

The biogeography of *Knightiella splachnirima*

Lars R. Ludwig

Department of Botany, University of Otago, Dunedin, New Zealand
e-mail: lars.ludwig@botany.otago.ac.nz or lars-ludwig@gmx.de

Abstract: A comprehensive, geo-referenced compilation of the known global distribution of *Knightiella splachnirima* is presented, based on herbarium records, literature, and personal observations in New Zealand and Australia (Tasmania and Victoria). *Knightiella splachnirima* probably is more widely distributed in New Zealand than current records show.

Introduction

Galloway (2000) transferred *Knightiella splachnirima* to *Icmadophila* Trevis., a change that has been widely accepted. However, a molecular-genetic reassessment of the phylogeny of the genus *Icmadophila* Trevis. (to be published elsewhere) showed that the species does not belong in *Icmadophila*. Hence, the previous name *Knightiella splachnirima* is correct, as argued earlier by Stenroos *et al.* (2002). The updated nomenclature is applied here as a prelude to a revision of the genus *Icmadophila*.

Knightiella splachnirima is endemic to south-eastern Australasia, defined here as the southern part of New Zealand, including its subantarctic off-shore islands, plus the Australian states of Tasmania and Victoria. Detailed biogeographic information on the species is difficult to compile, because it is scattered among various types of literature, a range of herbaria and ecological databases. This paper aims to provide a thorough compilation of the available information. The compilation is an essential part of my PhD study focusing on the species' reproductive ecology (Ludwig 2015), the contents of which will be published elsewhere.

Material and methods

To discover where specimens of *K. splachnirima* are currently held worldwide, searches were launched of several databases, including the New Zealand and Australian virtual herbaria, the Australian National Herbarium Specimen Information Register, the Global Biodiversity Information Facility, and the Consortium of North American Lichen Herbaria. Keywords for those searches were the currently accepted name and synonyms, including *Theleidea corrugata*, *Knightiella splachnirima* and *Icmadophila splachnirima*. Detailed specimen information has kindly been supplied by numerous herbaria (see Acknowledgements section). Additional localities and records were searched for in Dodge (1948), Dodge & Rudolph (1955), Martin (1960), Galloway (1968a+b, 1985, 2000, 2004, 2007), Fineran (1969), Bratt (1976a+b+c), Galloway & Elix (1980), Kantvilas & Seppelt (1992), Johnston (2001) and Hay *et al.* (2004). Because Otago Regional Herbarium (OTA) specimen data were not yet data-based, collection data were obtained from the herbarium packets themselves. The identities of all specimens lodged in New Zealand herbaria were verified. In addition, *K. splachnirima* was searched for in the field in New Zealand between 2010 and 2014.

A distribution map was generated with the package maps and the Pacific-centric map template "world2Hires" of freeware R 2.10.1. The geographic coordinates plotted in the map were either provided as geo-referenced public herbarium records, or manually inferred using Google Earth and topographical maps of New Zealand downloaded from either <http://www.topomap.co.nz/> or <http://www.linz.govt.nz/topography/topo-maps/index.aspx>. The coordinates of NZ herbarium specimens in NZTM or other formats were converted to the World Geodetic System 1984 (WGS84) format using the website <http://apps.linz.govt.nz/coordinate-conversion/>.

Results

All the records are compiled in Figure 1 as a global distribution map of *K. splachnirima*. The full dataset, in table form, can be downloaded as an Online Appendix

from the Dryad Data Repository (<http://datadryad.org/>). The link is <http://dx.doi.org/10.5061/dryad.43b8h/>. That dataset plus the remainder of the thesis will also be available for download, after publication, at the Otago University Research Archive <http://ourarchive.otago.ac.nz/>.

Tasmania stands out as the centre of distribution and abundance, with more than 70 sites spread over almost the entire island. In contrast, *K. splachnirima* is known from only four sites in Victoria, but they are widely scattered and include the northernmost and westernmost records in Australia. No confirmed record exists from Macquarie Island (Kantvilas & Seppelt 1992), but Dodge (1948:78) identified a poorly developed thallus as a species of *Theleidea*.

The species' known distribution is highly disjunct in New Zealand as well. It is centred around Stewart Island and the far South of the South Island, but more recently the species has been found in the north of the West Coast of the South Island. It is also known from subantarctic Auckland and Campbell Island, the latter being its southern limit. The easternmost collections were recently gathered from the Chatham Islands. Currently, no records exist for the North Island, Antipodes Island or Snares Island.

