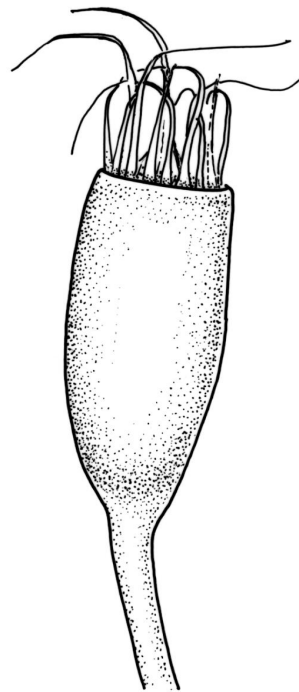


FLORA OF NEW ZEALAND
MOSSES

MITTENIACEAE



A.J. FIFE

Fascicle 23 – DECEMBER 2015

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Cover image: *Mittenia plumula*, capsule. Drawn by Rebecca Wagstaff from A.J. Fife 7079, CHR 406028.

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Introduction

The Mitteniaceae are a family of a single genus and species: *Mittenia plumula*. This attractive moss grows on heavily shaded, friable soil through much of New Zealand, and occurs also in south-eastern Australia and P.N.G. It is one of Australasia's bryological curiosities, both because of the "luminescent" quality of its protonema and because of its unique peristome structure. Because of the former it has been compared to the famed *Schistostega pennata* or "goblin gold" of the northern hemisphere. Although an inconspicuous plant, it is readily recognisable in a N.Z. context by having distichous stoutly costate leaves vertically inserted and with the basipetal margin strongly decurrent. Capsules are both uncommon and inconspicuous in N.Z. but are particularly beautiful, having very long and slender red-brown exostome teeth. There is no general agreement concerning the systematic affinities of *Mittenia*.

Mitteniaceae

Type taxon: *Mittenia* Lindb.

Taxonomy: The family Mitteniaceae includes only the genus *Mittenia*, which is, in turn, monotypic. Accordingly, the description of *Mittenia plumula* given below applies to both the family and its included genus.

The relationships of the Mitteniaceae have long been controversial. Brotherus (1924) placed the family in the order Bryales (“Eubryales”), suborder Rhizogoniineae with the Rhizogoniaceae, Calomniaceae, Sorapillaceae, and three other small families not occurring in N.Z.

The late Australian bryologist Ilma Stone studied the protonemal, gametophytic, and sporophytic morphology of *Mittenia* in meticulous detail (Stone 1961a; 1961b). She concluded (Stone 1961a) that the embryonic development of the *Mittenia* peristome is unique among the mosses for having an inner peristome derived from the outermost layer of the embryonic capsule (the amphithecium) and from the endothecium with “the wall between the two layers which contribute to the inner peristome [being] the original dividing wall between the embryonic amphithecium and endothecium”. This development pattern contrasts to all others known to Stone in which both the endostome and exostome cell layers derive exclusively from amphithecial tissue.

Some years later she made a detailed comparison (Stone 1986) of the sporophyte development of *Mittenia* and the famed northern hemisphere genus *Schistostega*. She concluded that the similarities in protonemal morphology and “a lack of any strong contraindication to a relationship in capsule anatomy” indicate that *Mittenia* and the eperistomate *Schistostega* should be placed in one order (Schistostegales) but retained in separate monotypic families.

Other (mostly subsequently published) classifications have not accepted Stone’s proposed close relationship of the *Mittenia* and *Schistostega*. Shaw (1985) independently studied the *Mittenia* peristome and concluded (similarly to Stone) that it was neither haplolepidous nor diplolepidous and that “no other peristomial structure known in mosses ... is homologous to the inner peristome of *Mittenia*”. He therefore proposed a new order, the Mitteniales to accommodate this family with its single genus and species.

