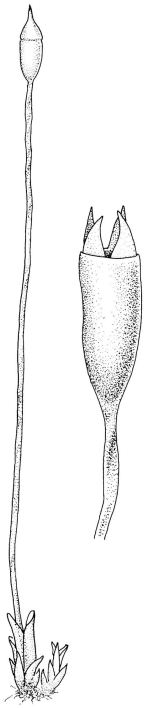
FLORA OF NEW ZEALAND

MOSSES

TETRAPHIDACEAE



A.J. FIFE

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Cover image: *Tetrodontium brownianum*, habit with capsule, moist, and capsule, dry. Drawn by Rebecca Wagstaff from *A.J. Fife 6314*, CHR 104731.

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Contents

Introduction

Tetrodontium brownianum, the only New Zealand representative member of the Tetraphidaceae, is a minute plant growing in deeply shaded and often moist crevices of siliceous rock. It is arguably the most dramatically disjunct of all the New Zealand mosses, being widespread but very rare through much of the northern hemisphere, and known in the southern hemisphere from only a small number of scattered high-elevation N.Z. localities. The Tetraphidaceae are a small family of only two genera, remarkable for their unique peristome of four large, narrowly triangular, unsegmented, and multicellular teeth. The structure of the peristome teeth is in sharp contrast to the articulated peristome teeth composed of fragmented cells found in the great majority of mosses. The family is taxonomically extremely isolated and is placed in its own subclass or class in modern classifications, suggesting that the disjunctive distribution is likely a very ancient one, and not a result of long-distance dispersal.

Tetraphidaceae

Type taxon: *Tetraphis* Hedw.

Plants minute or small, acrocarpous, with protonema giving rise to linear or spathulate protonemal flaps that may disappear (in *Tetraphis*) or persist (in *Tetrodontium*) after the development of gametophores (stems). **Shoots** well-developed, erect, to c. 15 mm (in *Tetraphis*) or highly reduced (in *Tetrodontium*), often terminating in a disc of broadly ovate leaves surrounding a cluster of multicellular and globose gemmae (in *Tetraphis*). **Stem leaves** (in *Tetraphis*) erect-spreading, 3-ranked, ovate and acute, weakly decurrent, entire, costate, becoming gradually narrower and longer acropetally in ♀ shoots or absent (in *Tetrodontium*); **laminal cells** firm-walled, smooth, rounded-hexagonal; **costa** ending below the leaf apex. **Gemmae** present (in *Tetraphis*) or absent (in *Tetrodontium*).

Autoicous. **Setae** straight, flexuose, or geniculate; **capsules** erect, ellipsoid or cylindric, exserted; **peristome** present, of four large, narrowly triangular, unsegmented, and multicellular teeth. **Operculum** conic. **Calyptra** mitrate.

Taxonomy: The Tetraphidaceae are highly isolated systematically and are assuredly an ancient group. The family is traditionally (Brotherus 1924, p. 344) placed in its own order. More recent authors place them in their own subclass (Crum & Anderson 1981) or their own class (Tetraphidopsida; Goffinet et al. 2009). The members of this family are unique by having four narrowly triangular peristome teeth, which are not jointed and are composed of intact but dead cells (nematodontous).

Crum & Anderson (1981) describe the protonemal flaps as “leaflike brood bodies”. They illustrate (their fig. 617, E, for *Tetraphis pellucida*) the multicellular gemmae as borne on a filamentous stalk.

The family consists of two genera. *Tetraphis* is circumboreal in distribution and contains two species, one of which (*T. pellucida*) is characteristic of rotten logs and stumps in coniferous forests throughout the northern hemisphere.

Tetrodontium Schwägr., *Sp. Musc. Frond. Suppl. 2(1),* 102 (1824)

Plants minute, green or brown, with persistent **protonemal flaps** surrounding very short (usually less than 1.0 mm) perichaetial buds or shoots. **Conspicuous shoots** and **vegetative leaves** absent.

