the subantarctic Island groups (the Auckland Islands). In both countries *Acromastigum colensoanum* is common and occupies a variety of microsites. It may be found growing as an epiphyte on tree trunks, on roots, rotting logs, on boulders and bedrock of sedimentary, igneous or volcanic origin, on humus, and on sand.

Identification: *Acromastigum colensoanum* is distinctive in its relatively large shoot size (up to 1.6 mm wide), mid-green colour, subequally lobed leaves, with the ventral distinctly narrower and usually shorter but sometimes slightly longer than the dorsal, and the absence of a vitta in the ventral leaf-lobe, and stems with more than 7 cortical cell rows. *Acromastigum colensoanum* could be confused with *A. cunninghamii* and *A. divaricatum*. *Acromastigum cunninghamii* is distinctive in its narrow postical lobe, which is around two cells broad throughout its length, and comprised of vitta cells for all or close to all its length; the postical lobe is also displaced forward to converge with the apex of the antical lobe. *Acromastigum colensoanum* differs from *A. divaricatum* in its larger shoots, larger leaves having tens more cells, and stems usually having more than seven cortical cell rows.

Representative specimens examined: Australia: Queensland: Moreton: Lamington National Park, MacPherson Range, Tooloona Lookout, 28°15'34''S 153°10'24''E, 1180 m, 6 Mar 2014, *M.A.M. Renner 6820 & A.E. Orme*, (NSW850580). New South Wales: Northern Tablelands: Barrington Tops, Laurie Lookout, carpark, Gloucester Falls, River Walk, 31°58'S 151°27'E, 16 Jul 1989, *E.A. Brown 89/174* (NSW435018); Central Tablelands: Barren Grounds Nature Reserve, Lamonds Creek between the Natural Stone Bridge and Wonga Falls, 34°41'S 150°43'E, 570 m, 22 Apr 1992, *R.G. Coveny 16071* (NSW262583); South Coast: Maxwell Road, near stream, Mt Dromedary area, 36°18'S 150°01'E, 9 Jun 1989, *E.A. Brown 89/151* (NSW427232); Victoria: East Gippsland: Sassafras Creek, Ellery Camp, 30 km SSW of Bendoc, 37°24'S 148°47'E, 750 m, 8 Apr 1987,

J.A. Curnow 1484 (HO120038); Tasmania: North West: Sith Cala Nature Reserve, 41°13'S 146°06'E, 60 m, 19 Oct 1994, *A. Moscal 26111C* (HO443739); Anthony Road, 41°49'S 145°38' E, 500 m, 1 May 1993, *J. Jarman s.n.* (HO551534); East Coast: Mt Field, Russell Falls Creek, 42°41'S 146°40'E, 710 m, 14 April 1992, *A. Moscal 23442* (HO132867); Sentinel Range, 42°52'S 146°14'E, 680 m, 25 Feb 1999, *J. Jarman s.n.* (HO445261); Tasman Peninsula, Wellard Rivulet, 42°56'S 147°52'E, 4 Feb 1899, *W.A. Weymouth 798* (HO88193); Mount Wellington: Mt Wellington, Bower Creek, 42° 55'S 147° 15' E, 28 Dec 1897, *W.A. Weymouth 332* (HO88195); Mt Wellington, gully at Jacksons Bend, 42° 55'S 147°16'E, 15 Oct 1979, *D.A. Ratkowsky* (HO409649); South West: South Bruny Range, Waterfall Creek State Reserve, 43° 24'S 147° 19'E, 100 m, 28 Apr 1993, *A. Moscal 25118* (HO443743); Deadmans Bay, 43° 32'S 146° 30'E, 15 m, 21 Jan 1987, A. Moscal 15925 (HO113404); *A. Moscal 15959* (HO113044).