The classification used for the Flora of Australia (McCarthy 2006) places the Mitteniaceae in the Dicranales, while Goffinet et al. (2009) placed the family in the Pottiales, with the large and cosmopolitan family Pottiaceae and the monogeneric families Pleurophascaceae and Serpotortellaceae.

Mittenia Lindb., *Öfvers. Kongl. Vetensk.-Akad. Förh.* 19: 606 (1863)

Type taxon: *Mittenia plumula* (Mitt.) Lindb.

Taxonomy: *Mittenia* is a monotypic genus with the characteristics of *M. plumula*.

Mittenia is one of Australasia’s bryological curiosities, because of its aberrant peristome and the “luminescent” quality of its sometimes persistent protonema. Stone (1961b) provided a fascinating explanation of cell form and arrangement of the protonema in *Mittenia*, and its resultant ability to refract ambient light; this ability sometimes gives the protonema a luminescent appearance. Stone referred to two phases in the protonemal development of *Mittenia*, with one being a “highly refractive stage with lens-like cells”. The protonema have branches “composed of lenticular cells spread out in a plane at right angles to the light and sometimes appearing like plates of tissue”. The lenticular shape of the cell walls concentrates incoming light on the chloroplasts, which are massed near the more highly convex underside of the cell. According to Stone the luminosity is a result of the light that is not absorbed by the chloroplasts being reflected, giving the protonema a “striking green lustre”. The lustrous areas of the protonema are “regions of the lenticular protonema...[receiving]...incident light from a suitable direction”.

Mittenia has often been compared in this regard to the famed *Schistostega pennata*, the “luminous moss” or “goblin gold” of the northern hemisphere. Plants of both these “luminescent” genera grow on soil in conditions of extremely low light.

Etymology: The genus is named in honour of the great 19th century English bryologist William Mitten. Mitten’s influence upon 19th century bryology is difficult to exaggerate. His most influential works were *Musci Indiae Orientalis* (1859b) and *Musci Austro-Americani* (1869). Mitten also published an important work on the mosses of N.Z. and Tasmania (1859a), a catalogue of Australian mosses (1882), and studied the mosses of many other parts of the world, including regions in the Pacific and Indian Oceans. He also contributed the hepatic treatments in J.D. Hooker’s *Flora Novae-Zelandiae* and *Flora Tasmaniae*.

***Mittenia plumula* (Mitt.) Lindb., *Öfvers. Kongl. Vetensk.-Akad. Förh.* 19: 606 (1863)**

≡ *Mniopsis plumula* Mitt. in Wilson, Bot. Antarct. Voy. III. (Fl. Tasman.) Part II 187 (1859)

Type (Holotype?): Tasmania: Ovens Creek, *W. Archer s.n.*, NY. (Cited by Stone 2006.) Not seen. Isotype: BM!

= *Mniopsis rotundifolia* Müll.Hal., *Hedwigia* 36: 332 (1897)

≡ *Mittenia rotundifolia* (Müll.Hal.) Paris, *Index Bryol. Suppl.*, 248 (1900)

Type: Australia, N.S.W., "Lilyvala" [Lilyvale], Septembri 1891; *Th Whitledge* in Hb. Brotheri." Not seen

Elements in the following description are taken from Stone (2006).

Plants grass green to dark green, rarely red-brown, gregarious or occurring as scattered shoots, often forming dense turves on deeply shaded friable soil. **Stems** simple, often several clustered, mostly c. 10 to at least 20 mm, green above and grading to dark red-brown near base, in cross-section weakly angled (\pm pentagonal) and with a faint central strand, with elongate, smooth, and often brittle yellow-brown **rhizoids** near base. **Protonema** sometimes persistent, with highly refractive lenticular cells and gemmae. **Leaves** distichous, scale-like below, becoming larger and evenly but distantly spaced above, rarely well-developed only at shoot apex, vertically inserted, oblong and tapered to an obtuse apex, entire, plane, with the proximal margin strongly and broadly decurrent nearly to the leaf below (but not confluent), mostly 0.6–1.0 mm on the distal margin and longer (mostly 0.9–1.3 mm) on the proximal margin, c. 0.40–0.55 mm wide; **upper laminal cells** mostly quadrate to short-rhombic, firm-walled, smooth, the lumina densely packed with chloroplasts, mostly 15–24 μ m in greater diameter, becoming more irregular in outline below. **Costa** stout, but ill-defined under compound microscope, 45–60 μ m wide at mid leaf and failing c. 6–10 cells below apex, in cross-section elliptical and scarcely projecting, with a few central stereids and larger cells on both the abaxial and adaxial surfaces.

