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RESEARCH ARTICLE

Leptospermum repo (*Myrtaceae*), a new species from northern Aotearoa / New Zealand peat bog habitats, segregated from *Leptospermum scoparium* s. l.

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Abstract. *Leptospermum repo* de Lange & L.M.H.Schmid sp. nov. (*Myrtaceae*) is segregated from *L. scoparium* J.R.Forst. & G.Forst. (sensu lato). The new species is endemic to the peat bogs of the Waikato, Bay of Plenty, and adjacent eastern ranges of the northern portion of Te Ika a Maui / North Island, Aotearoa / New Zealand. The new species belongs to the northern Te Ika a Maui / North Island clade of *L. scoparium* s. l., from whose other members it is morphologically distinguished by its gracile, spindly, open-branched growth habit; widely divergent, longer, linear, linear-lanceolate (rarely filiform), shortly cuspidate leaves; flowers with white petals, stamens mostly with white filaments (very rarely tinged pink near base), and by the style and stigma which are usually green (very rarely pink). *Leptospermum repo* now occupies ca. 10% of its former peat bog habitat, where aside from a few protected peat bogs the species is still in decline through loss of its habitat. A more recent potential threat to *L. repo* is myrtle rust disease, caused by *Austropuccinia psidii*, an exotic rust first detected in Aotearoa / New Zealand in May 2017. This rust poses a serious threat to the *Myrtaceae* of Aotearoa / New Zealand, for which there is at present no known effective treatment to prevent the death of infected hosts. Therefore, due to the historic loss of habitat, a threat which is still ongoing, causing the decline of many *L. repo* populations; and the potential threat of *Austropuccinia psidii* to this species, the listing proposed for the species (as *Leptospermum* aff. *scoparium* (c) (AK191319; "Waikato peat bog") by the New Zealand Indigenous Vascular Plant Threat Listing Panel of "Threatened / Nationally Critical_{DP, De}" is here upheld.

Keywords: Aotearoa / New Zealand, *Leptospermum*, *Leptospermum repo* sp. nov., *Leptospermum scoparium*, *Myrtaceae*, new species, taxonomy

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Introduction

Leptospermum J.R.Forst. & G.Forst. (*Myrtaceae*), a primarily Australasian genus, comprises ca. 87 species (Thompson, 1989; Bean, 1992; Lyne, 1993; Lyne, Crisp, 1996; Bean, 2004). The type of the genus is *L. scoparium* J.R.Forst. & G.Forst. As currently circumscribed (Thompson, 1989; Sykes, 2016) *L. scoparium* s. l. is a variable species complex of trees and shrubs found in

eastern Australia, Aotearoa / New Zealand, and the Cook Islands (Rarotonga).

Leptospermum scoparium was succinctly described by Forster & Forster (1776: 48 [72], tab. 36: f–l) "*L. fol., sparsis, ovato-lanceolatis*" (however, Table XXXVI [36] can be considered as an analytical illustration) from specimens that were probably collected from Dusky Sound, Fiordland, Aotearoa / New Zealand (Allan 1961; Buys et al., 2019). The perfunctory nature of the Forsters'

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diagnosis, has, understandably, failed to address the considerable variation within the species as it is now circumscribed (Thompson, 1989) either in its narrow or wide circumscription. Not surprisingly with a species hitherto believed to range across eastern Australia, Aotearoa / New Zealand and Rarotonga (Fig. 1.), there have been attempts by taxonomists to define more precisely the natural variation.

