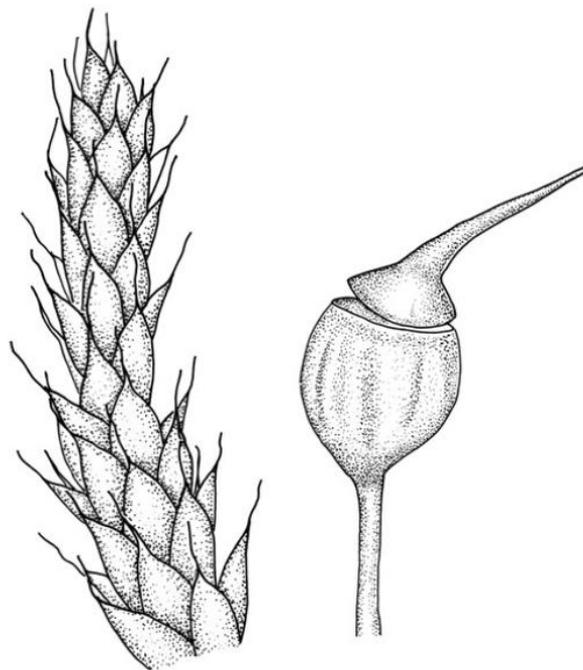


FLORA OF NEW ZEALAND
MOSSES

RHACOCARPACEAE



A.J. FIFE

Fascicle 36 – APRIL 2018

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Cover image: *Rhacocarpus purpurascens*, portion of shoot, moist and capsule, moist. Drawn from *B.H. Macmillan 94/65*, CHR 506931, and *A.J. Fife 11135*, CHR 515097.

Contents

- Introduction..... 1
- Taxa
 - Rhacocarpaceae* Kindb. 2
 - Rhacocarpus* Lindb. 2
 - Rhacocarpus purpurascens* (Brid.) Paris 3
- References 6
- Conventions 8
- Acknowledgements 10
- Plates 11
- Maps 12
- Index 14
- Image Information 15

Introduction

The Rhacocarpaceae are a small family with members traditionally placed in or near the Hedwigiaceae. Two genera are usually accepted for the family, of which *Rhacocarpus* is by far the better known. *Rhacocarpus* is characterised by a distinctive and multi-layered ornamentation of the laminal cell cuticles, an ornamentation that is unique among mosses. The genus also has distinctive erect, broadly obovoid, and gymnostomous capsules with deeply immersed stomata. *Rhacocarpus* has six or fewer species and is most diverse in South and Central America. The attractive *R. purpurascens* is the most widespread and best-known species and occurs, mostly on wet rock, through most of New Zealand, extending to Tasmania, mainland Australia, the subantarctic islands, the Andes, and elsewhere. In the N.Z. flora, pinnately branched stems, lacquered and usually glaucous leaves with bright red hair-points and margins, together with large and strongly pigmented alar groups of *R. purpurescens*, normally preclude its confusion with any other plant. The shoots are prostrate or self-supporting and sub-erect, and the plants often form extensive mats over irrigated rock faces.

Rhacocarpaceae Kindb.

Taxonomy: No family description is presented here, as the generic description of *Rhacocarpus*, below, applies to the family. Crum (1994) also provided an elegant description of the family, based solely upon *Rhacocarpus*.

Rhacocarpus has traditionally been placed in the Hedwigiaceae, where it was placed in its own subfamily Rhacocarpoideae by Brotherus (1925). Brotherus's placement in the Hedwigiaceae has largely been followed in subsequent Australasian literature (Dixon 1927; Sainsbury 1955; Scott & Stone 1976).