I have discovered several new localities in New Zealand, including the Blue Mountains summit plateau wetlands, Ajax Hill in the Catlins region, Bald Hill in the Longwood Range, the Heaphy Track between Karamea and Golden Bay, and Oban on Stewart Island. I have also collected specimens from three localities (Denniston Plateau near Westport, Takitimu Mts near Te Anau, and Rakeahua Flat on Stewart Island) that are reported in the literature (Galloway (1968a, 2007) but are not linked to any voucher specimens. In addition, I have collected further specimens from the Croesus Track in the Paparoa Range near Greymouth, a site that was discovered by Barbara Polly in 1999 but was not cited by Galloway (2007).

I could not find the species in the Black Swamp and Mt Maungatua sites in Otago, even though Black Swamp bog is only about 300 m diameter, and D.J. Galloway showed me the exact site on Mt Maungatua where he collected the species in 1966. Also, I could not find the species in the Awarua wetlands near Invercargill, but I visited the wetlands only briefly, and thus searched only a tiny fraction of that vast area. Unfortunately, draining of the Awarua plain by local farmers has encouraged the growth of manuka, which now forms a low forest cover over huge areas that during the 1960s were open bog (pers. comm., D.J. Galloway).

Discussion

After several years of searching for *K. splachnirima*, I am convinced that our understanding of its distribution is still incomplete, and probably will continue to be, because not only are few collectors out searching for it, but also it grows in wet and muddy sites that collectors typically avoid. I predict the discovery of many new localities along the South Island's West Coast, and the species is almost certainly present in the bogs of the Te Anau-Manapouri area (Southland), e.g. Kepler Mire just east of the Te Anau-Manapouri Aerodrome, and Dome Mire 13 km NNE of Te Anau (see Burrows & Dobson 1972). Possibly it also occurs at higher elevations on Banks Peninsula near Christchurch, even though I twice searched for it there without success. The vast boggy tussock grasslands on Antipodes Island appear suitable for the species as well, and it is likely to grow on Snares Island, if only because Stewart Island is nearby.

It should also be searched for in bogs and undisturbed subalpine areas of the North Island, e.g. Tararua and Ruahine Ranges or the Urewera National Park. Still another promising North Island site is the Kopuatai Peat Dome c. 30 km South of Thames (37°25'S, 175°34'E), an extensive lowland peat bog covering c. 10,000 hectares (Clarkson & Peters 2010, 2012). Other potential sites can be found by searching for suitable habitat in vegetation maps of New Zealand (Newsome 1987).

Although I suspect that *K. splachnirima* is much more widespread in New Zealand than current records show, I would argue that the species' current conservation status

of “Nationally Vulnerable” should not be relaxed (de Lange *et al.* 2012), because the species’ primary peat bog habitat continues to be threatened, especially in the lowlands.

In Australia, probably the species is more widespread in Victoria than records show. It should be searched for in the Australian Alps, which might well extend its range into New South Wales. King, Flinders and Cape Barren Islands, the major islands in Bass Strait north of Tasmania, could also have suitable habitats for it, although their highest points are below the elevations where it typically occurs. Clearly Tasmania is the species’ stronghold, and will be very important for its survival in a warming global climate.

Knightiella splachnirima might also occur on Macquarie Island. The island’s peaty soils and tussock grasslands are ideal habitats for it, and are already home to several other lichen species known to associate with it (Kantvilas & Seppelt 1992). Hence collectors visiting Macquarie Island should specifically search for it.

The disappearance of *K. splachnirima* from sites where it was collected in the past suggests that conservationists should assess its abundance every five or ten years. The distribution map of *K. splachnirima* presented here will be an essential reference for that task. Also in the future, the distribution data can be used to model the species’ macro-habit and potential distribution by superimposing Newsome’s (1987) vegetation cover maps and meteorological data from NIWA (National Institute of Water and Atmospheric Research) National Climate Database (<http://cliflo.niwa.co.nz>). Similar studies have been done on overseas lichens, among them the *Lecanora varia* group (McCune & Printzen 2011) and *Erioderma mollissimum* (Cameron *et al.* 2011).