The first to address this variation was William Aiton who placed *Leptospermum scoparium* into *Philadelphus* L., as *P. scoparius* (J.R.Forst. & G.Forst.) Aiton and recognised within it two varieties, var. *linifolius* Aiton and var. *myrtifolius* Aiton (Aiton, 1789: 156). Of these, var. *linifolius* is illegitimate because it included the type of *Leptospermum scoparium* s. str. (Buys et al., 2019), and thus the variety should be called *P. scoparius* var. *scoparius* (autonym, Art. 26 of the ICN: Turland et al., 2018). Twenty-five years later, William Townsend Aiton (1811: 181), the eldest son of William Aiton, returned *Philadelphus scoparius* and its varieties to *Leptospermum*. Hooker (1853) in his *Flora Novae-Zelandiae* recognised a further variety from that country, *L. scoparium* var. *prostratum* Hook.f., with the diagnosis ‘caule prostrato, ramulis ascendentibus, foliis late ovatis orbiculatisve squarroso-recurvis’, for which he gave no specific locations. Later, Aotearoa / New Zealand based botanist Kirk (1899) contributed a further variety, *L. scoparium* var. *parvum* Kirk, to cover specimens with coriaceous, ovate, sharp-tipped leaves, smaller flowers and glabrous hypanthia, which he had collected in the vicinity of Wellington. The most recent contribution to defining the variation of Aotearoa / New Zealand populations of *L. scoparium* was by Cockayne (1917a) who described *L. scoparium* var. *incanum* Cockayne from the sand country of the far north of Northland, Te Ika a Maui / North Island, Aotearoa / New Zealand.

Acceptance of these varieties has been variable. Hooker (1867: 728), for example, regretted his earlier naming of var. *prostratum*, and with respect to that variety and the others then recognised he stated that because "the species of the genus are ..., so variable" the recognition of further taxa from within it was unwise. Cheeseman was also uncertain in that case; in his first flora treatment (Cheeseman, 1906) he accepted the then named varieties without comment; however, nineteen years later he reduced all, except Cockayne's var. *incanum*, into synonymy within the widely circumscribed *L. scoparium* (Cheeseman, 1925). Allan (1961) offered no advance on Cheeseman (1925), if anything adding further confusion with his assessment of var. *incanum*, for which he offered

an incomplete treatment. Twenty-seven years later, Webb et al. (1988) only recognised the one species *L. scoparium* for Aotearoa / New Zealand, rejecting var. *incanum* altogether.

Collectively then, the various Aotearoa / New Zealand flora treatments of *Leptospermum scoparium* s. l. have retained the impression of a highly variable and morphologically "plastic" species, initially worthy of further infraspecific taxonomic segregation but now apparently not. In part, this modern view reflects the conservative approach to species limits adopted by Joseph Dalton Hooker and Thomas Cheeseman, whilst the treatment meted out by Allan (1961) seems to have been strongly influenced by his mentor Leonard Cockayne, an opinionated, politically astute though rather forceful botanist (Thomson, 1983, 2021; de Lange, 2019). Cockayne had by the early 1900s developed a strong dislike of taxonomy, taxonomic concepts and most Aotearoa / New Zealand based taxonomists (Cockayne, 1917b, 1919, 1926; Moore, 1967; Thomson, 1983, 1990, 2021; de Lange, 2019) such that he was happy to relegate the *Leptospermum scoparium* varieties established by Aiton, Hooker, and Kirk to mere "footnotes" in the annals of that species, though notably he retained his own contribution to the taxonomic resolution of that species variation, var. *incanum*, as unquestionable.

From an Aotearoa / New Zealand view point, Cockayne's dismissal of *Leptospermum scoparium* taxonomic segregates (either infraspecific or species-rank ones) seems to be at the root of the modern view that this species though highly variable, with well-marked races is best treated as belonging to a single species (Webb et al., 1988). The question is why did Cockayne have this view? The answer lies in the fact that while Cockayne had little interest in taxonomy, he exerted a strong influence on how he felt the discipline should be practised in Aotearoa / New Zealand (Cockayne, 1926; Moore, 1967; Thomson, 1990; de Lange, 2019), central to this was his view that taxonomic conclusion must result from a comprehensive analysis not only of morphological variation but also whether that variation was represented by "true breeding races" (Cockayne, 1917a, 1919, 1926). For *Leptospermum scoparium* then, Cockayne felt that the variation people were describing, required formal testing using what he called "experimental taxonomy" whereby the stability of characters in a plant were tested by cultivation. Without such tests Cockayne was mostly dismissive of taxonomic works (Cockayne, 1926; Moore, 1967).