Dioicous. **Perichaetia** terminal, the perichaetial leaves radially arranged, transversely inserted and lacking decurrencies, enlarged, c. 1.4–1.8 \times 0.55 mm, surrounding c. 12–15 archegonia and apparently lacking paraphyses. **Perigonia** not seen in N.Z. material. **Setae** single or occasionally paired, rather delicate, 2–4 mm, nearly hyaline to green at capsule maturity; **capsules** cylindric and symmetric, erect, slightly flared at mouth, variable in size, mostly c. 0.7–1.0 \times 0.35–0.4 mm diam. (occasionally as short as 0.5 mm), pale brown, red-brown at mouth; **exothecial cells** oblong, with firm longitudinal walls and thin transverse walls; **stomata** difficult to observe, superficial and few at base of the capsule; **annulus** absent; **operculum** long and obliquely rostrate from a conic base, nearly the length of the urn. **Peristome** double; **exostome teeth** 16, red-brown, very long and slender, recurved at base and strongly inwardly twisted above when dry, erect at base and strongly curved-reflexed above when moist, mostly c. 600–700 μ m (difficult to measure due to curvature), the outer surface apparently nearly smooth and with c. 13 transverse ridges, the inner surface with numerous (c. 100) lamellae, which give the teeth a densely articulated appearance, lacking a divisural line or surface ornamentation; **endostome** composed of 16 nodose but otherwise smooth segments and arising from a very low basal membrane, lacking **cilia**. **Spores** 9–12, pale, very finely ornamented.

Illustrations: Plate 1. Brotherus 1924, fig. 373; Stone 1961b, figs 1–20, pls xx–xxii; Stone 1961a, figs 1–81, pls 1–4; Shaw 1985, figs 1–10; Malcolm & Malcolm 2003, p. 44; Meagher & Fuhrer 2003, p. 45; Malcolm & Malcolm 2006, pp. 71, 79, 87, 137.

Taxonomy: The placement of *Mniopsis rotundifolia* Müll.Hal. in synonymy follows Dixon & Bartram (1937, p. 77). Stone (2006) also adopted the synonymy advocated by Dixon & Bartram; she also was unable to view type material but indicated her belief that material was present in the Brotherus herbarium.

Distribution: NI: N Auckland including offshore islands (LB), S Auckland, Gisborne (Waioeka Gorge), Taranaki, Wellington; SI: Nelson, Marlborough (Ship Cove Scenic Reserve), Canterbury, Westland, Otago (Cardrona, Leith Valley), Southland; St; Ch.

Australasian. Mainland eastern Australia*. Recorded also from Tasmania and from one locality in Western Australia by Stone (2006) and from a single collection in P.N.G. by Norris & Koponen (1987).

Habitat: Widespread through most of N.Z., on deeply shaded and friable soil and often associated with the root plates of wind-thrown trees. Also on shaded and often eroded banks, beneath overhanging vegetation, in "earth-caves", soil crevices, and cave or mine entrances. Not occurring directly on rock and avoiding limestone; sometimes forming extensive and dense turves or swards. Occurring in a wide range of vegetation types, including mixed broadleaved and southern beech-