Acknowledgements

I am grateful to the curators of AK, AZU, BG, BM, CABI, CANB, CBG, CHR, FH, HO, MEL, MSC, NSW, OTA, S, TSB and WELT for supplying essential specimen record data. For providing additional specimens or specimen information, I thank Dr Allison Knight, Ms Anna Harris, the late Dr David Galloway, Mrs Janet Ledingham, Dr Peter N. Johnson (all from Dunedin) and Mrs Sandy King (Oban). The PhD study from which this paper was derived was funded by a University of Otago Doctoral Scholarship and research grants by the Miss E.L. Hellaby Indigenous Grasslands Research Trust, the Dunedin branch of Forest & Bird, the British Lichen Society and Otago University’s Diane Campbell-Hunt Memorial Award. For supervision of my PhD study, I thank Dr Janice Lord.

References

- Bratt, GC (1976a): Lichens of South West Tasmania Part I - Lichens of the Button Grass Areas. *The Tasmanian Naturalist* **45**, 1–4.
- Bratt, GC (1976b): Lichens of South West Tasmania Part II - Mountain Peaks and Plateaux. *The Tasmanian Naturalist* **46**, 1–4.
- Bratt, GC (1976c): Lichens of South West Tasmania Part III - Forests. *The Tasmanian Naturalist* **47**, 1–4.
- Burrows, CJ; Dobson, AT (1972): Mires of the Manapouri-TeAnau Lowlands. *Proceedings of the New Zealand Ecological Society* **19**, 75–99.
- Cameron, RP; Neily, T; Clayden, SR (2011): Distribution prediction model for *Erioderma mollissimum* in Atlantic Canada. *The Bryologist* **114**, 231–238.
- Clarkson, B; Peters, M (2010, 2012): Wetland Types. In: Wetland Restoration: a Handbook for New Zealand Freshwater Systems. M Peters & B Clarkson (eds). Manaaki Whenua Press, Lincoln.
- de Lange, PJ; Galloway, DJ; Blanchon, DJ; Knight, A; Rolfe, JR; Crowcroft, GM; Hitchmough, R (2012): Conservation status of New Zealand lichens. *New Zealand Journal of Botany* **50**, 303–363.
- Dodge, CW (1948): Antarctic Research Expedition 1929–1931 vol. VII. Lichens and lichen parasites. <http://nhm2.uio.no/botanisk/lav/RLL/PDF1/M21215.pdf>

- Dodge, CW; Rudolph, ED (1955): Lichenological Notes on the Flora of the Antarctic Continent and the Subantarctic Islands. I–IV. *Annals of the Missouri Botanical Garden* **42**, 131–149. <http://biostor.org/reference/11801>
- Fineran, BA (1969): The Flora of the Snares Islands, New Zealand. *Transactions of the Royal Society of New Zealand, Botany* **3**, 237–270.
- Galloway, DJ (1968a): The Lichens of Stewart Island 1. - The Mount Anglem Highlands. *Transactions of the Royal Society of New Zealand, Botany* **3**, 231–236.
- Galloway, DJ (1968b): The Lichens of Stewart Island 2. Port Pegasus. *New Zealand Journal of Botany* **6**, 309–314.
- Galloway, DJ (1985): *Flora of New Zealand Lichens*. PD Hasselberg, Wellington.
- Galloway, DJ (2000): *Knightiella* belongs in *Icmadophila* (Helotiales: Icmadophilaceae). *The Lichenologist* **32**, 294–297.
- Galloway, DJ (2004): Note on some lichen names recorded from the Snares Islands, southern New Zealand. *Australasian Lichenology* **55**, 21–25.
- Galloway, DJ (2007): *Flora of New Zealand Lichens*. Revised second edition. Manaaki Whenua Press, Lincoln.
- Galloway, DJ; Elix, JA (1980): *Knightiella* Müll.Arg., a monotypic lichen genus from Australasia. *New Zealand Journal of Botany* **18**, 481–486.
- Hay, CH; Warham, J; Fineran, BA (2004): The vegetation of The Snares, islands south of New Zealand, mapped and discussed. *New Zealand Journal of Botany* **42**, 861–872.
- Johnston, J (2001): Icmadophilaceae. In: Flora of Australia. Volume 58A, Lichens 3. PM McCarthy (ed.). pp. 17–23. ABRIS/CSIRO, Melbourne.
- Kantvilas, G; Seppelt, RD (1992): The lichen flora of Macquarie Island: introduction and an annotated checklist of species. Antarctic Division, Department of the Arts, Sport, the Environment and Territories, iii + 20 pp.
- Ludwig, LR (2015): The reproductive ecology of *Icmadophila splachnirima*, including aspects of the reproduction in additional members of Icmadophilaceae. A thesis submitted for the degree of PhD, University of Otago, Department of Botany, Dunedin, New Zealand, xiii + 195 pp.
- Martin, W (1960): The Cryptogamic Flora of the Awarua Plains. *Transactions of the Royal Society of New Zealand* **88**, 161–167.
- McCune, B; Printzen, C (2011): Distribution and climatic niches of the *Lecanora varia* group in western U.S.A. *Bibliotheca Lichenologica* **106**, 225–234.
- Newsome, PFJ (1987): The vegetative cover of New Zealand. Wellington, National Water and Soil Conservation Authority, 153 pp. + 2 poster-sized maps.
- Stenroos, S; Myllys, L; Thell, A; Hyvärinen, J (2002): Phylogenetic hypotheses: Cladoniaceae, Stereocaulaceae, Baecomycetaceae, and Icmadophilaceae revisited. *Mycological Progress* **1**, 267–282.