Frahm (1996) erected the genus *Pararhacocarpus* to accommodate the Chilean *Rhacocarpus patagonicus* Broth. In his publication, Frahm suggested that *Pararhacocarpus* was not closely allied to *Rhacocarpus* s.s. and indicated, partly due to its unknown sporophytes, that it should be considered of uncertain familial affinities. An isotype (CHR 4385) of *Pararhacocarpus patagonicus* (Broth.) J.-P. Frahm has differentiated stem and branch leaves, both unbordered, with the former distinctly plicate. The branch leaves are spirally inserted, spirally twisted around their own axes, and have extremely thick-walled and highly porose laminal cells. They also lack the lacquered dry appearance and the cuticular ornamentation characteristic of *Rhacocarpus* s.s. All these features suggest that *P. patagonicus* is correctly excluded from *Rhacocarpus*.

Another genus segregated from *Rhacocarpus*, the New Caledonian *Metarhacocarpus* Nog. [Journ. Hattori Bot. Lab. 58: 87, 1985], was placed in the synonymy of *Dicnemon* by Allen (1987).

Barthlott & Schultze-Motel (1981) examined the fine structure of the leaf surface of *Rhacocarpus* spp. using both scanning and transmission electron microscopy. They characterised the surface ornamentation as "a complex multi-layered reticulate and perforated wall structure resembling superficially exine stratification in tectate pollen grains. This wall character seems to be unique within the Bryophyta and emphasizes the systematically isolated position of *Rhacocarpus*. Functionally these structures perhaps serve as a refined ectohydric water conducting system."

De Luna (1990) demonstrated that the protonema of *Rhacocarpus* lacked the globular form found in the other genera placed in the Hedwigiaceae. The separation of the Rhacocarpaceae from the Hedwigiaceae was thus supported by de Luna (1995) and by Goffinet et al. (2009).

Crum's (1994, p. 667) comments on this genus are worth quoting:

"*Rhacocarpus* is so distinctive in every way that it is difficult to understand why it has been included by most authors in the Hedwigiaceae, which it resembles only in lacking a costa and a peristome. The prostrate habit, pinnate branching, fiddle-shaped leaves and linear cells appearing to be densely and minutely papillose over the side walls, the strongly differentiated border, and the well-marked auricles consisting of short, dark cells with thick, porose walls demand familial recognition. The immersed position of the stomata seems especially significant in view of the rarity of immersed stomata among mosses."

Buck (1995) argued in favour of placement of *Rhacocarpus* close to the Dicnemonaceae in the Dicranales. He considered *Rhacocarpus* to be acrocarpous, but my observations on the perichaetial position in *R. purpurascens* do not support this.

***Rhacocarpus* Lindb., Öfvers. Kongl. Vetensk.-Akad. Förh. 19: 607 (1863)**

Type taxon: *Rhacocarpus humboldtii* (Hook.) Lindb. = *Rhacocarpus purpurascens* (Brid.) Paris

Plants rather robust, forming flat yellowish-brown, red-brown, or red mats. **Stems** red-brown, wiry, in cross-section with very thick-walled outermost cells grading gradually into medullary cells and lacking a central strand. **Stem** and **branch leaves** differentiated by size. **Stem leaves** erect, imbricate, smooth even when dry, ovate, oblong, or oblong-panduriform, either abruptly tapered to a slender and often castaneous hair-point or acute, concave, recurved at lower margins, and mostly strongly inrolled above (accentuating the taper of the leaf tip), entire below, denticulate near apex, with a large and strongly differentiated alar group, ecostate. **Branches** variable in length on the same plant, straight or curved. **Branch leaves** smaller; **upper laminal cells** linear-rhomboidal or fusiform, firm-walled, obscure because of a very fine cuticular reticulum covering both surfaces, more or less porose (sometimes conspicuously so), becoming extremely thick-walled at the base of the acumen and more elongate towards the insertion; **basal cells** lacking cuticular reticulations and strongly orange-brown in several rows; **marginal cells** narrowly linear, smooth, forming a border extending to mid leaf or beyond, rarely not differentiated (in non-N.Z. taxa); **alar cells** thick-walled and brightly pigmented

(usually red), forming a large, strongly differentiated, and auriculate group. **Asexual propagulae** lacking. **Paraphyllia** and **pseudoparaphyllia** absent.