dominated forests. It is poorly documented and probably very uncommon in both Marlborough and Otago L.D.; it is not recorded from Hawke's Bay L.D. At Puketoki Scenic Reserve, near Whakamārama (S Auckland L.D.) fruiting plants of *M. plumula* have been observed forming a nearly pure sward as much as 20–30 cm wide and many metres in (horizontal) length on a deeply shaded, ± vertical, track-side silt bank derived from volcanic bedrock in a *Beilschmiedia tawa*-dominated lowland forest. *Ditrichum* spp. (especially *D. difficile*) are probably the most frequently associated mosses but other often associated bryophytes include *Fissidens asplenioides*, *F. pallidus*, *F. tenellus*, *Leucobryum javense*, *Rhizogonium pennatum*, the hepatics *Balantiopsis* spp., *Kurzia hippuroides*, *Lepidozia* spp., *Tylimanthus diversifolius*, and *Zoopsis argentea* as well as the lichen genus *Lepraria*. On North I. occurring from c. 80 m (Whanganui River, Taranaki L.D.) to at least 750 m (Erua and the Akatarawa Ranges, both Wellington L.D.) and on South I. from c. 30 m (Pororari River, Nelson L.D.) to 1150 m (Paparoa Range, Nelson L.D.).

Notes: Stone recorded gemmae to be formed on both the protonema (Stone 1961b) and on rhizoids (Stone 1961a). No gemmae have been seen in N.Z. material.

The “luminescence” for which *M. plumula* is renowned is very striking but is relatively rarely seen, at least in N.Z. Stone (2006) described colonies of luminous protonema in Australia that “sometimes covers very large areas and can persist for many years, reproducing asexually and forming few or no sterile gametophores”. Such growth may be a response to marginal growth conditions.

Recognition: *Mittenia* is most likely to be confused with species of “micro” *Fissidens*, because they share a strongly distichous habitat and because many species of *Fissidens* share its preference for deeply shaded soil banks. *Mittenia* lacks the vaginant lamina and the strongly conduplicate “dual laminae” leaf structure found in all species of *Fissidens*. The leaves in *Mittenia* are generally widely spaced on the stems and always strongly decurrent, while the leaves in “micro” *Fissidens* species are generally ± imbricate and never strongly decurrent.

Etymology: The epithet *plumula* refers to the feather-like form of the gametophyte.