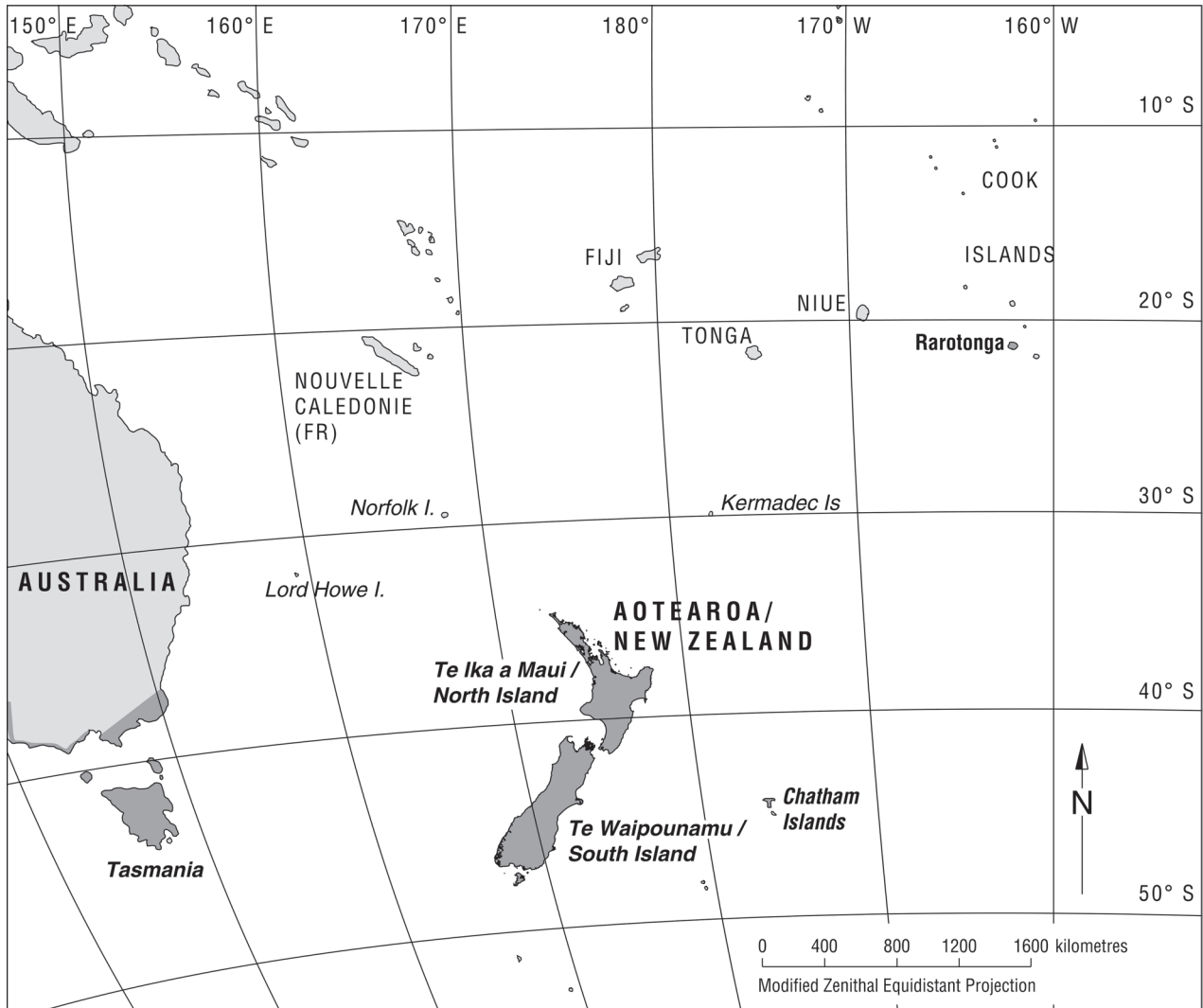


Fig. 1. Distribution of *Leptospermum scoparium* s. l. as accepted by Thompson (1989) and Sykes (2016) which encompasses (shaded areas only) South Eastern Australia, Tasmania, Aotearoa / New Zealand, Chatham Islands and Rarotonga (Cook Islands)

