

Cephaloziella remotifolia (Marchantiopsida, Cephaloziellaceae), a new species from alpine New Zealand

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Abstract

Cephaloziella in New Zealand comprises 20 taxa with the addition of *Cephaloziella remotifolia* sp. nov., newly described based on a recently collected male specimen from alpine Western Nelson. *Cephaloziella remotifolia* is distinguished from other New Zealand *Cephaloziella* species by a distinctive combination of remote leaves, the stem and leaves pluripapillose, leaf base processes absent or slight, stem cortical cells not differentiated from inner cells, leaves asymmetrically bilobed and divided to $\times 0.4$ their length, and leaf margins entire. Other features include underleaves absent or very small with a few cells only, they are never bifid and are not papillose, and the leaf cell walls are only 2 μm thick. The species is dioicous and androecia are terminal on the main shoot, becoming intercalary, the bracts much larger than leaves. The plants have been found in penialpine seepage among other bryophytes and on peat soil over granite in stunted shrubland.

Introduction

Cephaloziella (Spruce) Schiffn. is a genus of about 90 described species (Söderstrom et al. 2016) with a world-wide distribution extending from the Arctic to Antarctica. The New Zealand species of *Cephaloziella* were the subject of two studies by Schuster (1972, 1996) in which 13 species and one variety were described as new. One New Zealand species has been described since then (Beveridge et al. 2016).

Excluding *Cephaloziella rufobrunnea* R.M.Schust. (a synonym of *Marsupella sprucei* (Lind.) Dumort., *vide* Váňa et al. 2014), and including *Cephaloziella tahora* P.Bever. & Glenny (Beveridge et al. 2016), there are currently 17 *Cephaloziella* species plus one variety and one subspecies known in New Zealand. Nine of these 19 taxa were described from single collections. Of the new species and variety described by Schuster (1972 and 1996) two, *C. exigua* R.M.Schust. and *C. densifolia* var. *dubia* R.M.Schust., were described from single sterile specimens and two, *C. aenigmatica* R.M.Schust. and *C. pseudocrassigyna* R.M.Schust., were described from female specimens only. *Cephaloziella subspinosa* R.M.Schust. was described from male plants but androecia were neither described nor illustrated. The remaining seven species were described from material including male and female reproductive structures, sporophytes and spores. *Cephaloziella tahora* was described from female plants (Beveridge et al. 2016) and is most similar to *Cephaloziella remotifolia* (see Discussion).

Incomplete descriptions from sterile and/or few available collections has not presented an obstacle to making identifications in the genus because sterile plants offer many useful differentiating vegetative characters and these are presented in Schuster's (1972 and 1996) informative illustrations. Nevertheless, Schuster (1980 p. 39) commented "Perhaps no genus of Hepaticae is more difficult than *Cephaloziella*" and part of this difficulty he attributed to variability within species and the difficulty of finding populations on which to base a study of that variation. That problem exists for the species described here.

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Cephaloziella remotifolia was recently found at Lake Clara, Western Nelson by Greg Napp (Department of Conservation) while collecting an undescribed *Riccardia*. There is only one collection, but it is abundant. Undetermined *Cephaloziella* specimens at CHR were searched for further collections and one collection from Stewart Island was found that is probably *C. remotifolia* but the specimen is sterile (see Discussion for further details).

Methods

Light microscope photographs were taken with a Leica DMLB 2500 compound microscope with a Flexacam camera and differential interference contrast. The stem transverse section (Fig. 1B) was bleached to make the cell walls rigid. Ruthenium red was used after bleaching to make features of the shoot more visible in Fig. 1C. Scanning electron micrographs were taken of dry plants with a Hitachi desktop scanning electron microscope after gold coating.

Taxonomy

Cephaloziella remotifolia Glenny, *sp. nov.*

Type: New Zealand: South Island, Western Nelson, Amphitheatre Creek below Lake Clara, 1300 m, near 172.562°E, 40.894°S, terrestrial, with *Hymenophyllum revolutum* and *Radula australiana*, 14 Feb 2025, G. Napp s.n. (holotype: CHR 698205; isotypes: HO, F).