Autoicous (perichaetial and perigonial buds arising from the same protonema). **Perichaetial shoots** brown, less than 1.0 mm, arising from a whorl of protonemal flaps. **Perichaetial leaves** with or without costa. **Setae** straight or weakly flexuose; **capsules** erect, ellipsoid, with rim undulate or not; **exothecial cells** oblong and ± incrassate; **stomata** reportedly present at capsule base. **Peristome teeth** four, triangular, consisting of multiple layers of dead but intact cells. **Operculum** high conic, acute. **Calyptra** completely enclosing the maturing capsule, becoming mitrate, divided into c. 6 narrow lobes c. ⅔ to apex.

Taxonomy: A genus of 1 to 3 species, depending on taxonomic interpretation. The type species is apparently not designated. All species are largely restricted to mountainous areas of the northern hemisphere. One species is dramatically disjunct in N.Z.

Etymology: The generic name refers to the unique peristome of four large, narrowly triangular, unsegmented, and multicellular teeth.

Tetrodontium brownianum (Dicks.) Schwägr., *Sp. Musc. Frond. Suppl. 2(1),* 102 (1824)

≡ *Bryum brownianum* Dicks., *Fasc. Pl. Crypt. Brit. 4,* 7 (1801)
≡ *Tetraphis browniana* (Dicks.) Grev., *Fl. Edin.,* 230 (1824)
Type: Scotland. Not seen.

Protonemal flaps green or brown, abundant or sparse, linear or spathulate, crenulate, entire, or obtusely and finely toothed at margins, rounded, obtuse, or acute at apex, with or without an apical mucro, unistratose near margins but nearly always bistratose medially, (400–)800–1500 × 75–105 µm.

Perichaetial shoots mostly <0.5 mm; **perichaetial leaves** to c. 1 mm, with an oblong or ovate base, tapered gradually to a rounded, obtuse, or acute apex, entire or crenulate; **costa** weak or rarely absent, with cells multistratose and longer than the adjacent laminal cells, extending from upper leaf to leaf base or vanishing in lower leaf, often with one or more projecting abaxial spines near the terminus. **Perigonia** not seen. **Setae** red-brown, 6–10 mm, slender and flexuose, twisted to the right (dextrorse) above or throughout when dry; **capsules** erect, ellipsoid, red-brown, 0.8–1.0 mm, with rim

undulate or not; **stomata** not seen. **Peristome teeth** 4, c. 400 µm long, erect wet or dry. **Operculum** high conic, acute, c. 0.5 mm. **Calyptra** 1–1.5 mm, with faint longitudinal, multistratose, and raised bands of cells in lobes. **Spores** 9–15 µm, smooth, yellow in mass.

Illustrations: Plate 1. Nyholm 1969, fig. 427A; Crum & Anderson 1981, fig. 619; Smith 2004, fig. 38, 6–9; Harpel 2007, p. 114.

Distribution: NI: Taranaki (Mt Taranaki), Wellington (several localities on Mt Ruapehu); SI: Nelson (Fyfe River in Marino Range, Hope Range, Mt Arthur?, Mt Euclid), Westland (Sewell Peak).

Bipolar. Widespread but rare in the northern hemisphere.

Habitat: *Tetrodontium brownianum* usually occurs in rock crevices or caves, often on the undersurface of overhangs, and is usually associated with small streams or their margins. The several Mt Ruapehu (most collected by G.O.K. Sainsbury) and two Mt Taranaki (both collected by J.K. Bartlett) collections are from shady crevices in scoria. Most South I. occurrences are from granite or quartzite, and subject to at least periodic irrigation. A population from the Hope Range (*A.J. Fife 7460*, CHR 406869) occurred on granitic gravel in a rivulet shaded by red tussock, while one from Mt Euclid (*A.J. Fife 6314*, CHR 104731) occurred on "moist granite stones in [a] deep crevice; subject to flood [at the] margin of a small, cascading stream". Recorded from between c. 1310 (Mangaturuturu Valley on Mt Ruapehu) to 1675 (Mt Taranaki) m elevation on the North I. and between 620 (Fyfe River) to c. 1100 m (Mt Euclid) on the South I. Associated species include *Diplophyllum domesticum*, *Telaranea tetradactyla*, *Zoopsis setulosa*, and *Mittenia plumula*, all chasmocolous species.