New Zealand: North Island**,** Western Northland: Waipoua Forest, Yakas track extension to headquarters, 35° 38'S 173° 32'E, 300 m, 25 Nov 1994, *J.E. Braggins 94/211* (AK257216); Auckland: Waitakere Ranges, Spraggs Bush, near car park, 36°54'S 174°33'E, 31 Jun 1983, *J.E. Braggins* (AK325140); Waitakere Ranges, Kellys Road University Reserve, Oratia, on slope from road to stream near uphill end of reserve, 36° 54'S 174° 36'E, 80 m, 16 Apr 2005, *J.E. Braggins 05/039* (AK290018); Hunua Range, start of track to summit off mine road, 37°2'24'' S 175°11'6'' E, 470 m, 29 Jul 2003, *J.E. Braggins 03/334* (AK284049); Coromandel Range, Kaitarakihi Track, lower third, 37° 9'S 175° 40'E, 540 m, 31 Jan 1987, *J.E. Braggins 87/016* (AK259070); Taranaki: Manaia Road, in mixed broadleaf forest near third Island in road, 39° 21'S 174° 8' E, 580 m, 26 Aug 1998, *J.E. Braggins 98/271B* (AK254258); Volcanic Plateau: Mt Ruapehu, off Ohakune Mountain Road, c. 100 m, downhill of 7 km marker, 39°22'S 175°28'E, 890 m, 27 Nov 1992, *J.E. Braggins 92/090 0*(AK325220); Southern North Island: Manawatu Gorge, Totara Reserve Pohangina, Fern Walk, No 1 Line Road of Pohangina Valley East Road, 40°8' 56'' S 175° 50' 32'' E, 480 m, 9 Dec 2005, *J.E. Braggins 05/086A,* (AK294767); South Island: Western Nelson: Golden Bay, Washbourne Reserve, Pohara, 40° 44' 40''S 172°41'22"E, 70 m, 29 Oct 2004, *J.E. Braggins 04/061* (AK290503); Paparoa Range, Sewell Peak, in Nothofagus forest near top of road to first peak, 42° 24' 32''S 171°20'24''E, 780 m, 6 Dec 2000, *J.E. Braggins* (AK287210); Southland: Catlins Ecological Region, Tahakopa Ecological District, Paptowai Scenic Reserve, on north bank of Tahakopa River, 46°34'S 169°28'E, 3 m, 23 Nov 1998, *J.E. Braggins 98/390A* (AK253811); Campbell: Auckland Islands, Ocean Island, 50°31'S 166°16'E, 24 Jun 1998, *A.J.D. Tennyson* (AK258342).

Acromastigum divaricatum (Nees) A.Evans in Reimers, *Hedwigia* 73: 142 (1933) Fig. 19.

Jungermannia divaricata Nees, *Enumeratio plantarum cryptogamicarum Javae.* 60 (1830), non *J. divaricata* Sm. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* plate *719* (1800).

Type: Asia**,** Java (not located).

Forming loose tufts composed of procumbent or slightly arching stems, yellow-green, never with brownish pigmentation. Shoots 0.7(–1.2) mm wide when flattened, up to 15 mm long. Stems rather lax, 115–185 (255) μm and 5 or 6 cells in diam., occasionally very slightly dorsi-ventrally flattened; cortical cells 1.2–1.5 × as long as wide, 55–85 μm long, 40–55 μm wide, 25–75 μm in diam., in 7 rows; medullar cells more elongate, c. 3.8–5.7 × as long as wide, 70–75 μm lomg, 10–20 μm wide, 13–55 μm diam. (ends slightly tapered to square); cortical and medullar cells with walls 1–5(–12) μm thick, outer tangential walls of cortical cells thicker (i.e. 5–22 μm) and radial walls of cortical cells frequently slightly thicker (i.e. 2–5(–11) μm); oil-bodies unknown. Branches infrequent, usually more than 5 mm apart, lateral (usually diverging at an angle of 90–100°); flagella commonly 2 or more per stem. Rhizoids not observed. Leaves inserted at an angle of c. 40–60 from the vertical, distant to very slightly imbricate, ± flat or with apices slightly deflexed, 2-lobed (ventral usually distinctly narrower but not infrequently with lobes of similar length or ventral distinctly longer, but also with ventral lobe occasionally noticeably smaller), 330–530(–630) μm long × 145–205 μm wide, usually ± parallel sided or widest in middle of leaf but some leaves widest just above the narrowed base, dorsal base varying from distinctly auriculate to obtuse, ventral margin often straight, sometimes concave or even bulging slightly at ventral lobe; no vitta present but 1 or 2 rows of cells towards the ventral margin sometimes very slightly larger than those elsewhere; ventral lobe 100–195 (260) μm long, 55–95 μm (2–4 cells) wide at base; dorsal lobe 105–205 μm long, 80–110(–140) μm (3–5 cells) wide at base; lobes acute. Cells of leaf slightly bigger towards ventral margin (c. 30–50 × 25–35 μm) and smaller towards the dorsal margin especially in the basal lobe (15–25 × 10–25 μm); moderately thick walled throughout, especially in the corners (but not forming distinct trigones); oil-bodies unknown; cuticle minutely striate/papillate, especially on lobes and margins, (2–)4(–10) μm thick at margins. Underleaves distant, insertion ± transverse, small (c. 0.1(–0.3× size of lateral leaves), slightly narrower than stem, subquadrate or with margins very slightly curving, 80–135 μm long, 105–150 μm wide, obtuse at base; 3-lobed, sinuses usually c. ½ way (ranging from 0.15–0.6); lobes (1 or) 2(or 3) cells long, 1–3 cells wide, often with one lobe larger or smaller than the others (base 2–5 cells high); apices of lobes rounded to truncate or emarginate. Asexual reproduction not observed. Androecia, gynoecia and sporophytes not observed.