Dioicous. Plants prostrate and forming pure loose parallel wefts, 10–27 mm long (Fig. 1A). Shoots including leaves 250–320 µm wide, when fresh mid-green with weak orange-red pigments in parts of the male bracts and the ventral epidermis, older basal part of plants becoming hyaline and the leaves eroding. Shoots unbranched or sparsely branched (up to 3 branches per shoot system), branching mostly lateral-intercalary, rarely ventral-intercalary, terminal branches not seen. Microphyllous shoots uncommon and not well differentiated from normal-leaved shoots. Stem 90–100 µm and 8 cells in diameter, the surface densely pluripapillose, the papillae usually elliptical (Fig. 2). Cortical cells in c. 23 rows, rectangular in surface view and 15–24 µm long and 9–12 µm wide, in transverse section not differentiated in size or wall thickness from c. 28 inner rows of medulla cells, all 11–20 µm in diameter, walls c. 2 µm thick with slight, concave trigones (Fig. 1B). Rhizoids hyaline, c. 350 µm long, sparsely scattered on ventral stem surface (Fig. 1C), dense on the ventral stem surface in the androecium (Fig. 4A,B). Leaves reaching the dorsal stem midline, distant, the internode length on one side twice the leaf length with 19–20 intervening cortex cells, insertion subtransverse, leaf angled to stem 45–60°, not conduplicate-folded and very slightly cupped in the disk (Fig. 3A). Leaves 170–200 µm long, 120–150 µm wide, asymmetrically bifid $\times 0.34$ – 0.42 of leaf length (Fig. 3B). Larger lobe 54–69 µm and 5–7 cells long, 53–64 µm and 5 cells wide at the base, terminating in a single hyaline acute-tipped cell. Smaller lobe 35–45 µm and 3–4 cells long, 48–55 µm and 4 cells wide at base, also terminating in a single hyaline acute-tipped cell. The smaller lobe 0.6 – $0.8 \times$ the area of the larger lobe. Lobe apices adaxially hooked when dry but not when moist, Leaf margins plane, usually untoothed

but irregular due to papillae and slight projections, rarely with one single-celled tooth per leaf. Cells at mid-disc nearly square, 13–17 µm long, 11–15 µm wide, walls 1.5–2.0 µm thick, trigones concave and small (Fig. 5C). Oil-bodies in leaves 3–4 per cell in leaves, in male bracts 3–4(6) per cell, finely granular, ovoid, colourless, 4 – 6×3 – 5 µm (Fig. 5C). Leaf surfaces both papillose with 3–6 papillae over each leaf cell, the papillae hemispherical and 6–8 µm high (Fig. 3A, Fig. 5D). Processes weakly developed at leaf base, mostly in the form of larger surface papillae but sometimes single cells project from the leaf surface (Fig. 3A). Underleaves usually absent, when present composed of 3–8 cells, 1–3 cells wide at base, ending in up to 3 uniseriate cells, never bifid, free from lateral leaves but adjacent to the ventral base of a leaf, surfaces smooth. Gemmae absent. Androecium terminating main axis (Fig. 1C) or leafy side branches, a series of 5–12 alternating and contiguous bracts 400 µm wide, the androecium 1.6 – $2.0 \times$ wider than the vegetative shoot width, superseded by normal leaves and becoming intercalary with up to 3 androecia per unbranched axis. Male bracts conchiform (Fig. 5A,B), 270–340 µm long, 260–320 µm wide, asymmetrically bifid to a depth of 0.15 – $0.30 \times$ the bract length, one lobe broad and rounded, the other acute-tipped, margins entire or with 1–3 single-celled teeth per lobe. Bract surfaces with 3–5 papillae over each cell, the papillae 6–8 µm high (Fig. 5A,B). Abaxial bract surface more strongly pluripapillose than adaxial surface, particularly near the bract base. Antheridium one per bract, 180 µm long, 150 µm in diameter, stalk 50 µm long, stalk cells uniseriate. Male bracteole connate to one adjacent bract, 35–75 µm long, 21–33 µm wide, rectangular or ovate (Fig. 4). Female plants and sporophytes not seen.

Distribution and ecology: New Zealand: Western Nelson (Lead Hills Range, Amphitheatre Creek below Lake Clara). Stewart Island (Gog), 180–1300 m. At both sites on wet infertile sloping soils and exposed gravel derived from granite, with stunted *Leptospermum scoparium* shrubland including *Oreobolus pectinatus*, *Gleichenia* and *Chionochloa rubra*. On Stewart Island plants were threaded through *Rhacocarpus purpurascens*. At Lake Clara plants formed a dense but loose weft on soil mixed with *Radula australiana* (Fig. 6).