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Conventions

Abbreviations and Latin terms

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

PK	Poor Knights Islands
P.N.G.	Papua New Guinea
<i>pro parte</i>	in part
Qld	Queensland
q.v.	which see (<i>quod vide</i>)
RT	Rangitoto Island
S.A.	South Australia
<i>s.coll.</i>	without collector (<i>sine collectore</i>)
<i>s.d.</i>	without date (<i>sine die</i>)
sect.	section
SEM	scanning electron microscope/microscopy
<i>sensu</i>	in the taxonomic sense of
SI	South Island
<i>sic</i>	as written
<i>s.l.</i>	in a broad taxonomic sense (<i>sensu lato</i>)
<i>s.loc.</i>	without location (<i>sine locus</i>)
Sn	Snares Islands
<i>s.n.</i>	without a collection number (<i>sine numero</i>)
Sol	Solander Island
sp.	species (singular)
spp.	species (plural)
<i>s.s.</i>	in a narrow taxonomic sense (<i>sensu stricto</i>)
St	Stewart Island
<i>stat. nov.</i>	new status (<i>status novus</i>)
subg.	subgenus
subsect.	subsection
subsp.	subspecies (singular)
sub spp.	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 (<i>videlicet</i>)
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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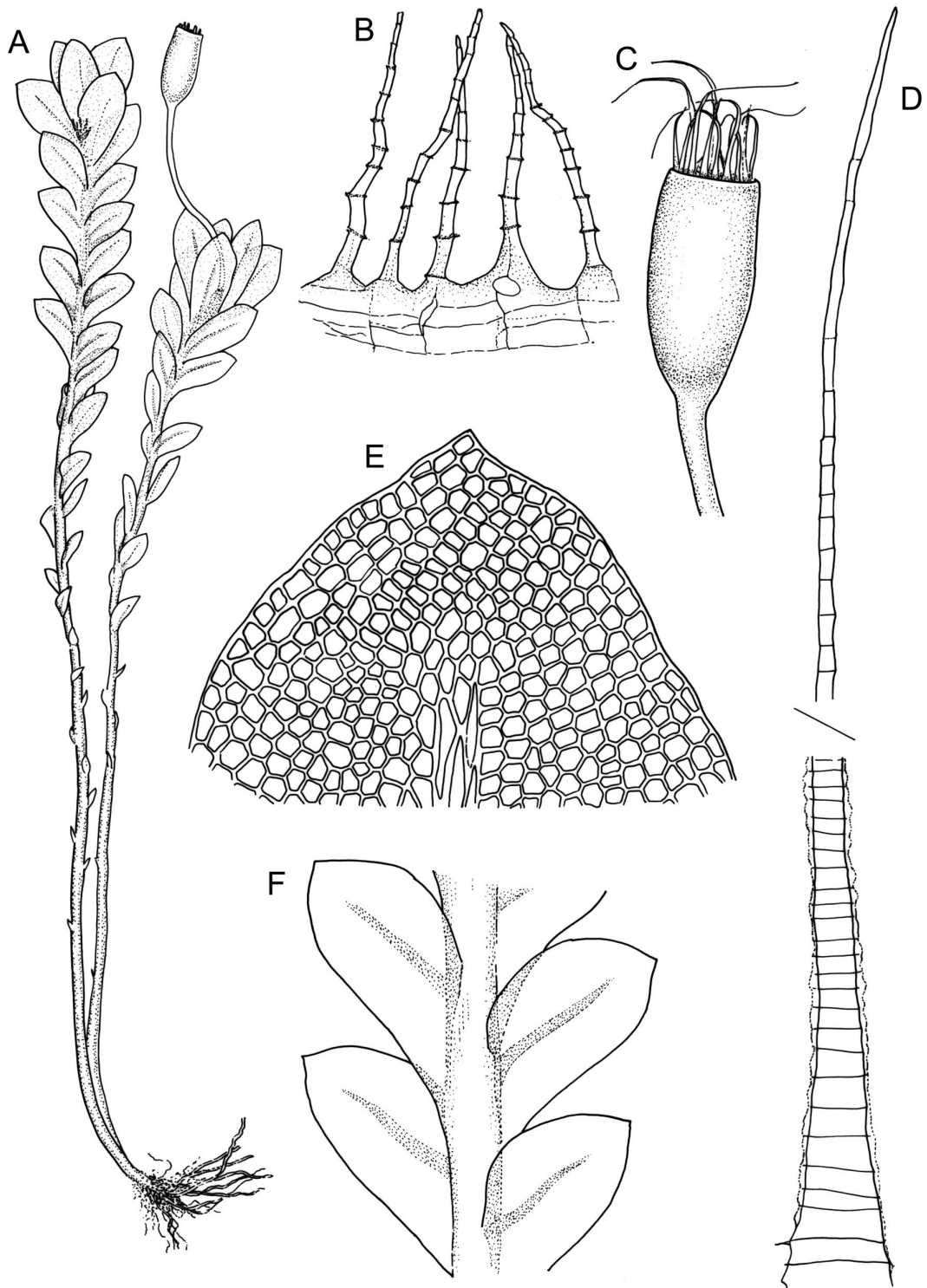
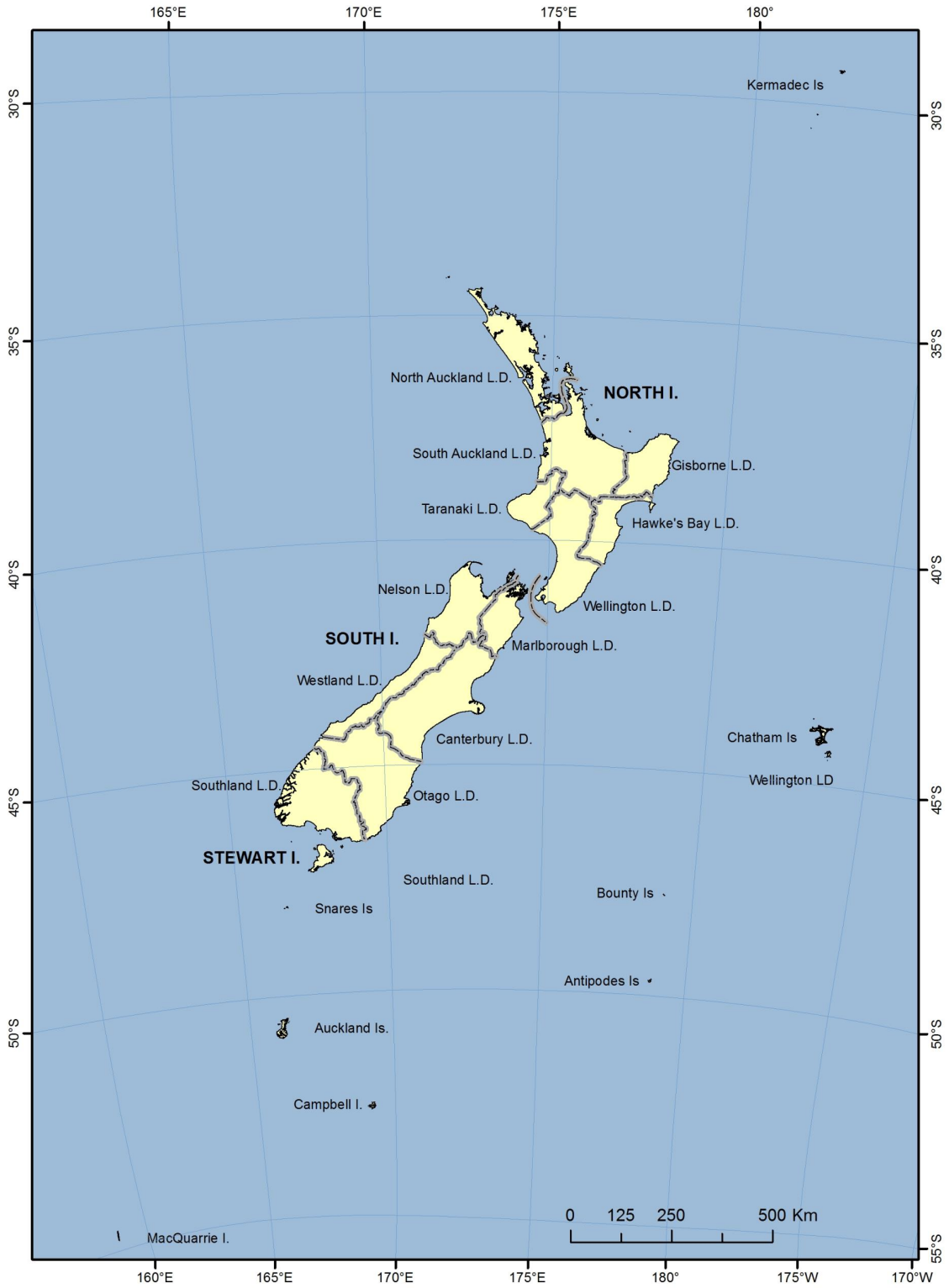