Distribution and ecology: In Australasia *A. divaricatum* occurs in Australia (Tasmania) and New Zealand (North Island). It occupies forest and scrub, from near sea-level (2 m asl) to the alpine zone in Tasmania

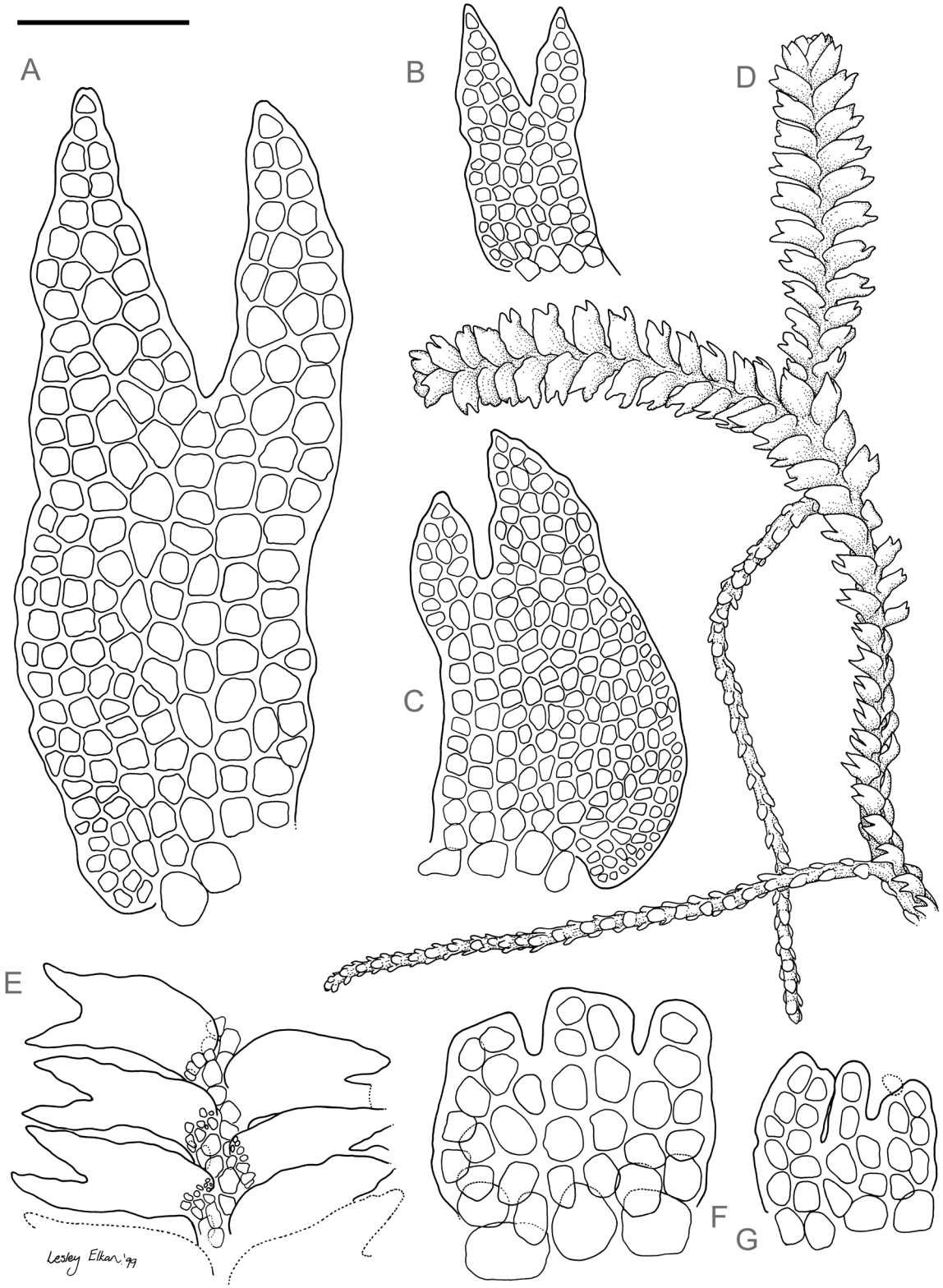


Fig. 19. *Acromastigum divaricatum*. **A–C,** Leaf cellular detail. **D,** dorsal view of shoot. **E,** Dorsal view of shoot sector, showing stem cellular detail. **F–G,** Underleaf cellular detail. Scale (approximate) **A,** **F**, **G,** 100 μm; **B**, **C,** 200 μm; **D**, 1000 μm; **E,** 250 μm. From *E.A. Brown 94/91, E. Jarman 87/3, W.A. Weymouth 925*.

(820 m asl). The few widely separated specimens of this species in Australasia were collected from a variety of habitats and substrates, including on streambank boulders with *Lepidozia*, in gullies with waterfalls in lowland forest; on soil under overhanging rock on the southern side of a rock outcrop emerging above alpine scrub dominated by *Astelia*, *Richaea*, and Southern Beech; and on damp rhyolitic saprolite under *Blechnum triangularifolium* just above the spray zone of a boulder beach.