Recognition: Plants are mid-green with slight orange-red tinting. The stem is green but can be slightly orange on the ventral surface, the stem surface is pluripapillose and stem cortical cells are not differentiated in size, wall thickness or colour from inner stem cells. Leaf-base processes are absent or slight. Leaves are very small (170–200 µm long), remote, asymmetrically bilobed to $0.4 \times$, and the margins are usually completely untoothed (Fig. 4A,B). The leaf lobe apices are acute and leaves are angled to the stem. Microphyllous shoots are rare and not very distinct from normally-leaved shoots. Underleaves are completely absent or composed of a few cells, difficult to see without staining and never bifid; their surfaces are smooth (Fig. 4C). Leaf cell walls are not thick (2 µm wide). Gemmae are absent. The species is dioicous, with androecia terminal, becoming intercalary, the bracts and bracteoles larger than leaves and underleaves. All features of *Cephaloziella remotifolia* can be seen in other New Zealand species of *Cephaloziella* but not in this combination.

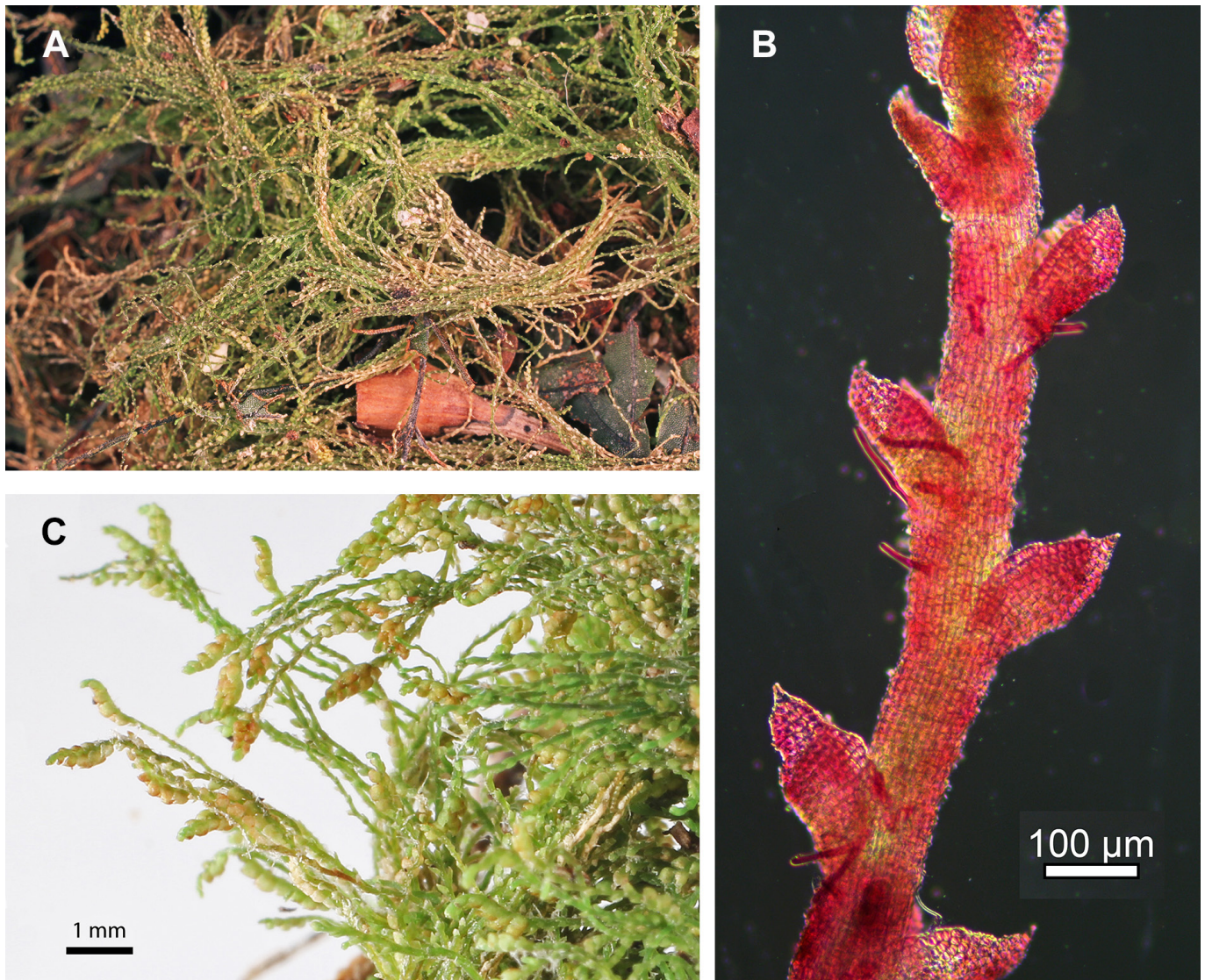


Figure 1. *Cephaloziella remotifolia*. A. Plants forming dense, pure wefts. B. Ventral view of sterile shoot. Cells of the stem cortex are only slightly longer than leaf cells. Stained with ruthenium red. C. Abundant androecia terminating shoots. Photographed from the type (G. Napp s.n.; CHR 698205).

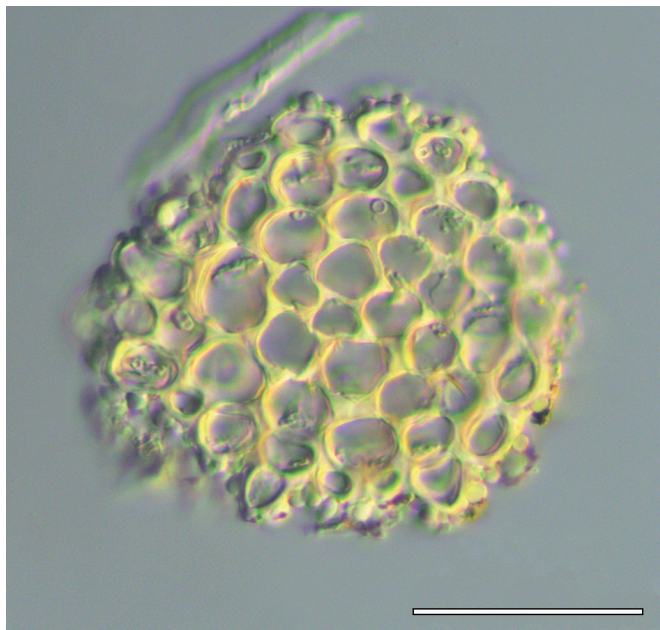