The "experimental taxonomy" advocated by Cockayne has since been well-established, though not by design rather by accident, as *Leptospermum scoparium* s. l. is an important horticultural plant (Dawson, 1997a, b), and now increasingly, one of economic value because of the oils and honey obtained from the species (Molan, Russell, 1988; Molan et al., 1988; Molan, 1995; Perry et al., 1997; Porter et al., 1998), The result has been that well established "races" and wild-selected cultivars have been widely grown in "common garden experiments" from seed and cuttings for many decades, so demonstrating their stability under a range of conditions (Metcalf, 1972, 1993; Dawson, 1997a, b).

Outside Aotearoa / New Zealand the concept of *Leptospermum scoparium* (Thompson, 1989; Sykes, 2016) remains that of a single variable species indigenous to Eastern Australia, Tasmania, and Aotearoa / New Zealand and Rarotonga (Fig. 1). However, in her treatment of the genus Thompson (1989) paid little attention to the variation within the Aotearoa / New Zealand range of *L. scoparium*, possibly because she saw that variation as a purely Aotearoa / New Zealand issue outside her remit. Now that *Leptospermum scoparium* has significant economic value (McDonald et al., 2018; Taunton, 2021), there is increased interest in resolving whether the species (in the strict sense) is endemic to Aotearoa / New Zealand or not. Buys et al. (2019) undertook a limited

phylogenetic study of Australian and New Zealand members of *Leptospermum scoparium* s. l. They found a mainland Australian, Tasmanian and New Zealand clade. That data infers that *Leptospermum scoparium* s. str. is endemic to New Zealand, a revelation strengthened by a much wider sampling of the species using pooled whole genome re-sequencing of 76 *L. scoparium* and outgroup populations from Aotearoa / New Zealand and Australia (Koot et al., *in sub.*) confirming the same pattern. Therefore, for this paper we treat *Leptospermum scoparium* group as an endemic Aotearoa / New Zealand lineage.

Within Aotearoa / New Zealand *Leptospermum scoparium*, Buys et al. (2019) recognised three clades: (1) northern Te Ika a Maui / North Island, (2) Central Te Ika a Maui / North Island, and (3) Te Wai Pounamu / South Island (which includes the type of *L. scoparium*). To this Koot et al. (submitted, preprint) added two more clades, the Tairāwhiti / East Cape (Te Ika a Maui / North Island) and the North West Nelson (Te Wai Pounamu / South Island) clads.

This paper is concerned with one of the races of *Leptospermum scoparium* found in the northern Te Ika a Maui / North Island clade, an extremely fine (linear-leaved) race found in restiad high moor and low moor peat bogs throughout the Waikato lowlands. That race was noted by Allan (1961) who discussed a specimen (CHR [BD] 76026, *A.L. Poole s.n.*) within his interpretation of what he thought *Leptospermum scoparium* var. *linifolium* might represent. That specimen had been collected from a *Phormium* community "north of Kaihere by the Piako River" (ca. 37.324769° S, 175.506879° E, ca. 5 m a.s.l.). This location was probably a portion of the now mostly drained Torehāpe Peat Bog. This fine (linear-leaved) race has long been recognised as potentially distinct by field botanists working in Waikato Peat Bogs; most recently it has been recorded in the literature as *Leptospermum* aff. *scoparium* (c) (AK191319; "Waikato peat bog") on the basis that it is now threatened and that its taxonomic status needed resolution (de Lange et al., 2018). The inclusion of this race within the northern Te Ika a Maui / North Island clade of Buys et al. (2019) suggests a relationship to *Leptospermum scoparium* var. *incanum*, and two other races *L.* aff. *scoparium* (a) (AK284541; Auckland) and *L.* aff. *scoparium* (b) (AK247250; "coastal silver prostrate", also informally recognised by de Lange et al., 2018). From these taxa, *Leptospermum* aff. *scoparium* (c) (AK191319; "Waikato peat bog") differs ecologically through its restriction to peat bogs, and morphologically by its gracile growth habit, consistently narrower linear

leaves, white staminal filaments, and green style and stigma. This race is also broadly sympatric with *L.* aff. *scoparium* (a) (AK284541; Auckland) throughout its range, and in places is found growing syntopically, with no evidence of hybridisation.