Dioicous. Perichaetia scattered on stems. **Perigonia** inconspicuous, on stems. **Setae** smooth, red-brown; **capsules** erect, gymnostomous, broadly obovoid with a poorly defined neck, furrowed when dry; **mouth** transverse and wide; **exothelial cells** more or less isodiametric or rectangular, firm-walled; **stomata** restricted to neck, deeply immersed; **annulus** lacking; **operculum** obliquely long-rostrate. **Peristome** lacking. **Calyptra** cucullate. **Spores** ± tetrahedral.

Taxonomy: Frahm (1996) considered the genus to include six species worldwide, with four species restricted to South and/or Central America. The characters by which Frahm (1996) differentiated taxa are primarily the presence/absence of an apical hair-point, the strength of the leaf border, and leaf shape. Magill & van Rooy (1998, p. 543) did not accept *R. rehmannianus*, which was accepted by Frahm, in their treatment of the genus for southern Africa.

Rhacocarpus purpurascens is the most widespread and best-known species in both the genus and family.

Etymology: The generic name (Greek *rhako-karpos*) means “frayed seed”; according to Meagher (2011) it “presumably [alludes] to the raggedly split base of the calyptra”. The calyptrae in N.Z. material are not frayed at the base, and hence the name does not seem particularly apt.

Excluded Taxa: *Rhacocarpus*: excluded species

Rhacocarpus strictipilus (Müll.Hal.) Par. was described from the Auckland Is as a *Harrisonia* by Müller (1897) using material collected by J.D. Hooker. Frahm (1996) was unable to locate type material, but indicated that it was probably a synonym of *R. purpurascens*. Little purpose would be served to question his conclusion.

***Rhacocarpus purpurascens* (Brid.) Paris, *Index Bryol. Suppl.*, 292 (1900)**

≡ *Hypnum purpurascens* Brid., *Muscol. Recent. Suppl.* 2., 121 (1812)

Type: Réunion. Not seen.

= *Anictangium humboldtii* Hook., *Pl. Crypt.*, pl. 1A (1816)

≡ *Hedwigia humboldtii* (Hook.) Hook., *Musci Exot.* 2., 137 (1819)

≡ *Rhacocarpus humboldtii* (Hook.) Lindb., *Öfvers. Kongl. Vetensk.-Akad. Förh.* 19: 607 (1863)

Type: Venezuela. Not seen.

= *Anoetangium humboldtii* var. *australe* Hook.f. & Wilson, *Bot. Antarct. Voy. I. (Fl. Antarct.) Part I*, 135 (1845)

≡ *Hedwigia humboldtii* var. *australis* (Hook.f. & Wilson) Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II*, 93 (1854)

Syntypes: Auckland and Campbell Is. Not seen.

Plants lustrous and appearing lacquered when dry, yellow-green to castaneous below, usually glaucous in parts and with bright castaneous or golden hair-points, rarely black throughout, forming prostrate and loosely interwoven mats or self-supporting and sub-erect, subpinnately branched. **Stems** (20–)60–80(–100 mm or greater). **Rhizoids** apparently absent. **Stem** and **branch leaves** differentiated. **Stem leaves** erect, imbricate both moist and dry, inserted in ranks and sometimes appearing funiculate, with an oblong-panduriform base and appearing abruptly tapered (due to inrolled upper margins) to a very slender, pale, golden, or castaneous hair-point, ecostate, concave, smooth even when dry, strongly inrolled at upper margins (and thus accentuating the taper of the leaf tip), denticulate near the base of the hair-point, entire below, auriculate and decurrent at insertion, mostly c. (2.0–)2.3–2.9 × (0.6–)0.8–1.0 mm (under cover slip). **Branches** mostly 7–10 mm, cuspidate at apex. **Branch leaves** mostly c. $\frac{2}{3}$ the length and width and less strongly decurrent than stem leaves; **upper laminal cells** as per genus, mostly 27–42 × 7–9 µm; **basal cells** as per genus; **marginal cells** forming a distinct and often pigmented border c. 3–4 cells wide (at mid leaf) and extending from the leaf base to mid leaf or nearly to the base of the hair-point; **alar cells** rectangular to quadrate, extremely thick-walled and porose, forming a conspicuous, strongly pigmented, and auriculate group.