Figure 2. *Cephaloziella remotifolia*, stem in transverse section. Bleached. Photographed from the type (G. Napp s.n.; CHR 698205). Scale bar = 50 µm.

Etymology: The epithet *remotifolia* refers to the distance between leaves on the stem, the most conspicuous feature of the plants on first examination.

Conservation status: Data deficient in the scheme of Townsend et al. (2008) as known from one, and perhaps two localities (see discussion below). *Cephaloziella remotifolia* may be more widespread throughout alpine habitats of the western South Island, but this remains to be established.

Other specimen examined: Stewart Island, Gog, 180 m, 167.563°E, 47.193°S, on granite outcrop, edge of soil hump with *Leptospermum scoparium*, *Oreobolus pectinatus* and *Gleichenia*, threaded among *Rhacocarpus purpurascens*, 27 Feb 1999, P. Warren s.n. (sterile) (CHR 623892).

Discussion: *Generic placement:* Despite the lack of perianths, there is no doubt that *Cephaloziella remotifolia* belongs in *Cephaloziella*. Features that place it there are its small size, remote leaves that reach the dorsal stem midline, reduced underleaves, branching mostly or entirely intercalary, leaves only 170–200 µm long, bifid, and sub-transverse. Leaf cells are quadrate and the walls slightly thickened, oil-bodies are finely

granular, (2)3–9 per cell. Androecia are on the main shoot and are intercalary. Antheridia are one per bract, the antheridial stalk 1-seriate.