Because of this sympatry and morphological disparity from other members of the Aotearoa / New Zealand *Leptospermum scoparium* clade, we describe here *Leptospermum* aff. *scoparium* (c) (AK191319; "Waikato peat bog") as a new species. The remaining members of the northern Te Ika a Maui / North Island plants will form the focus of a separate paper.

Materials and Methods

This article is based on the study of live plants cultivated over the last three decades in Auckland, and Hamilton, Te Ika a Maui / North Island, Aotearoa / New Zealand by the lead author, field work in the greater Waikato and Bay of Plenty and examination of herbarium specimens held at AK, CHR, WELT and UNITEC; herbarium acronyms follow Thiers (2008—continuously updated). With the exception of those measurements of stature and branch / branchlet widths, dimensions have been derived from dried material held in AK and UNITEC.

Taxonomy

Leptospermum *repo* de Lange & L.M.H.Schmid sp. nov.

Type: AOTEAROA / NEW ZEALAND, Te Ika a Maui / North Island, South Auckland, Waikato, Whangamarino, southern side of Island Block Road Bog. Latitude 37.312512 S, Longitude 175.13232358 E. Co-occurring species: *Empodisma robustum* Wagstaff & B.R.Clarkson, *Coprosma tenuicaulis* Hook.f., *Epacris pauciflora* A.Rich., *Salix cinerea* L., *Gleichenia dicarpa* R.Br. and *Schoenus brevifolius* R.Br. (habitus – <https://inaturalist.nz/observations/66458480>). **Holotype:** P.J. de Lange 15000 & T.J.P. de Lange, 12 Dec 2020, AK382940A (Fig. 2), AK382940B (Fig. 3), one specimen mounted on two herbarium sheets containing five parts of the same individual plant as follows: AK382940A – one flowering and one fruiting branch, two portions of branchlets showing bark, and AK382940B – one flowering branch. **Isotypes:** NSW, UNITEC 12809.

Illustrations: Figures 2–3.



Fig. 2. Holotype of *Leptospermum repo de Lange & L.M.H.Schmid* (AK382940A), specimen spread over two sheets AK382940A and AK382940B (Fig. 3)



Fig. 3. Holotype of *Leptospermum repo de Lange & L.M.H.Schmid* (AK382940B), specimen spread over two sheets AK382940A (Fig. 2) and AK382940B

Diagnosis: Distinguished from *Leptospermum scoparium* s. str. by the gracile, spindly, open-branched growth habit; widely divergent, longer, linear, linear-lanceolate (rarely filiform), shortly cuspidate leaves; white petals, stamens mostly with white filaments (very rarely tinged pink near base), style and stigma usually green (very rarely pink); and by its restriction to peat bog habitats.