Dioicous. Perichaetia occurring in clusters of 2–4 or more, at intervals (apparently at annual growth intervals) on stems, the inner leaves oblong-lanceolate, strongly pigmented, c. 4 mm long, and strongly sheathing the seta base, with laminal cells lacking cuticular reticulations. **Perigonia** inconspicuous, best observed near stem apices, c. 2 mm, the bracts very concave, more ovate and pigmented than vegetative leaves, surrounding antheridia and numerous filiform 5–6-celled

paraphyses. **Setae** c. 10–20 mm, red-brown, weakly dextrorse; **capsules** erect, broadly obovoid with a poorly defined neck, weakly furrowed when dry, 2.0–2.5 mm, nearly globose after dehiscence; **exothecial cells** mostly isodiametric and firm-walled, with ill-defined vertical bands of thinner-walled cells, becoming much smaller near mouth; **stomata** immersed, few and restricted to neck; **annulus** lacking; **operculum** obliquely rostrate, \pm equal the capsule in length. **Spores** \pm tetrahedral, 21–28 μm , coarsely papillose-lirate.

Illustrations: Plate 1. The habitat drawing, fig. A, inadequately illustrates the conspicuous hair-points. Scott & Stone 1976, p. 359; Beever et al. 1992, fig. 54; Crum 1994, fig. 498; Magill & van Rooy 1998, fig. 151, 1–11; Malcolm & Malcolm 2003, p. 58; Meagher & Fuhrer 2003, p. 77; Seppelt 2004, fig. 96; Seppelt et al. 2013, pl. 26.

Distribution: NI: N Auckland, including offshore islands (GB), S Auckland, Gisborne (Raukūmara Range, Te Rangaakapua), Hawke's Bay (Black Birch Range), Wellington, Taranaki; SI: Nelson, Marlborough (Mt Stokes, Richmond Range), Canterbury, Westland, Otago, Southland (Longwood Range, many localities in Fiordland); St; A; C; M.

Anomalous. Tasmania*, mainland Australia*, Chile*, Argentina*, Bolivia*, Ecuador*, Dominican Republic*, Rwanda*, Kenya*. Reported also from Mexico, Central America, and from other South American and African localities by Crum (1994). The genus occurs in Malesia, including New Guinea, but the specific status of this material is debatable (cf. Frahm 1996; Koponen & Norris 1986).

Habitat: An easily recognised species of dripping rock faces (basalt, granite, greywacke, sandstone, serpentine, conglomerate), where it forms extensive prostrate or self-supporting and sub-erect mats, sometimes several square metres in extent. It is nearly ubiquitous in N.Z. and is known from many localities from all the L.D. for which specific localities are not cited above. This species avoids calcareous and/or cation-rich rocks and at lower elevations it prefers south-facing and moist slopes. Also occurring on waterlogged peat, at the margins of intermittent pools in cushion bogs and pākihi, in bryophyte mats over gravel banks, in intermittent streams, and rarely over rotten wood. On the North I. from near sea-level (North Cape, N Auckland L.D.) to at least 1700 m (Mt Hikurangi, Gisborne L.D.), but most common above c. 400 m. On the South I. from near sea level (Dusky Sound, Southland L.D.) to at least 1975 m (Remarkable Range, Otago L.D.) elevation. Frequently associated species in moist sites include *Andreaea nitida*, *Breutelia elongata*, *B. pendula*, *Campylopus bicolor*, *Pulchrinodus inflatus*, *Racomitrium crispulum* s.l., and *Warnstorfia fluitans*, as well as *Isotachis* spp., *Jamesoniella colorata*, *Frullania rostrata*, *Drosera arcturi*, and *D. spathulata*. In drier sites associates may include *Andreaea subulata*, *Austrohondaella limata*, *Campylopus clavatus*, *C. introflexus*, *Dicranoweisia antarctica*, *Ditrichum punctulatum*, and *Racomitrium pruinosum*, as well as *Cladia aggregata* and *Hypogymnia lugubris*.