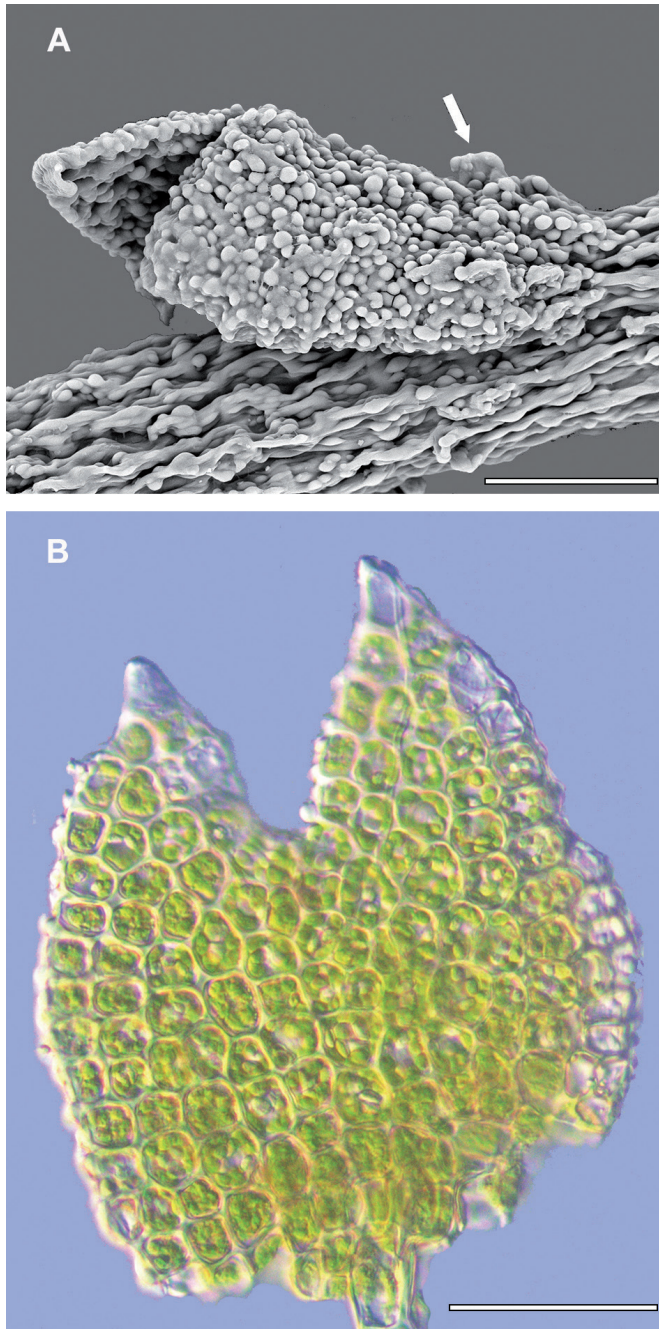


Figure 3. *Cephaloziella remotifolia*. A Sterile leaf showing papillae on both leaf surfaces and slight processes at leaf base. B. Vegetative leaf. Images from the type (G. Napp s.n.; CHR 698205). Scale bars = 50 µm.

Infrageneric placement: Thirteen New Zealand species are in subgenus *Cephaloziella*, one in subgenus *Schizophyllum* Müll. Frib., one in subgenus *Evansia* Müll.Frib., and one in subgenus *Distichopsis* R.M.Schust. (Engel and Glenny 2008). *Cephaloziella remotifolia* belongs in subgenus *Cephaloziella*, following the subgenus key in Engel and Glenny (2008).

Similar species: Of New Zealand's 17 known *Cephaloziella* species, 12 are dioicous, 12 have papillose leaves, and 6 have stem papillae. In combination, these three features rule out all but *C. tahora* as confusable with *C. remotifolia*.

Cephaloziella tahora is similar to *C. remotifolia* in the cortical cells not differing from the internal stem cells, the stem surface densely papillose, leaves are green, distant (8–14 cells between adjacent leaves) with margins entire, and the underleaves are reduced to a few cells. Leaves are on average larger, 120–250 µm long and 170–300 µm wide. *Cephaloziella tahora* differs in having leaf margin gemmae, oil-bodies few, (0)1–3(4) per cell, appearing homogenous; leaf apices are rounded or obtuse, rarely acute; underleaf cells are densely papillose; and there are no processes at the leaf base.