Material from Mt Arthur (a limestone/marble massif) was collected by J.K. Bartlett (AK 189125) and its substrate is unknown. Occurrence on limestone would be anomalous compared to all other known N.Z. localities and to the species' substrate preference of "siliceous or granite overhangs", both in North America (Crum & Anderson 1981) and in Fennoscandia (Nyholm 1969). The Mt Arthur locality, while not rejected outright here, deserves confirmation.

Notes: In some respects N.Z. material falls between descriptions of *T. brownianum* and *T. repandum* (Funck) Schwägr. [*Spec. Musc. Frond. Suppl.* 2: 102. 1824] given in northern hemisphere treatments, especially those given by Nyholm (1969, p. 653). However, the absence of abundant flagelliferous shoots (a defining feature of *T. repandum*) and the variability of the N.Z. material taken collectively dictates the recognition of one taxon here. Based on comparison to limited northern hemisphere material and to the literature cited above, our material is best assigned to *T. brownianum*.

New Zealand *T. brownianum* is variable with respect to the shape, number of cell layers, toothing, and development of an apical mucro in the protonemal flaps, the strength of perichaetial leaf costae, and the undulation of the capsule mouth. The strength of perichaetial leaf costae varies even within a single female shoot. In some N.Z. collections costae are more distinct in the mid to upper leaf than near the insertion and bear one or more abaxial spines; such spines have not been seen in European material available for comparison, nor are they reported by Nyholm (1969).

Populations occurring on South I. granite/quartzite tend to have shorter (less than c. 1 mm) protonemal flaps with more strongly crenulate margins and more distinctly mucronate apices than the North I. populations. In such material, the protonemal flaps are at least partially bistratose. Perichaetial leaf costae are weakest in material from Mt Euclid, which is also unusual by having an undulate capsule rim.

Etymology: According to the protologue the species is named after a Mr D. Brown who collected the type specimen at Roslin in Scotland. Robert Brown's (of Australian botany and Brownian movement fame) early associations with James Dickson as well as Crum & Anderson's (1981, p. 1245) suggestion that the collector was "presumably the famous Robert Brown" suggest that the protologue may be in error.

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Conventions

Abbreviations and Latin terms

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

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

Symbols

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

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

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

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Jessica Beever provided helpful discussion of both the habitat and the morphology of *Tetrodontium* and advised me during the preparation of this treatment. Rod Seppelt read a draft and suggested improvements. David Glenny provided a description of the site where he found *Tetrodontium* at Fyfe River. Dhahara Ranatunga supplied information concerning specimens in AK. Sue Gibb located older references and provided much other help. Ilse Breitwieser encouraged me to submit this manuscript as part of the eFlora of New Zealand series. Sue Gibb, Aaron Wilton, Katarina Tawiri, and Kate Boardman converted the manuscript into a format suitable for electronic publication, and Ray Prebble provided skilled editing. The preparation of this treatment was supported by Core funding for Crown Research Institutes from the Ministry of Business, Innovation and Employment's Science and Innovation Group.