Schiffner (1898) reported occurrences of *A. divaricatum* in Ambon, the Straits of Magellan and Tasmania. Evans (1934) regarded the Tasmanian report as dubious and probably based on *A. colensoanum*. This species has almost certainly been overlooked because of it's superficial similarity to *A. colensoanum* (see discussion under that species). The other possibility is that it is genuinely rare; recent collections are from the Mount Sprent area and from Mt Hesperus. It is a morphologically variable species, some forms of which closely resemble *A. colensoanum*. Recent reports of this species from Papua New Guinea (Grolle 1978, Piippo 1991) give the impression that this is a montane taxon so it's occurrence in Tasmania might not be anomalous. If these New Guinea records are genuine then one would also expect, however, to also find it in suitable geographically intermediate localities such as Mount Lewis, Mount Bellenden Ker and Barrington Tops.

Identification: Distinguished from *A. colensoanum* by the 7 rows of cortical cells with 2 rows of ventral cortical cells that continue into the ventral lobe of the lateral leaf to give the appearance of being distinctly larger than the cells in the rest of the leaf (when viewed at 40× magnification). Specimens often have a yellowish tint. The leaves are often remote, falcate and narrower at the base than at the apex, the postical leaf lobe is often slightly shorter than the antical lobe. The underleaves are rectangular, as wide or narrower than the stem, the underleaf lobes are close set, and usually 2 cells wide throughout, and have a distinct notch in the apex due to the rounded outline of adjacent apical cells.

Remarks: We accept Schiffner's (1898) record and broad circumscription for *A. divaricatum*.

Representative specimens examined: Australia: Tasmania: South West: tributary of Serpentine River, *E.A. Brown 94/91 & K.L. Radford*, 16 Jan 1994 (NSW285478, det. *E.A.Brown*); Mount Sprent, *J. Jarman 87/3*, 1987 (JE); Barker's Creek, near Williamsford, *W.A. Weymouth 925*, 02 Jan 1900 (G); Southwest National Park, Huon Valley, Arthur Range, Mt Hesperus, summit ridge, 43°06'40.5''S 146°13'09.3''E, 820 m, 24 Jan 2012, *M.A.M. Renner 5972* (NSW850379); Wilson Bight, 43°33'S 146°04'E, 15 m, 14 Jan 1987, *A. Moscal 15561* (HO501795); A. Moscal 15583 (HO501796); Mt Sprent, 42°47'S 145°58'E, 930 m, 17 Mar 1991, *A. Moscal 20667* (HO133807).

New Zealand: North Island**,** Western Northland Ecological Region, Tutamoe Ecological District, Waipoua Forest, Mataraua Plateau, bottom of Waoku Coach Road, 35°39'S 173°39'E, 500 m, 24 Apr 2003, *M.A.M. Renner 416*, *J.E. Braggins & R.M. Schuster* (AK282784); Coromandel Peninsula, Tairua, Paku Hill, Te Huruhuru Point, NZMS 260 T11 657624, 2 m, 14 Nov 2009, *P.J. de Lange 8109 & T.J.P. de Lange* (AK307214).

Excluded from the Australian flora

Acromastigum anisostomum (Lehm. & Lindenb.) A.Evans, *Annales Bryologici*, Supplement 3: 48 (1934). Figs 20 & 21.

Jungermannia anisostoma Lehm. & Lindenb. in Lehm., *Novarum et Minus Cognitarium Stirpium Pugillus*. 6: 57 (1834).

Type: New Zealand**,** South Island**,** Dusky Bay, without date, *A. Menzies s.n.* (B).

Jungermannia atrovirens Taylor, *London Journal of Botany* 3: 388 (1844).

Type: New Zealand, Auckland Island, 1840, *J.D. Hooker s.n.* (B, E293975!, H, NY961612! NY961684!, NY961686! YU).

Mastigobryum anisostomum Lehm. & Lindenb. in Gottsche, Lindenb. & Nees, *Synopsis Hepaticarum* 219 (1845).

Bazzania anisostoma (Lehm. & Lindenb. in Lehm.) Trevis. *Memoire del reale Istituto Lombardo de Scienze e Lettere. Serie 3. Classe di Scienze Mathematiche e Naturali:* 4: 414 (1877).

Mastigobryum chiloënse Steph. *Kongliga Svenska vetenskaps-akademiens handlingar* 46: 59, *f.* 22, e-h (1911).

Type: Chile**,** San Pedro Island, Chiloé, 1908, *C. Skottsberg s.n.*

Acromastigum brachyphyllum A.Evans *Annales Bryologici*, Supplement 3: 60 (1934).

Type: New Zealand**,** South Island**,** Paparoa Range, without date, *R. Helms 4848* (original material: CHR! MPN! P, Y) *syn. nov.*

See Engel and Glenny (2008) for description based on New Zealand material.