Cephaloziella remotifolia keys near to *C. aenigmatica* in the partial key of Beveridge et al. (2016), which is from similar alpine habitat in the Paparoa Range, Western Nelson. That species is also dioicous, underleaves are absent or very reduced, and leaf margins are rarely toothed but appear crenulate due to papillae. *Cephaloziella aenigmatica* differs from *C. remotifolia* in having imbricate leaves and the stem wiry and the cortex cells thick-walled. No mention is made by Schuster (1996) of stem papillae and they are not shown in his illustration of the stem section. Leaves are more deeply bifid to 0.55–0.75×, cell walls are thick, and gemmae are present.

Cephaloziella pulcherrima subsp. *sphagnicola* has papillose leaves and stems and has processes at the leaf base. However, the underleaves are not much smaller than the lateral leaves and it is autoicous.

Eleven of the 17 currently known New Zealand species are endemic. All six of the non-endemic species are shared with Australia: *Cephaloziella exiliflora* (Taylor) Douin, *C. hirta* (Steph.) R.M.Schust., *C. muelleriana* R.M.Schust., *C. pulcherrima* R.M.Schust., and *C. varians* var. *subantarctica* (R.M.Schust.) R.M.Schust. ex J.J.Engel (Renner et al. 2024). Two Australian species are not shared with New Zealand, *Cephaloziella levieri* (Steph.) Schiffn. ex Douin and *C. arenaria* (Steph.) R.M.Schust. Both are monoicous and cannot be equated with *C. remotifolia*.

Fulford (1976) recognised 13 species of *Cephaloziella* in South America. *Cephaloziella remotifolia* shares many similarities to *C. spegazziniana* (C.Massal.) Douin of Tierra del Fuego: plants of *C. spegazziniana* are green tinged with red, occasionally branched, with distant small leaves (500–1000 µm long) that are verrucose, and underleaves are absent or composed of 1 or 2 cells. However, Massalongo (1885) believed his species was monoicous despite not describing male features, the leaves are much longer than those of *C. remotifolia*, and the leaf lobes are narrowly triangular rather than broadly triangular, and cells in the leaf lobes are elongate parallel to the leaf axis and are thick-walled. No mention is made of papillae on the stem surfaces.

A sterile collection made on Stewart Island from very similar habitat to the type may be this species (Fig. 4D). It shares most features of the type (Table 1) but differs in a few respects as ventral intercalary branches predominate whereas in the type of *Cephaloziella remotifolia* they are uncommon. Proportions of branching types can vary considerably between populations of a species (Glenny & Fish 2023). Underleaves in the Stewart Island plants are well developed and bifid near the shoot apices, not seen in the type of *C. remotifolia*. The Stewart Island specimen has not been used for the description of *C. remotifolia* because of uncertainty that this sterile specimen is the same species.