Growth habit – [Fig. 4, A–E] Shrub to small tree (1–) 3 (–6) m tall, sometimes much reduced in extreme acid wetlands, then attaining heights of 100 mm or less. **Trunk** – usually unbranched at base, up to 0.1 m d.b.h, usually devoid of branches in lower $\frac{1}{3}$ to $\frac{1}{2}$. **Bark** – firmly attached, fibrous, often deeply fissured. **Branches** – usually 3 or more, and openly branching with semi-erect to widely spreading branches, young stems copiously covered in (0.12–0.24) 0.48 (–0.80) mm long, white, straight to slightly flexuous, sericeous, antrorse-appressed hairs, becoming glabrescent with age. **Vegetative buds** – 3–8, mostly shedding soon after vegetative growth commences, rarely with a few persistent, (0.4–) 0.6–0.8 (–1.0) \times (0.3–) 0.5–0.7 (–0.9) mm, amber to red-brown, scarious, oblong to ovoid, inner surface smooth, glossy, outer with frayed, lacerate margins or entire, basal portion densely invested in white antrorse-appressed to suberect sericeous hairs up to 0.01 mm long. **Leaves** – pleasantly spicy-scented when crushed, divergent to spreading, (5.0–) 8.0–11.0 (–15.0) \times (0.3–) 0.5–0.8 (–2.0) mm, glossy yellow-green, green to dark green; lamina linear, linear-lanceolate, narrowly lanceolate, occasionally filiform, flat to weakly concave, acute, minutely cuspidate, bases narrowly cuneate, margins minutely denticulate; surfaces sericeous hairy near base and along midrib, and proximal $\frac{1}{3}$ of leaf margin, glabrescent with hairs \pm persisting on basal portion of leaf and; oil glands numerous, more evident when dry. **Perules** – 4–6, shedding at bud burst, (0.4–) 0.6–0.8 (–1.0) \times (0.4–) 0.6–0.8 (–0.9) mm, glabrous, hyaline, amber to pale red-brown, scarious, orbicular, margins usually entire, sometimes frayed inner surface smooth, glossy. **Inflorescence** – monadic on short axillary brachyblasts, or, on occasion on long, 200 mm long or more, terminal shoots. **Prophylls** – caducous, 2, 0.1–0.2 mm long, oblong, midrib scarcely developed, yellow-green, green to red-green when fresh, tan when dry, abaxial surface densely invested in white sericeous hairs. **Pedicels** – sessile, or 0.1 mm long at anthesis, elongating to 2.4 mm after anthesis, terete, sparsely invested with antrorse-appressed, sericeous white hairs. **Flower buds** – clavate, tholiform with calyx lobes not meeting. Fresh

flowers when fully expanded 10–11 (–15) mm in diameter. **Hypanthium** – (2.8–) 3.0 (–4.0) \times (1.6–) 2.2 (–4.0) mm, green or honey-brown, obconic, obconic-funnelform. Terminating in a slightly thicker rim bearing five calyx lobes; surface smooth (wrinkling in dry specimens) finely glandular punctate, glabrous. Calyx lobes 5, spreading, 2.4–2.6 \times 2.4–2.6 mm, caducous, broadly deltoid with rounded apices, usually glabrous except for margins which may be sparsely ciliate, oil glands colourless. Receptacle dark red at anthesis. **Petals** – 5, spreading, 4–5 \times 2–3 mm, white, orbicular, apex obtuse to rotund, margins finely crimped, oil glands not evident. **Stamens** – (15–36, in 1–2 weakly defined whorls adnate to receptacular rim, filaments white. Antipetalous stamens 3(+2), antisepalous 4–6. Outermost antipetalous stamens erect or weakly incurved, on filaments 1.20–1.68 mm long, occasional inner whorl of 2 stamens present, these erect or incurved, 0.9–1.2 mm long, positioned at base of the outermost antipetalous pair. Antisepalous stamens about half length of antipetalous, on filaments 0.6–0.84 mm long, incurved, erect or in mixtures of both. Anthers dorsifixed 0.36 \times 0.12 mm, ovoid, latrorse. Pollen white to cream. Anther connective gland 0.24 mm long, amber, narrowly obovoid. **Ovary** – 5-locular, each loculus with c.80 ovules, set in 8 rows on each placental lobe. Style (0.96–) 1.9–2.0 mm long at anthesis, elongating to 3 mm after anthesis, green (very rarely pink – one population); stigma 0.70–0.78 mm in diameter at anthesis, expanding to 0.9 mm following anthesis, flat, green, sometimes flushing pink at anthesis, finely papillate rugulose. **Fruits** – persistent, woody, (5–) 8 (–9) \times (5–) 6 mm, pale brown-grey to grey, hemispherical / globose (sometimes broadly obconic), centre often with persistent style remnant, valves 5, exserted as a dome, indented at centre, \pm symmetrical with base. Valves opening on dead branches or following fire. **Seeds** – 2.3–2.4 (–2.6) \times 0.24–0.24 mm, linear, linear-cuneiform, curved, flexuous to sigmoid, laterally compressed or terete, 2–4-angled, apex truncate or acute, testa dull or glossy, orange-brown, glabrous, longitudinally striate.