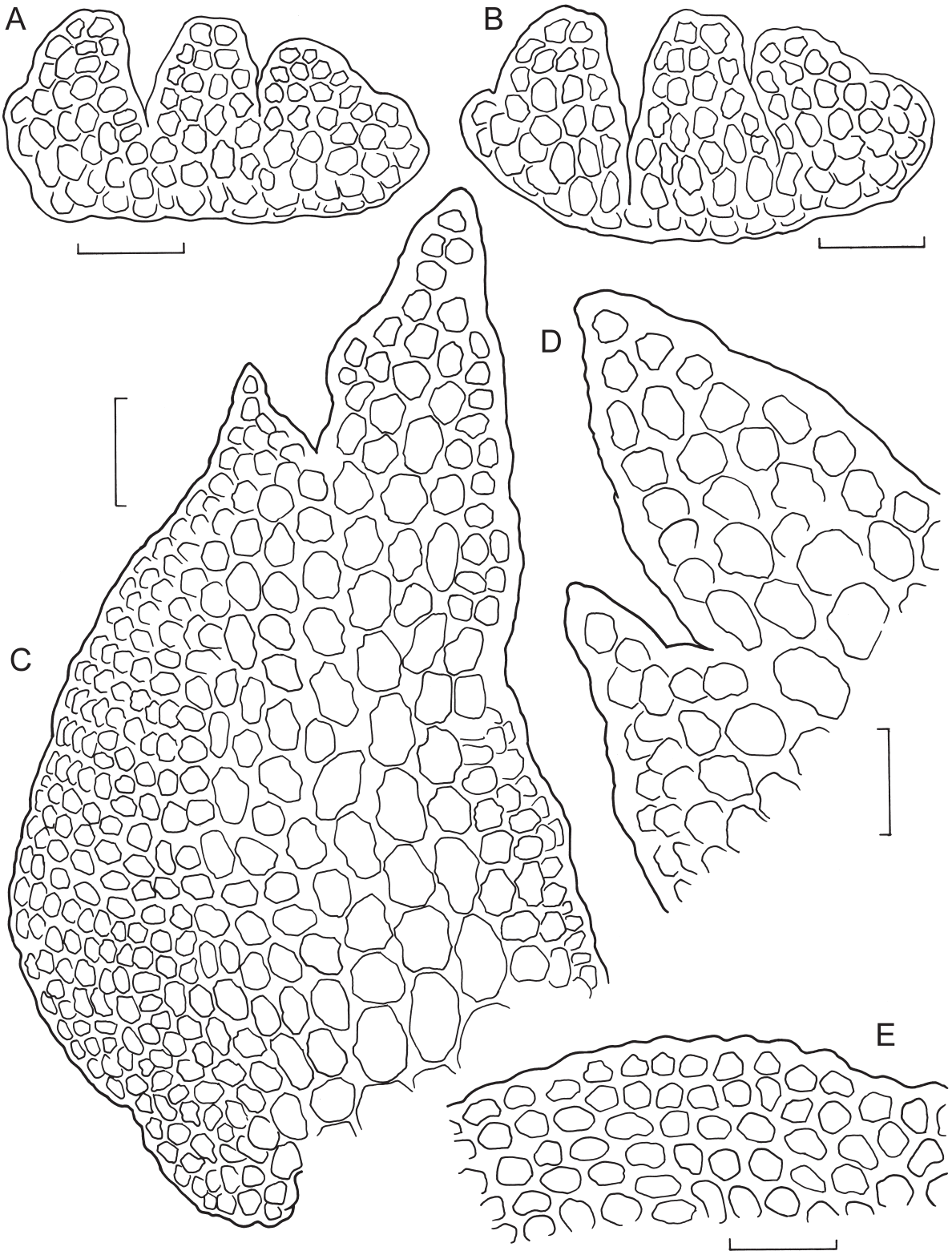


Fig. 20. *Acromastigum anisostomum*. **A, B,** Underleaves showing cellular detail. **C,** Leaf showing cellular detail. **D,** Leaf apex showing cellular detail. **E**, Dorsal leaf margin. Scale **A–C,** 60 μm; **D, E,** 40 μm. All from NSW745732.

Distribution and ecology: New Zealand, the Chatham Islands, Subantartic Islands including the Auckland Islands, and Chile. In New Zealand common in hyperhumid cool temperate podocarp-broadleaf and beech forests and subalpine scrubs from Hauturu (Little Barrier Island) and Te Moehau on the Coromandel Peninsula south, descending to near sea-level on the West Coast of the South Island. *Acromastigum anisostomum* occupies a wide range of microsites within forests, scrubs and heaths; and has been collected forming turfs on peat in low subalpine vegetation, on lignicolous hummocks on the floor within closed forests, on rocks and on soil banks alongside streams, and occasionally on bark of trees including *Leptospermum* and on Southern Beech. *Acromastigum anisostomum* grows in association with a wide range of other bryophyte and lichen species, including *Archeophylla schusteri*, *Crocodia rubella*, Dicranoloma *robustum*, *Lepidozia kirkii*, *L. procera*, *Paraschistochila pinnatifolia*, *Plagiochila ramosissima*, *Pseudocyphellaria glabra*, *P. homoeophylla*, and *Rhizogonium distichum*. A more complete list of associates is provided by Engel and Glenny (2008). In particular *A. anisostomum* may grow alongside, and even be admixed with, *A. marginatum*, *A. mooreanum*, and *A. interstisiale*.