Notes: Once the characteristic appearance of *R. purpurascens* is recognised, especially the pinnately branched stems, the lacquered and usually glaucous appearance of the leaves with castaneous leaf margins and hair-points (especially in lower portions of the plants), together with the large and strongly pigmented alar group, there is nothing else in the N.Z. flora with which this species could be confused. The fine structure of the leaf surface is also highly distinctive. The degree of hair-point development is highly variable and does not appear to be geographically correlated.

Very strongly pigmented and sometimes nearly black material seems to be associated with prolonged submersion; very dark material frequently has particularly obviously porose laminal cells. Occasional herbarium specimens turn dull grey with age.

Frahm (1996) searched unsuccessfully for type material of *Hypnum purpurascens* Brid. in the Bridel herbarium and suggested that the selection of a neotype from Réunion might be required.

Both the names *Rhacocarpus humboldtii* and *R. australis* have been widely applied in N.Z. literature and herbaria. *Rhacocarpus australis* (Hampe) Paris [Ind. Bryol. 1068, 1898] is founded on *Harrisonia australis* Hampe [Linnaea 30: 636, 1860], which has a type (not seen) from the Grampian Range of Victoria. Streimann & Klazenga (2002) include *H. australis* in the synonymy of *R. purpurascens* and no useful purpose would be served by questioning this placement. Frahm (1996, p. 56) placed *Anoetangium humboldtii* var. *australe* Hook.f. & Wilson in the synonymy of *R. purpurascens*, citing a Victorian specimen gathered by Walter as the type. However, the protologue shows the syntypes of this name are clearly from Auckland and Campbell Islands, and were presumably collected by Hooker. These have not been seen.

Recognition: Some material of *R. purpurascens* could conceivably be confused with alpine forms of *Wijkia extenuata* var. *extenuata* given their similar growth habit, branching patterns, and abruptly tapered leaves. *Rhacocarpus purpurascens* differs from the *Wijkia* by having leaves that appear thick and lacquered with pigmented hair-points. The alar cells of *R. purpurascens* are rectangular,

extremely thick-walled, strongly pigmented, and porose, in contrast to the highly inflated and very thin-walled alar cells of the *Wijkia*. The capsules of the two plants are completely different. *Rhacocarpus purpurascens* usually grows on rock, while the *Wijkia* grows mostly on rotten wood.

Etymology: The epithet *purpurascens* aptly means becoming purple. The disused epithet *humboldtii* honours the great Prussian explorer and geographer Alexander von Humboldt who, together with Aimé Bonpland, gathered the type of *Hedwigia humboldtii* at high elevation in the northern Andes.