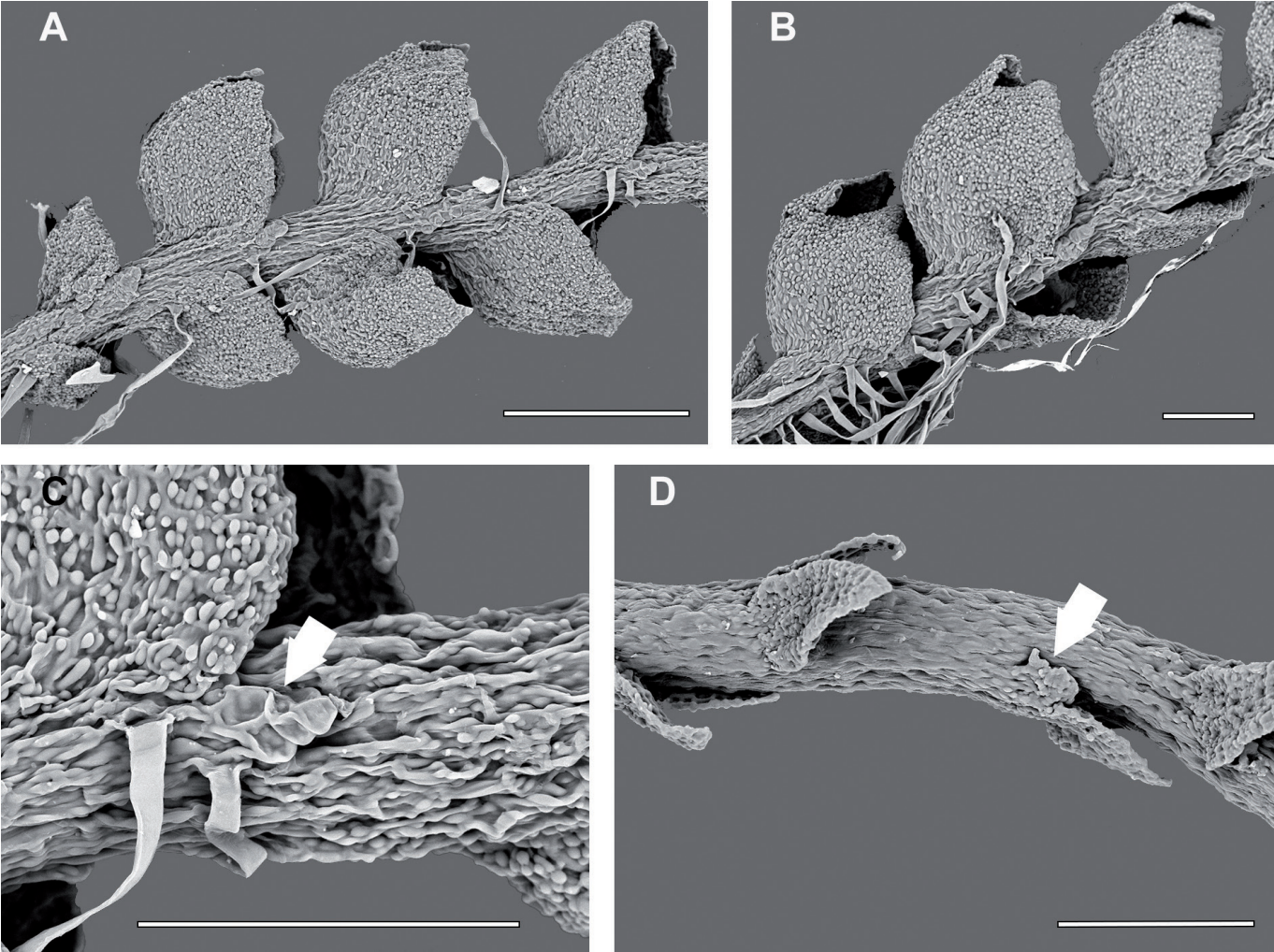


Figure 4. *Cephaloziella remotifolia*. A. Whole androecium in ventral view with three pairs of bracts and small bracteoles adjacent to each bract in the upper half of the image, sterile leaves before and after the androecium. B. Ventral view of androecium showing conchiform bracts and dense but scattered rhizoids. C. Base of male bract and associated bracteole (arrow). D. Ventral view of shoot showing leaves, underleaf (arrow), papillae on stem and leaves, and slight processes at leaf base. Images A–C from the type (*G. Napp s.n.*; CHR 698205); D from CHR 623892, Stewart Island. Scale bars = 100 μm.

Table 1. Comparison of the holotype of *Cephaloziella remotifolia* with CHR 623892.

	Holotype, Lake Clara	CHR 623892, Stewart Island
stem cortex cells between adjacent leaves	19–20	20
stem and leaves papillose	yes	yes
processes at leaf base	slight	slight
stem cortex	not differentiated	not differentiated
stem diameter, μm	90–100	75–100
leaf length, μm	170–200	100–230
depth of leaf sinus	0.40–0.42×	0.45–0.76×
larger lobe size	7 cells wide, 5 cells long	6 cells wide, 7 cells long
branching	sparse, lateral-intercalary (11/13), ventral-intercalary (2/13), terminal (0/13)	sparse, lateral-intercalary (2/7), ventral-intercalary (4/7), terminal (1/7)
vegetative shoot underleaf	absent or ~13 μm wide, not bifid	absent or ~170 μm wide, sometimes bifid
microphyllous branches	uncommon	absent
rhizoids in normal shoots	scattered and sparse	scattered and sparse
secondary pigments	orange-red	red
gemmae	absent	absent