Representative Specimens. Aotearoa / New Zealand. Coromandel Peninsula, Whangamata, Whangamata Estuary, *G. Don. s.n.*, 30 Sep 2004, AK339689; Waikato, Huntly Basin, Whangamarino Wetlands, Te Reao Arm, Island Block Road, *P.J. de Lange 12401*, 11 Dec 2014, AK355754; Waikato, Huntly Basin, Whangamarino Wetlands, southern side of Island Block, *P.J. de Lange 14999*, 12 Dec 2020, UNITEC 12634; Waikato, Huntly Basin, Whangamarino, Te Reao Arm, *P.J. de Lange 5811*, 27 Nov 2003, AK285238 (Duplicate: CHR);

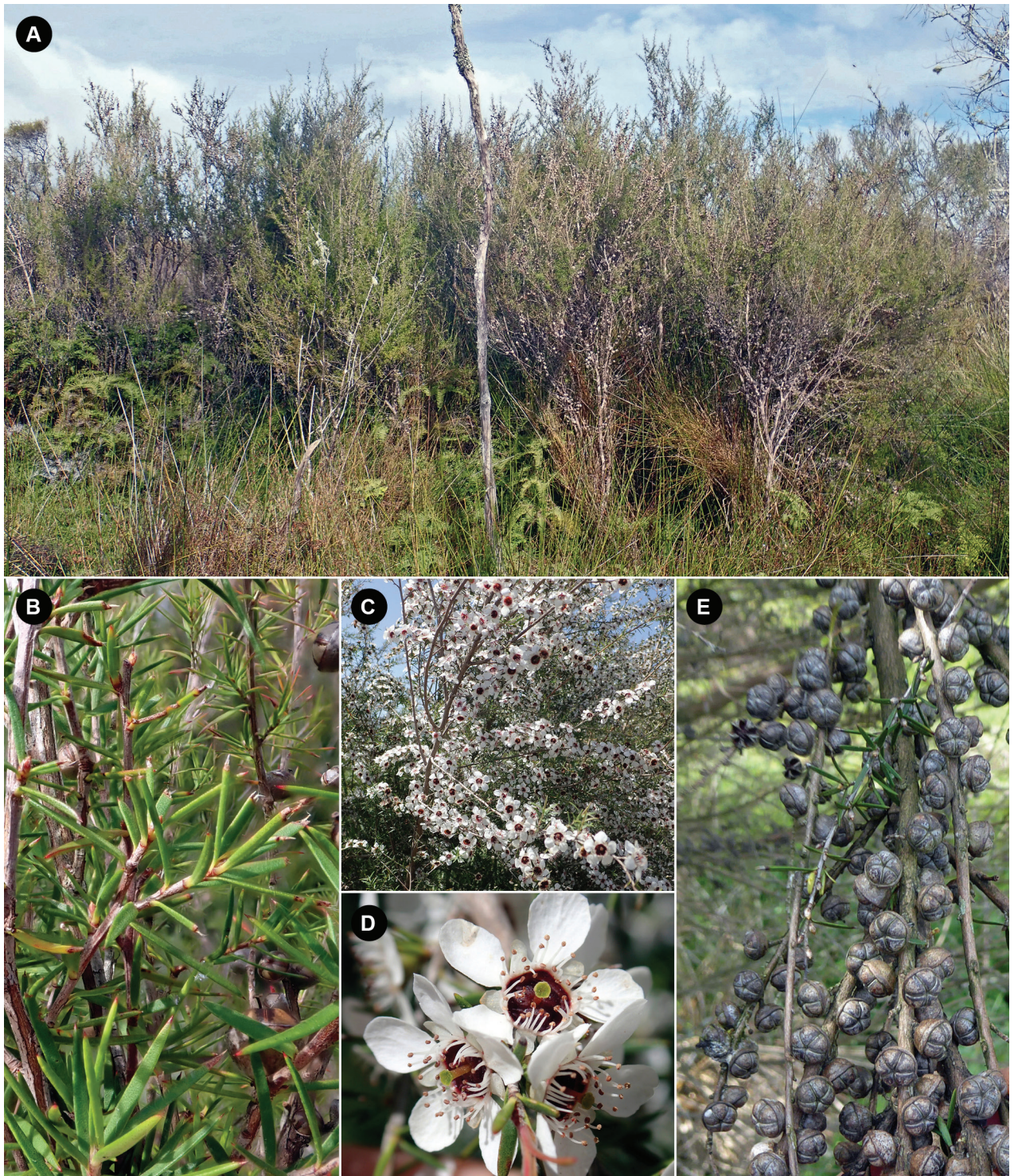


Fig. 4. *Leptospermum repo* de Lange & L.M.H.Schmid. A: habitat within restiad bog, Kopouatai Peat Bog – the dominant shrub in this image is *L. repo* growing through an understorey of *Gleichenia dicarpa* (Gleicheniaceae), *Schoenus brevifolius* (Cyperaceae) and *Empodisma robustum* (Restionaceae). B: *L. repo* foliage, Kopouatai Peat Bog. C: Flowering branches, Kneebone Road, Te Mimiha Peat Bog. D: Flowers, Kneebone Road, Te Mimiha Peat Bog. E: Unopened, mature fruiting capsules, Valinitine Road, Komakorau Peat Bog (all images: P.J. de Lange)

Waikato, Huntly Basin, Opuatia wetland, north of Lake Whangape, SE of "Lake Opuatia", *E.K. Cameron 13218*, 19 Nov 2005, AK294600; Waikato, Hauraki Plains, between Torehape & Ngatea, Landcorp land, *E.K. Cameron 11702*, AK283564; Waikato, Hauraki Plains, Eastern side of Kopouatai