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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)
subsp.	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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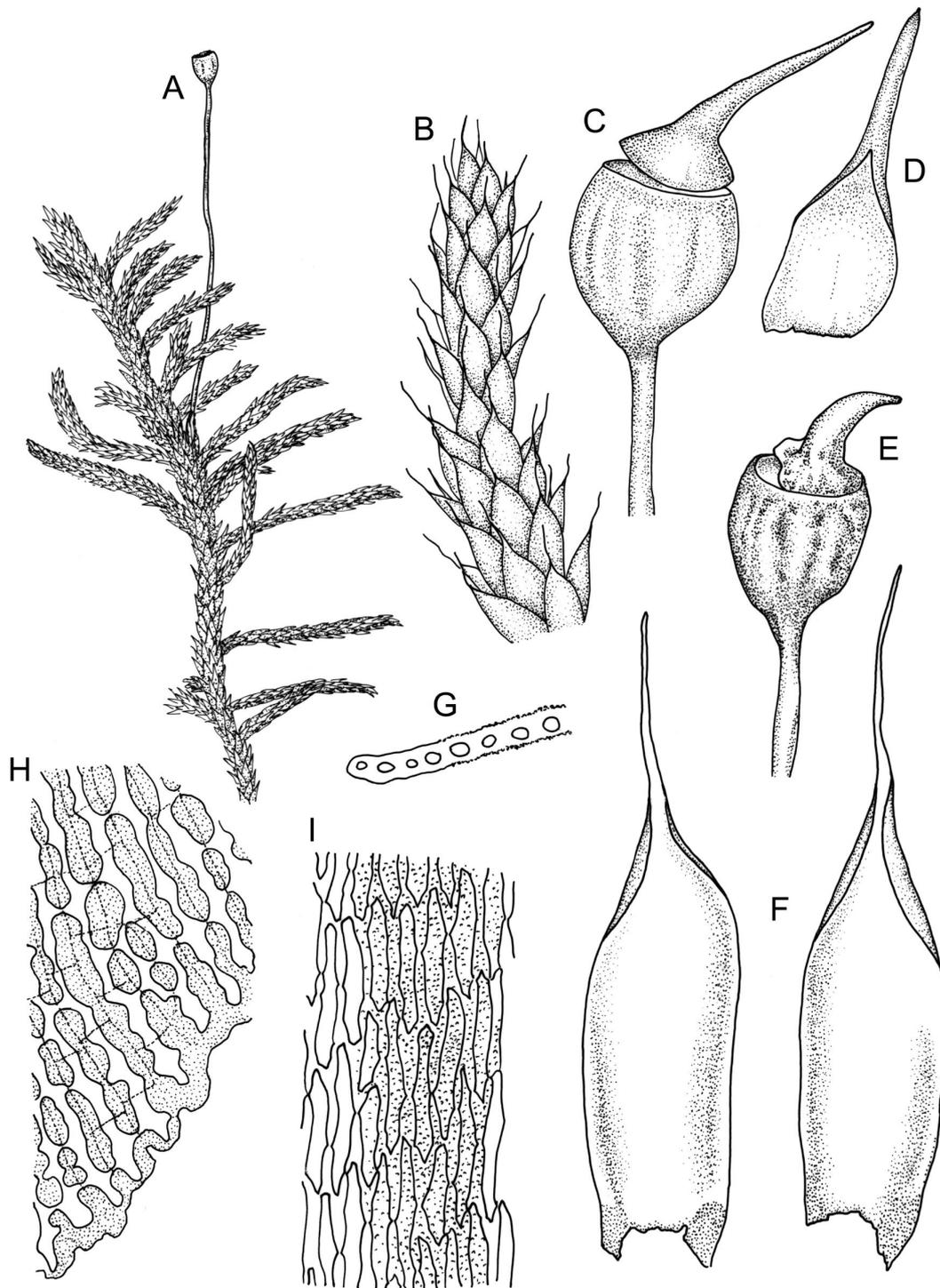
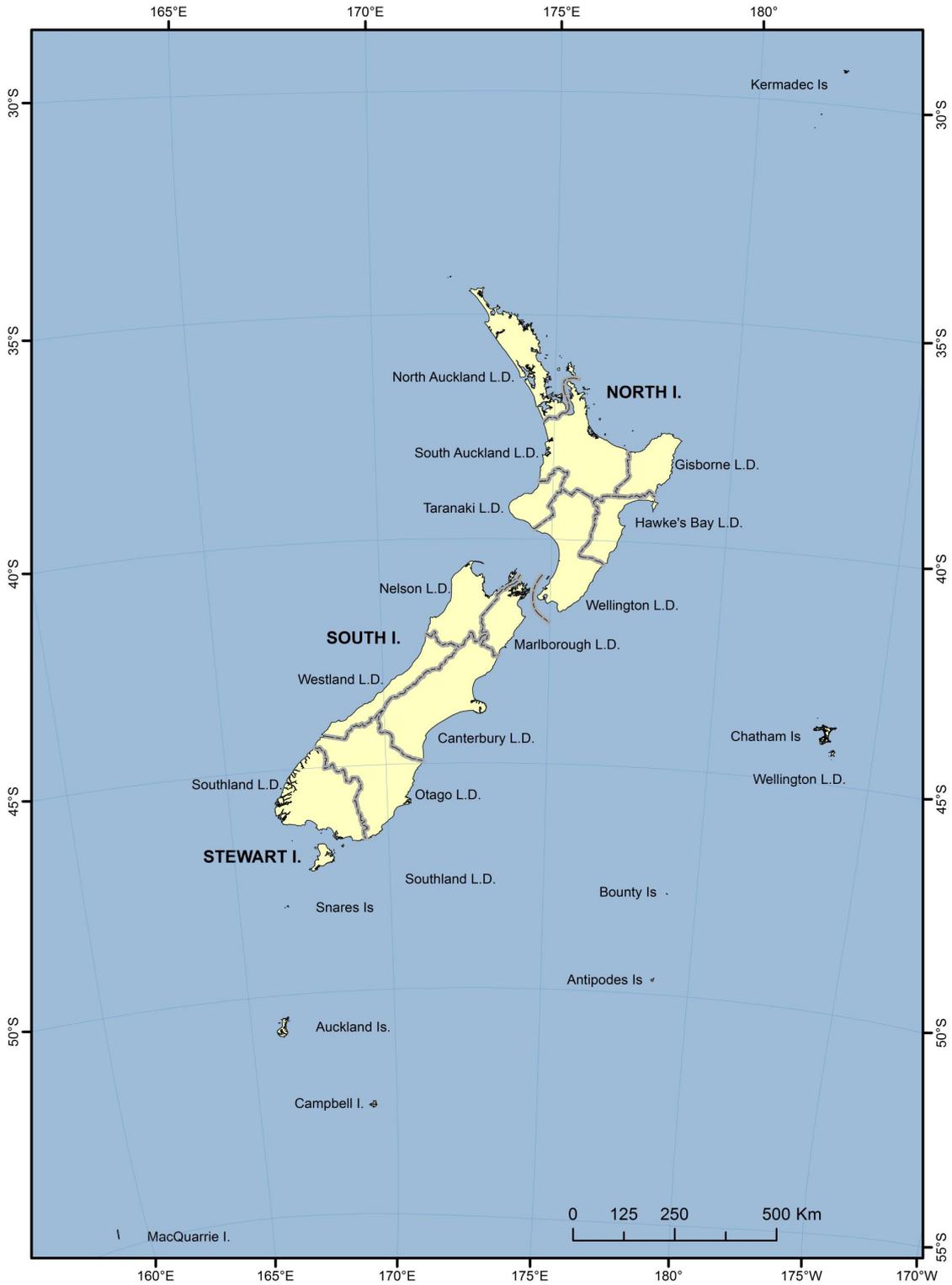
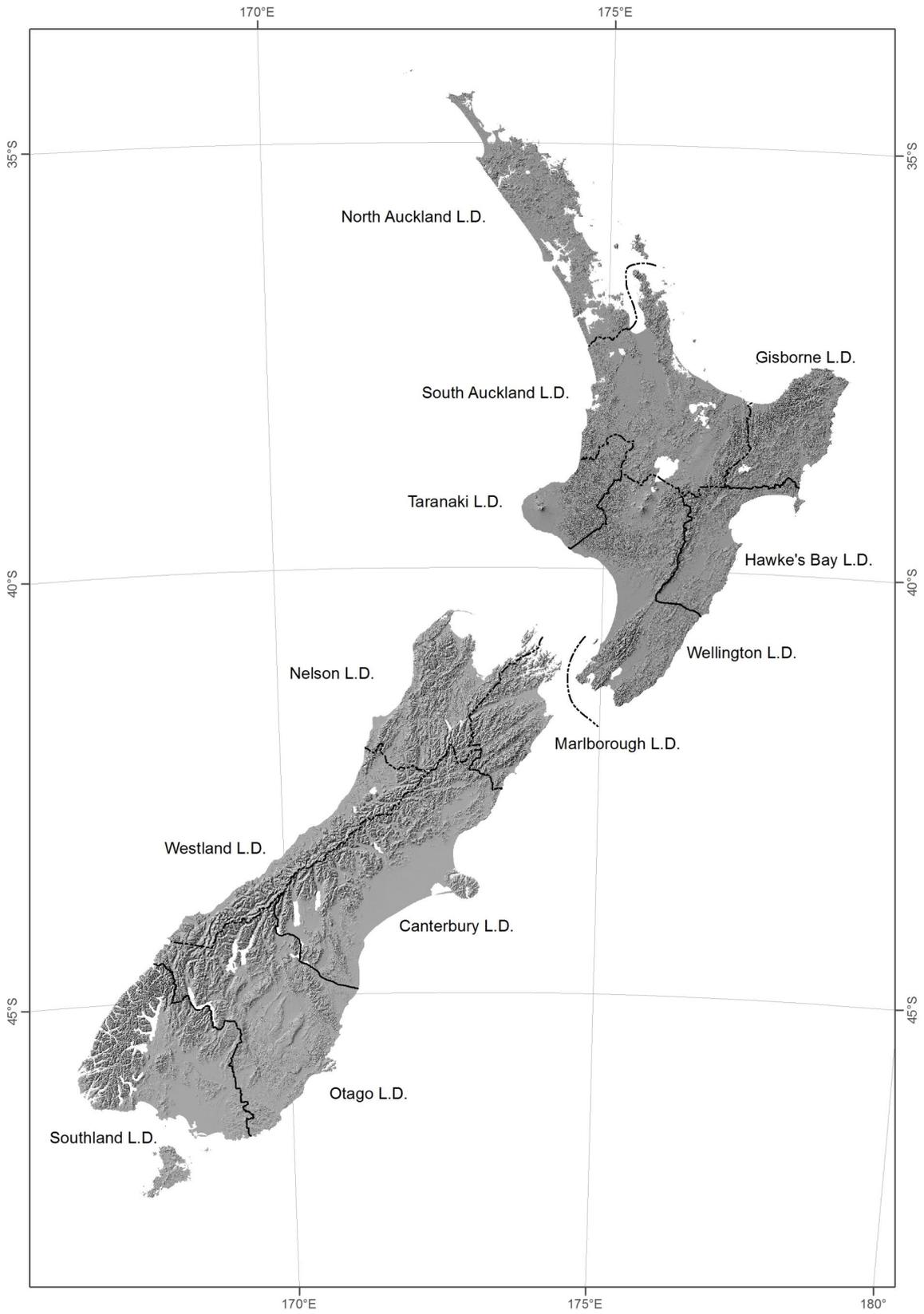


Plate 1: *Rhacocarpus*. A–I: *R. purpurascens*. A, habit with capsule. B, portion of shoot, moist. C, capsule, moist. D, calyptra. E, capsule, dry. F, stem leaves. G, cross section of mid laminal cells. H, alar cells. I, upper laminal cells. Drawn from *B.H. Macmillan 94/65, CHR 506931, and A.J. Fife 11135, CHR 515097.*



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.

Anictangium humboldtii Hook. **3**

Anoetangium humboldtii var. *australe* Hook.f.
& Wilson **3**

Hedwigia humboldtii (Hook.) Hook. **3**

Hedwigia humboldtii var. *australis* (Hook.f. &
Wilson) Hook.f. & Wilson **3**

Hypnum purpurascens Brid. **3**

Rhacocarpaceae Kindb. **2**

Rhacocarpus Lindb. **2, 2**

Rhacocarpus humboldtii (Hook.) Lindb. **3**

Rhacocarpus purpurascens (Brid.) Paris **2, 3, 3**

Image Information

Image
Plate 1
Map 1
Map 2

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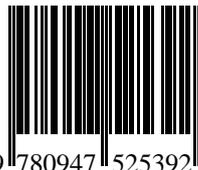
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