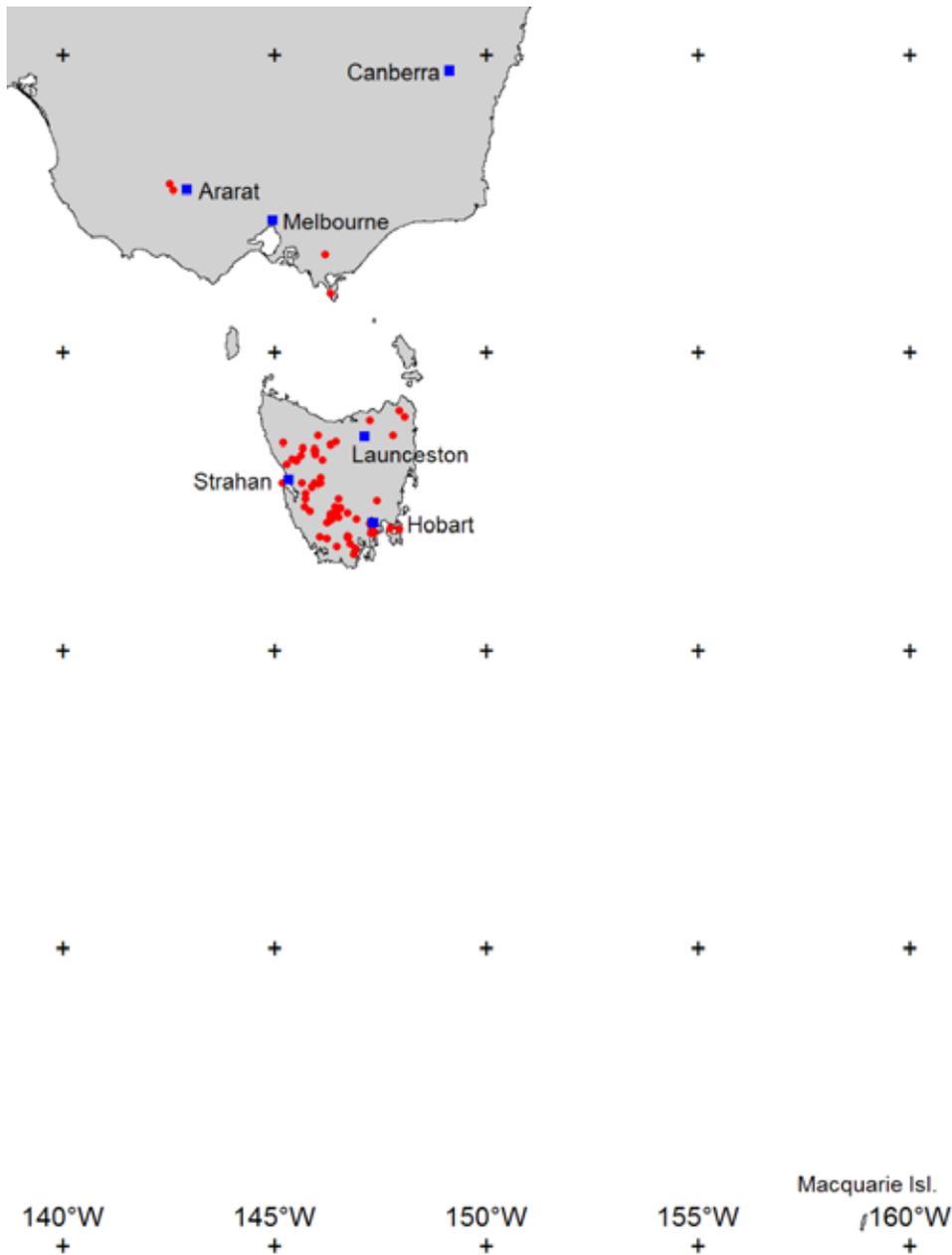
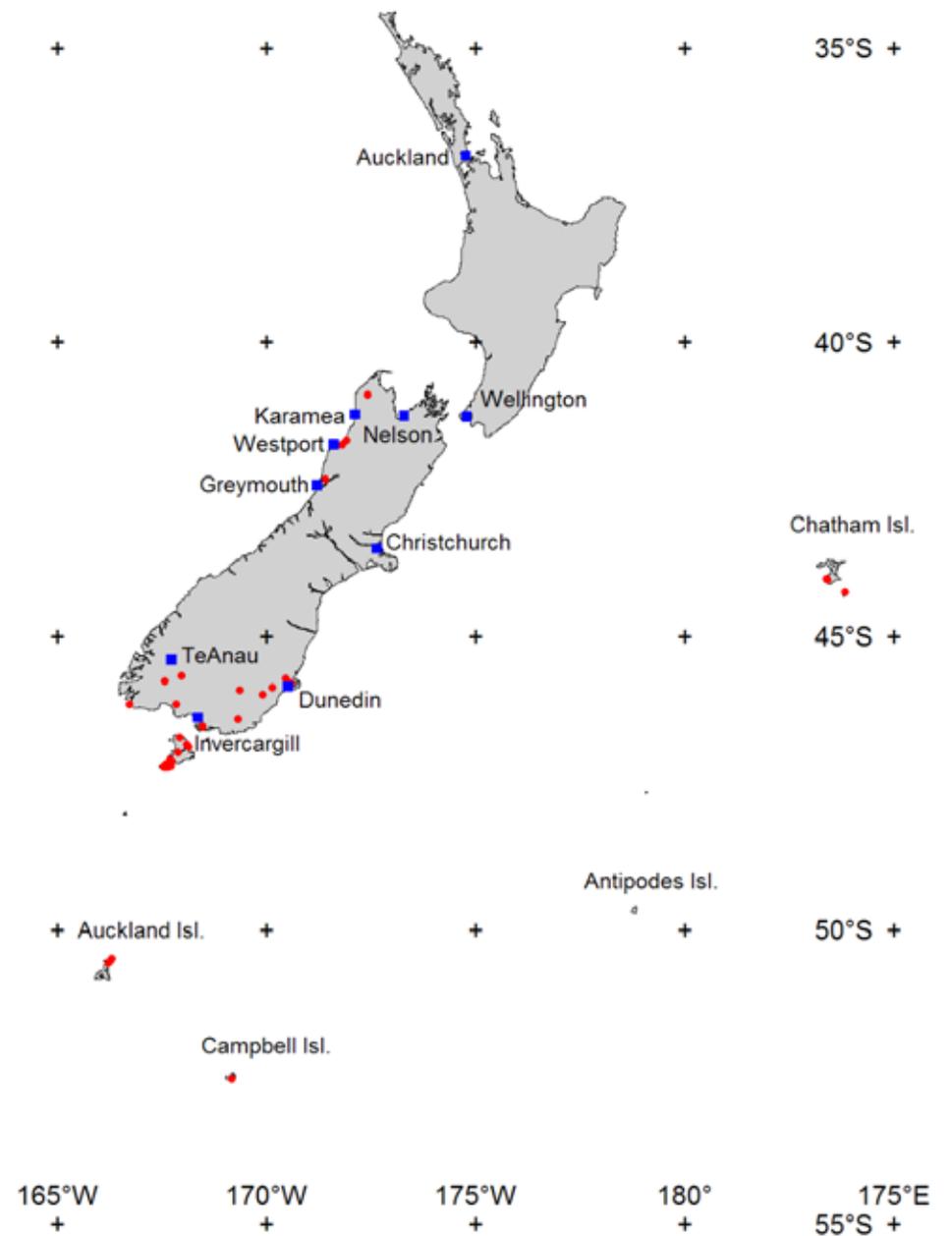


Figure 1. Dot map showing the known global distribution of *Knightiella splachnirima* in south-east Australia (Victoria and Tasmania) and New Zealand. The red dots are



known localities of the species, whereas the blue squares are cities or towns. The + symbols represent intersections of every 5th meridian and parallel.