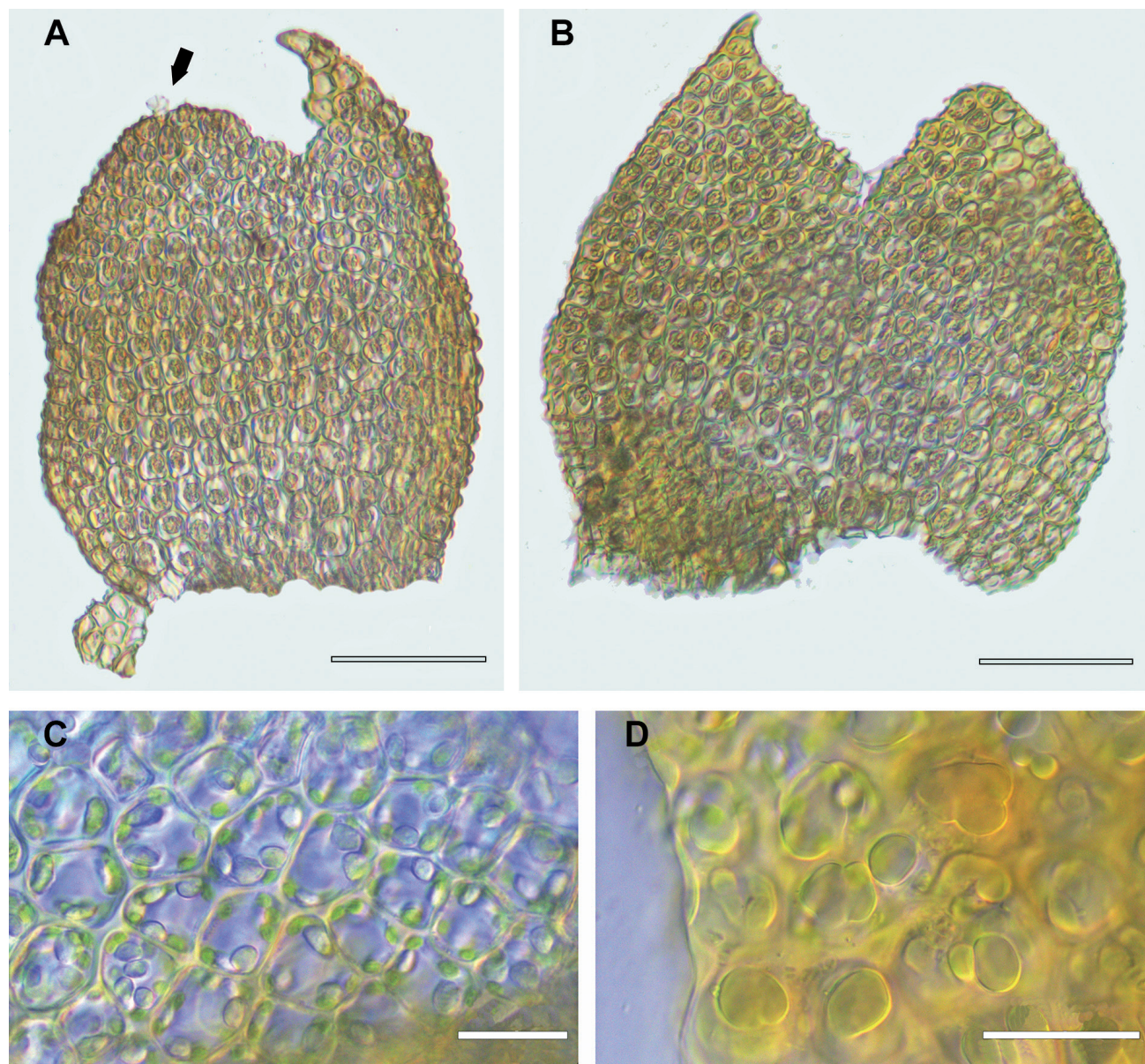


Figure 5. *Cephaloziella remotifolia*. A, B. Male bracts (arrow in A indicating slime papilla). Connate bracteole at lower left. Collapsed hyaline papilla at the apex of the broad bract lobe at upper left. C. Oil-bodies at mid-leaf. D. Leaf papillae at the margin. Photographed from the type (*G. Napp s.n.*; CHR 698205). Scale bars A, B = 100 μ m; C, D = 50 μ m.



Figure 6. Location of type locality of *Cephaloziella remotifolia*, Lake Clara, in the north-west of the South Island of New Zealand.

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