Variation: Despite being confused with several other species (see recognition section). Individuals of *A. anisostomum* are generally consistent in morphology though some specimens exhibit variation in shoot size and leaf shape. Typical individuals form turfs of more or less erect shoots up to 800 µm wide whose leaves have a distinct sinus between antical and postical lobes. Within these individuals shoots are infrequently branched.

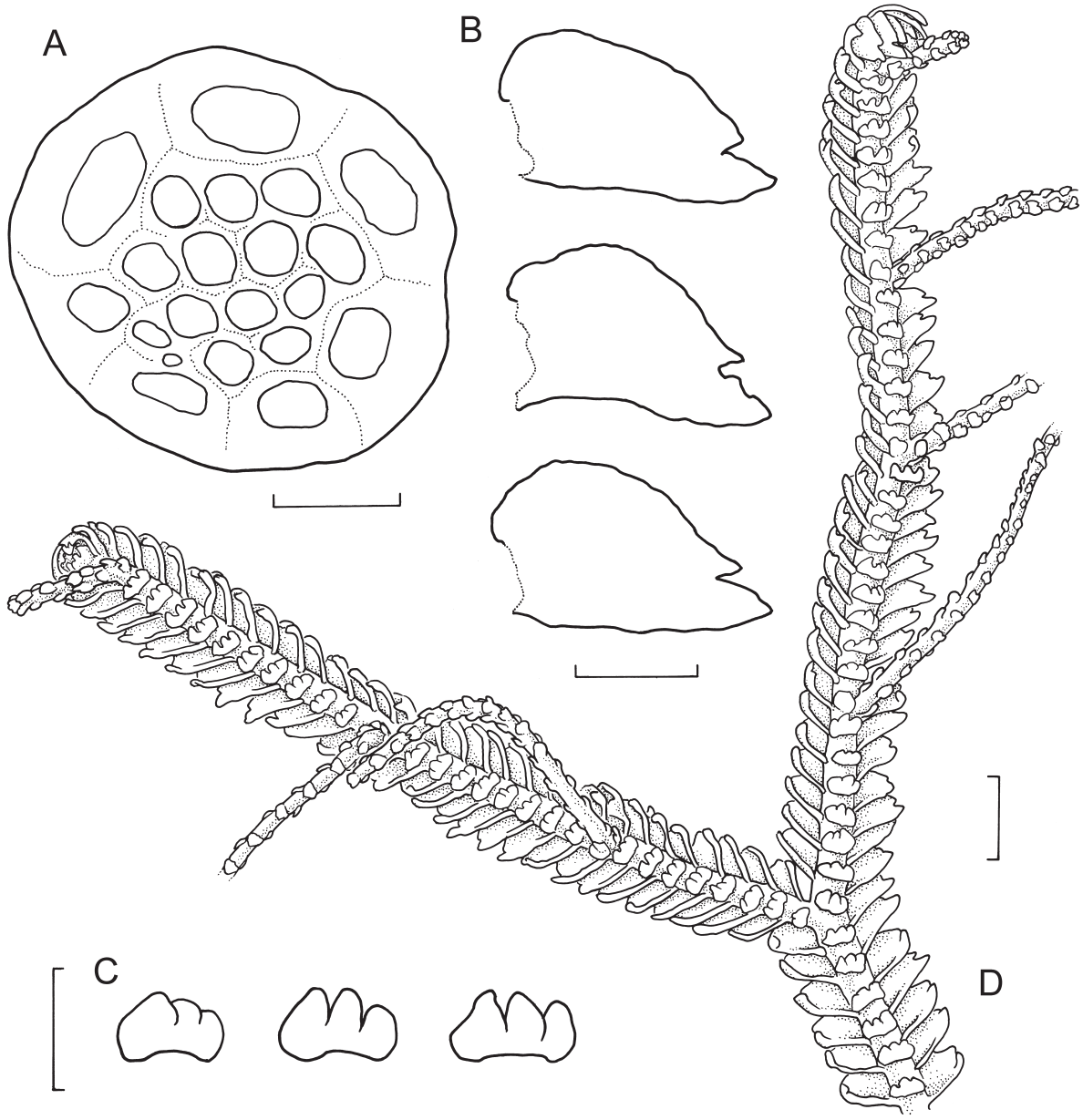


Fig. 21. *Acromastigum anisostomum*. **A,** Stem transverse section. **B,** Three leaf outlines. **C,** Three underleaf outlines. **D,** Ventral view of shoot. Scale **A,** 60 µm; **B**, **C,** 240 µm; **D,** 600 µm. All from NSW745732.