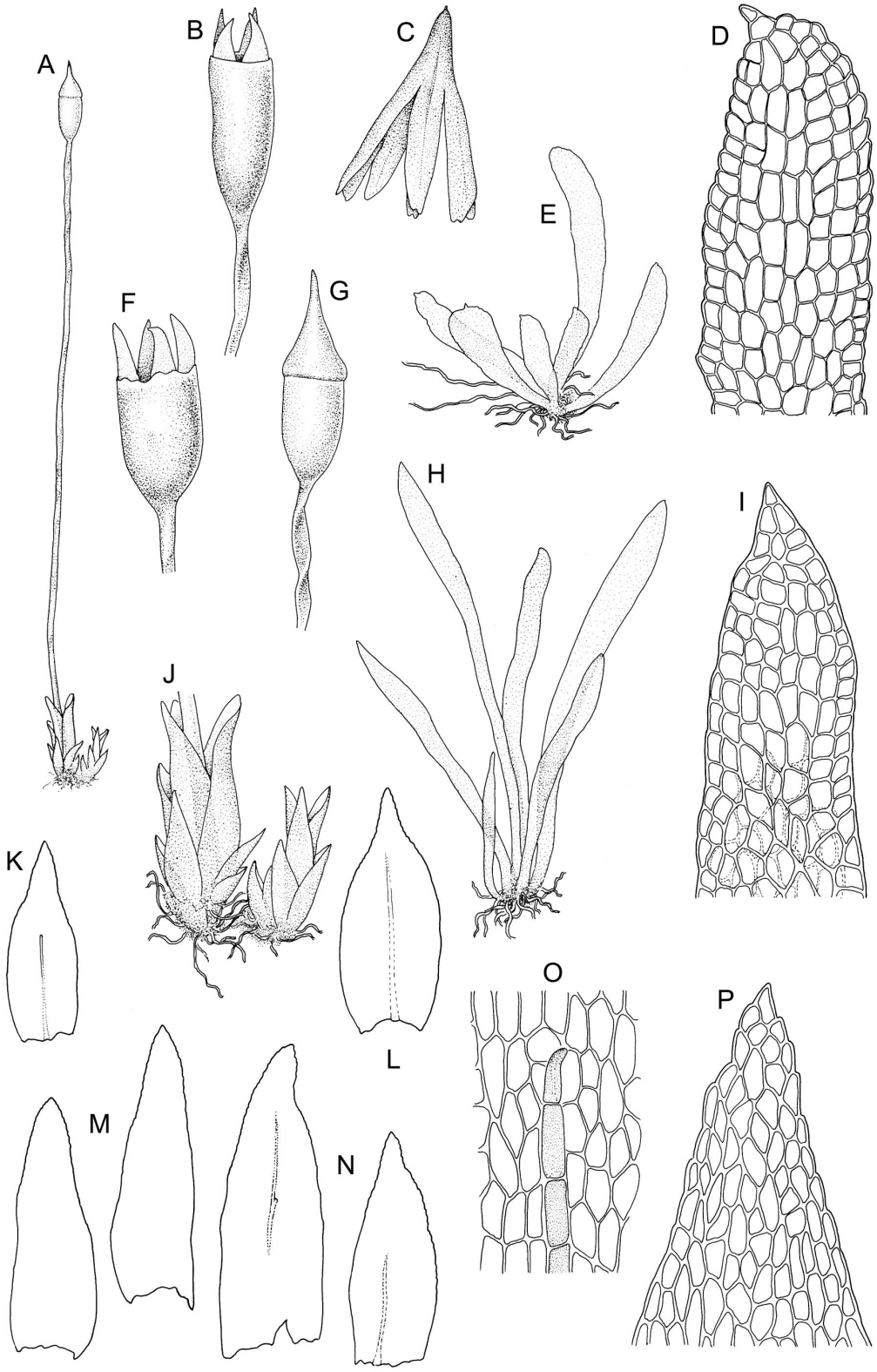
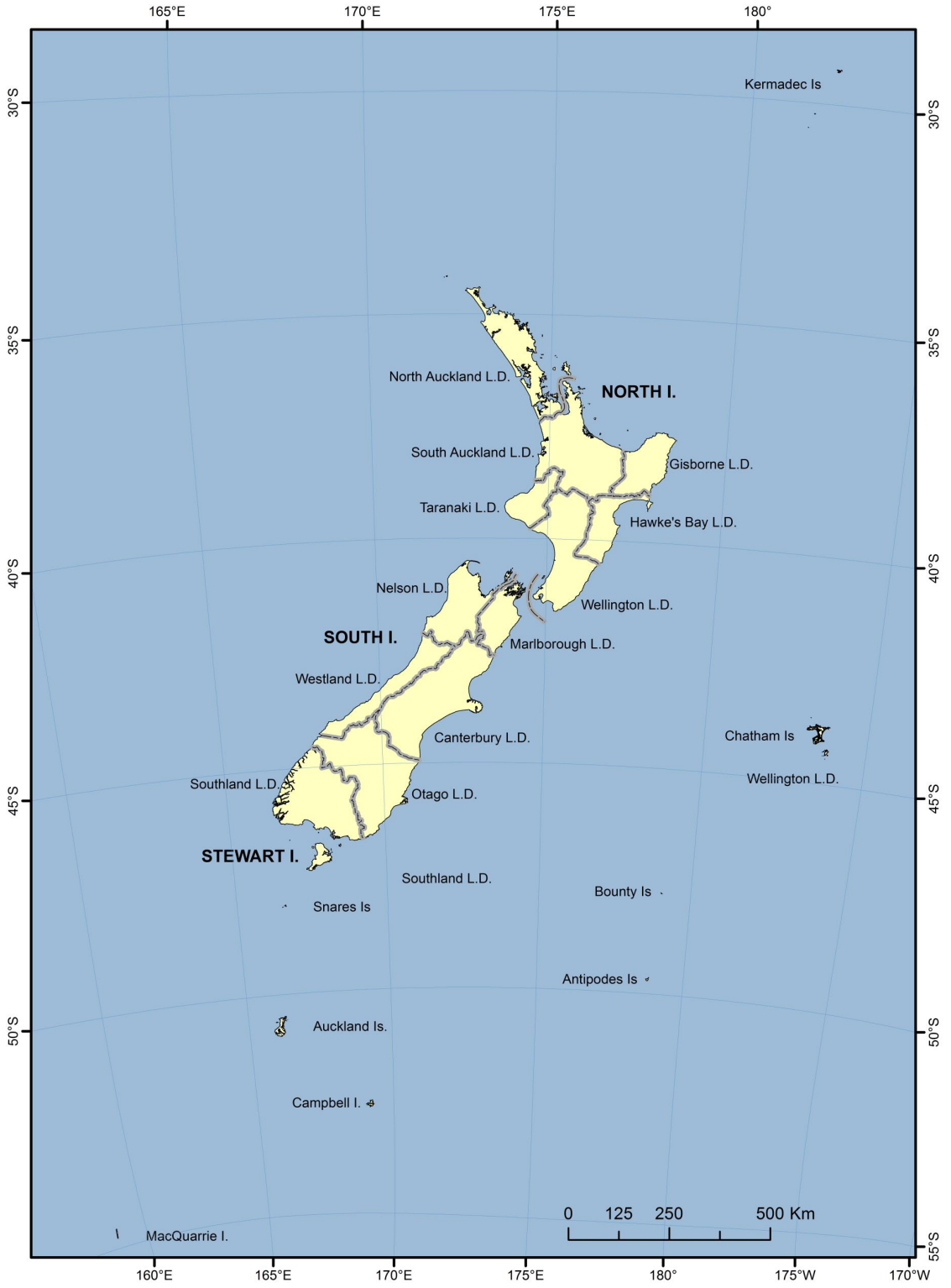
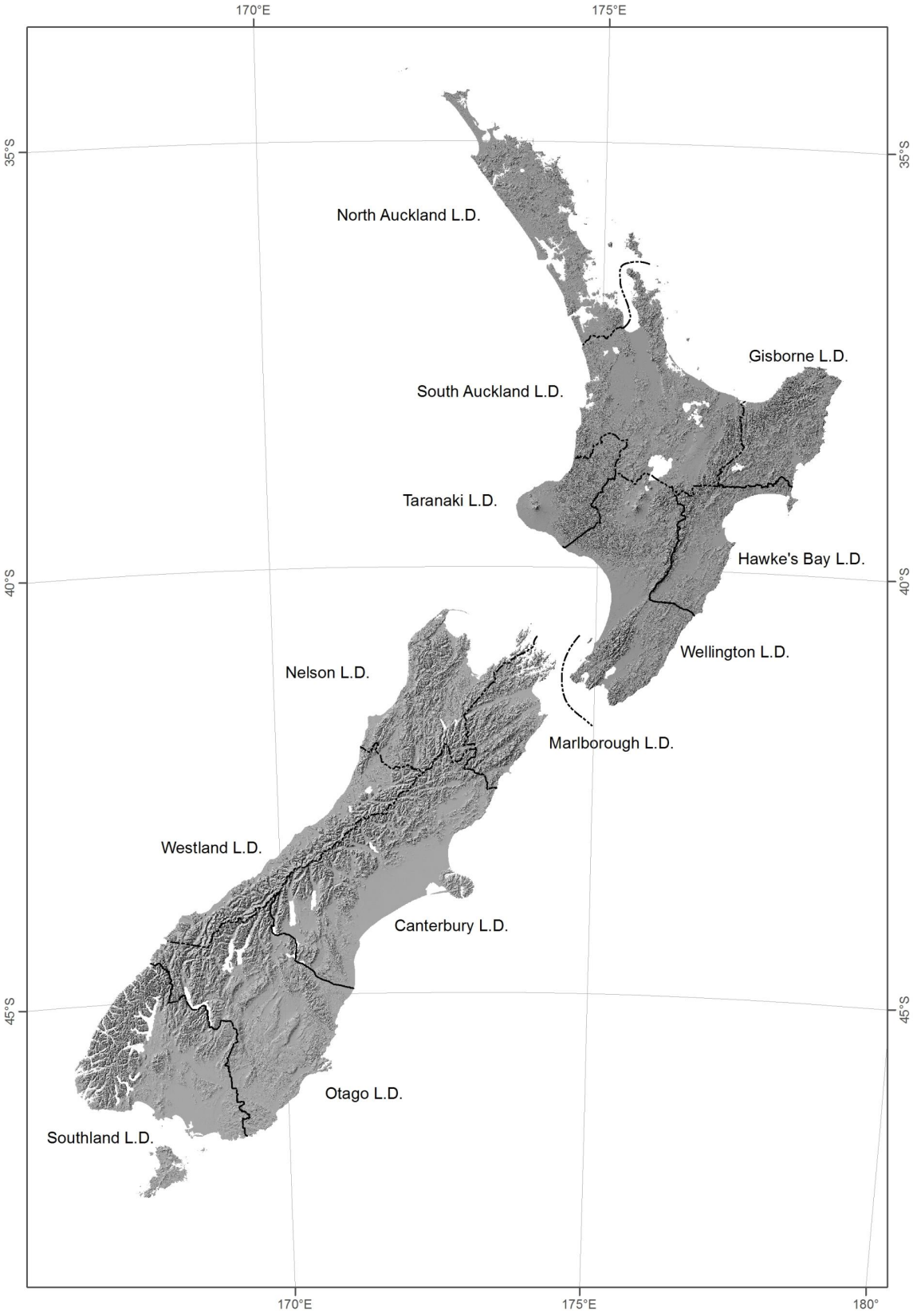


Plate 1: ***Tetrodontium*. A–P: *T. brownianum***. A, habit with capsule, moist. B, capsule, dry. C, calyptra. D, apex of protonemal flap. E, cluster of protonemal flaps. F, capsule, dry. G, capsule with operculum, moist. H, cluster of protonemal flaps. I, apex of protonemal flap showing bistratose area. J, detail of female and adjacent sterile shoot. K–N, perichaetial leaves. O, apex of costa and adjacent cells, abaxial view. P, apex of perichaetial leaf. A–B, D–F, H, J, M–N drawn from *A.J. Fife 6314*, CHR 104731; C, O drawn from *G.O.K. Sainsbury s.n.*, 28 Dec. 1940, CHR 398345; G, I, K–L, P drawn from *G.O.K. Sainsbury s.n.*, 27 Mar. 1940, CHR 398344.



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



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

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Page numbers are in **bold** for the main entry, and *italic* for synonyms.

Image Information

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