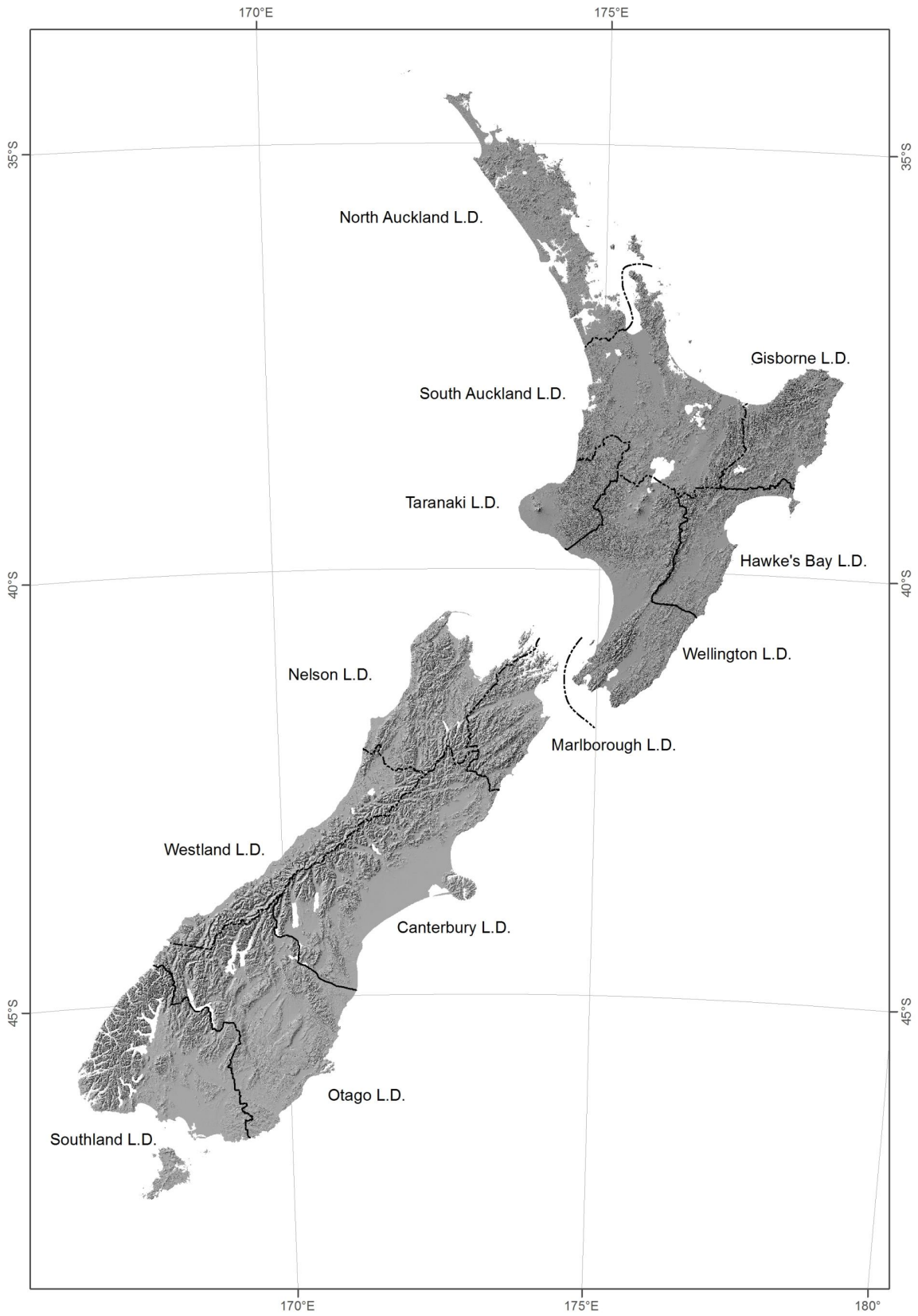


Plate 1: *Mittenia*. A–F: *M. plumula*. A, habit with capsule. B, endostome detail. C, capsule. D, exostome tooth. E, leaf apex. F, shoot detail. Drawn from A.J. Fife 7079, CHR 406028.



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

Index

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

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Mniopsis plumula Mitt. **3**

Mniopsis rotundifolia Müll.Hal. **3**

Image Information

Image
Plate 1
Map 1
Map 2

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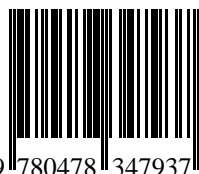
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