Individuals from sites exposed to periodic dehydration typically form mats of prostrate shoots, with frequently pseudodichotomously branched shoots around 600 µm wide. Within these individuals the antical leaf-lobe may be reduced such that the sinus is indistinct. The leaves tend to be more concave in individuals with prostrate shoots. The size of the leaves in the type of *A. brachyphyllum* represent the lower end of a continuum and the sinus size relative to the length of the leaf falls well within the range observed for *A. anisostomum*. The divisions are no more 'bluntly pointed, in many cases being obtuse rather than acute' than found in other populations of *A. anisostomum*, e.g. JE-H3220, WELT-H6175, WELT-H3579; this variation may be a plastic response to environment.

Recognition: *Acromastigum anisostomum* is distinctive in its shoots being golden-brown, reddish-brown or brown, its mature stem sectors being black, its turf forming habit, comprising densely packed, erect, infrequently branching shoots, and leaves with a shallow sinus and obtuse postical lobe apex.

Acromastigum anisostomum is similar to *A. mooreanum* and *A. interstisiale* and has been confused with both. See the recognition sections of those species for characters differentiating them from *A. anisostomum*.

Acromastigum anisostomum could be confused with *A. prismaticale* but latter is distinct in postical leaf-lobes being two cells wide from base to near tip, the cell walls of which are unevenly but broadly thickened forming broad but low and indistinct papillae.

In Australia specimens of *A. exiguum* have been mistaken for *A. anisostomum*. *Acromastigum anisostomum* differs from *A. exiguum* in the brown-tinted colouration of living plants and the leaf shape, where the postical margin is straight or nearly so. *Acromastigum exiguum* is bright green or yellow green in colour, and the postical leaf margin is curved.

Remarks: *Acromastigum brachyphyllum* A.Evans is placed into synonymy of *A. anisostomum*. The characters exhibited by this species are only slightly out of the normal range of variability encountered in *A. anisostomum*. Evans observed 'the occurrence of regions in which the cells are in two layers' in groups of 2–5 cells. Whilst this feature has not been observed in any other taxon involving 5 cells, it is not uncommon to observe bistratose regions involving 2 or 3 cells, particularly in taxa with strongly convex leaves, including *A. mooreanum* (e.g. AK300453). It may be that this feature is a structural response to the stresses involved in a leaf being flexed in such a manner.

Representative specimens examined: New Zealand: North Island: Auckland: Hauraki Gulf, Aotea (Great Barrier Island), Hirakimata (Mt Hobson), 36°11'S 175°25'E, 500 m, Dec 1986, *W.R. Sykes s.n.* (AK258878); Hauturu o Toi (Little Barrier), Mt Hauturu, summit ridge, 36°12'S 175°5'E, 700 m, 13 Jun 1984, *J.E. Braggins 84/183a* (AK313249); Thumb track to summit, 2 Sep 1963, *P. Hynes s.n.* (AK116852); Coromandel Range, Mt Moehau, NW from trig, 36°32'18''S 175°23'59''E, 820 m, 3 Nov 1980, *E.K. Cameron* (AK325181); South Island, Western Nelson: Mt Burnett, along 4WD track to summit, 40°38'21''S 172°38'12''E, 580 m, 30 Nov 1995, *J.E. Braggins 95/684A* (AK285907); Stockton mine area, Webb Stream, a tributary of Waimangaroa River, 41°40'12''S 171°52'53''E, 700 m, 5 Dec 2006, *J.E. Braggins 06/247A* (AK301819); Paparoa Range, Ohikanui River, 41°57'S 171°41'E, 200 m, 19 Feb 2003, *M.A.M.Renner 297* (AK283009); Paparoa Range, Sewell Peak, road to summit about half way up, 42°24'53''S 171°19'19''E, 400 m, 6 Dec 2000, *J.E. Braggins s.n.* (AK287116); Westland: Gillespies Beach Road, 10 km west of Fox Glacier, 43°25'S 169°55'E, c. 160 m, 24 Dec 1983, *J. Child H4876* (F1088077); Omoeroa Saddle, between Fox and Franz Joseph, 43°25'S 170°7'E, 320 m, 29 Nov 1998, *J.E. Braggins 98/474B* (AK254037); Cascade Road, 44°7'S 168°33'E, 140 m, 27 Nov 1998, *J.E. Braggins 98/444* (AK253905); Chatham: Rangiauria (Pitt Island), Waipapaku Creek (Second Water Creek), Waterfall, 44°17'S 176°12'W, 80 m, 30 May 2008, *P.J. de Lange CH1715 & P.B. Heenan* (AK303448).

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References

Anderson RH (1961) Flora of New South Wales. *Contributions from the New South Wales Herbarium, Flora series* Introduction: 1–15.

Anonymous (1975) [untitled map] *Contributions of the Queensland Herbarium* 19: back end paper.

Brown EA, Söderström L, Hagborg A, von Konrat M (2012) Notes on Early Land Plants Today. 10. A new combination in *Acromastigum*. *Phytotaxa* 65: 58.

Carrington B (1870) Dr. Gray's arrangement of the Hepaticae. *Transactions and Proceedings of the Botanical Society, Edinburgh* 10: 305–309.

Conn BJ (1993) Natural regions and vegetation of Victoria. In Foreman DB, Walsh NG (eds), *Flora of Victoria*, Volume 1 (Inkata Press, Melbourne)

Cooper ED, Shaw AJ, Shaw B, Henwood MJ, Heslewood MM, Brown EA (2011) A multi-locus molecular phylogeny for the Lepidoziacea**E,** laying the foundations for a stable classification. *Molecular Phylogenetics and Evolution* 59: 489–509. http://dx.doi.org/10.1016/j.ympev.2011.02.006

Engel JJ, Merrill GLS (1994) Studies of New Zealand Hepaticae 8-13: *Bazzania* and *Acromastigum*. *The Bryologist* 97: 313–320. http://dx.doi.org/10.2307/3243464

Evans AW (1934) A revision of the genus *Acromastigum*. *Annales Bryologici, Supplement* 3: 1–178, plates 1-40.

Glenny D, Fife AJ, Brownsey PJ, Renner MAM, Braggins JE, Hitchmough R (2011) Threatened and uncommon bryophytes of New Zealand (2010 revision). *New Zealand Journal of Botany* 49: 305–327. http://dx.doi.org/10.1080/0028825X.2011.561864

Gottsche CM, Lindenberg JBG, Nees von Esenbeck SG (1845) *Synopsis Hepaticarum*, Hamburg, Meissner.

Grolle R (1978) Lebermoose aus Neuguinea 16. *Acromastigum*. *Journal of the Hattori Botanical Laboratory* 44: 1–15.

Heslewood MM, Brown EA (2007) A molecular phylogeny of the liverwort family Lepidoziaceae Limpr. In Australasia. *Plant Systematics and Evolution* 265: 193–219. http://dx.doi.org/10.1007/s00606-006-0512-z

Hodgson EA (1954) New Zealand Hepaticae (liverworts)–VIII. A review of the New Zealand species of the genera *Bazzania* and *Acromastigum*. *Transactions of the Royal Society of New Zealand* 82: 7–24.

Hürlimann H (1983) Hepaticae aus dem Gebeite des südlichen Pazifik VII. *Bauhinia* 7: 259–268.

Jarman SJ, Fuhrer BA (1995) *Mosses and liverworts of rainforest in Tasmania*. CSIRO Publications, East Melbourne. 134 pp.

Kitagawa N (1985) A study on the genus *Acromastigum* (Hepaticae) of New Caledonia. *Acta Phytotaxa et Geobotanica* 36: 107–122.

Orchard, A.E. (1988) A natural regions map for Tasmania. Proceedings of the Royal Society of Tasmania 122(2): 48.

Piippo S (1991) Bryophyte flora of the Huon Peninsula, Papua New Guinea. XL. *Acromastigum* and *Hygrolembidium* (Lepidoziaceae subfam. Bazzanioideae and Lembidioideae, Hepaticae). *Acta Botanica Fennica* 143: 23–34.

Renner MAM (2013) *Lejeunea subelobata* and *Lejeunea drummondii* (Jungermanniopsida) in Australasia. *Polish Journal of Botany* 58: 193–203.

Rodway L (1917) Tasmanian Bryophyta. Hepatics. *Papers and Proceedings of the Royal Society of Tasmania* 1916: 1–92.

Schiffner V (1893) Hepaticae (Lebermoose). In Engler-Prantl (eds) *Die natürlichen Pflanzenfamilien* 1: 3–141, figs 1–141.

Schiffner V (1898) *Conspectus Hepaticarum Archipelagi Indici*. 1-382. Batavia

Schuster RM (1963) Studies on antipodal Hepaticae I. Annotated keys to the genera of antipodal Hepaticae with special reference to New Zealand and Tasmania. *Journal of the Hattori Botanical Laboratory* 26: 185–309.

Schuster RM (1968) Studies on Hepaticae. XXIX-XLIV. A miscellany of new taxa and new range extensions. *Nova Hedwigia* 15: 437–529.

Schuster RM (1969) *The Hepaticae and Anthocerotae of North America II*. Columbia University Press, New York and London. 1062 pp.

Schuster RM (1984) Evolution, phylogeny and classification of the Hepaticae. In Schuster RM (ed.) *New Manual of Bryology II*. *The Hattori Botanical Laboratory*, Nichinan: 892–1070.

Schuster RM (1997) On a new microphyllus New Caledonian *Acromastigum* (Lepidoziaceae). *Nova Hedwigia* 6 4: 613–620.

Spruce R (1885) Hepaticae Amazonicae et Andinae. *Proceedings of the Botanical Society of Edinburgh* 15: i-xi, 1–588, plates 1–22.

Stephani F (1885–1886) Hepaticarum species novae vel minus cognitae. VIII. *Hedwigia* 25: 233–249, plates 1 & 2.

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