Peat Bog, c.1.7 km west from the end of Canal Roads, *E.K. Cameron 11771*, 14 Sep 2003, AK284314; Waikato, Hauraki Plains, Kopouatai Peat Dome, Tee Canal Access, *P.J. de Lange 6990 & J.R. Rolfe*, 17 Jul 2007, AK300200 (Duplicate: NSW); Waikato, Hauraki Plains, Kopouatai Peat Dome, Tee Canal Access, *P.J. de Lange 15052 & L.M.H. Schmid*, 4 Apr 2021, UNITEC 12846 (Duplicate: AK, NSW); Waikato, Hamilton Basin, Te Hoe o Tainui Bog, northern outlet stream, *P.J. de Lange 12400*, 11 Dec 2014, AK355753; Waikato, Hamilton Basin, Hoe o Tainui Basin, Tainui Road above former Hoe o Tainui Peat Bog, *P.J. de Lange 13223*, 8 Oct 2016, AK362920 (Duplicate: NZFRI); Waikato, Hamilton Basin, Te Mimiha Peat Bog, Kneebone Road, *P.J. de Lange 14980 & T.J.P. de Lange*, 5 Oct 2019, UNITEC 12421; Waikato, Hamilton Basin, Netherby, Orini Bog, *P.J. de Lange 12399*, 11 Dec 2014, AK355752; Waikato, Hamilton Basin, Komakorau Peat Bog, Valintine Road, *P.J. de Lange 123198*, 11 Dec 2014, AK355751 (Duplications: CHR, NSW); Waikato, Hamilton Basin, Hamilton Basin, Komakorau (Motumaoho) Peat Bog, Woodlands Road, *P.J. de Lange 13222*, 8 Oct 2016, AK363436 (Duplications: NZFRI, WELT); Waikato, Hamilton Basin, Komakorau Peat Bog, *P.J. de Lange 14978 & T.J.P. de Lange*, 6 Jul 2019, UNITEC 12419 (Duplicate: AK); Waikato, Hamilton Basin, Hamilton, Claudelands, *H.B. Matthews s.n.*, 10 Dec 1923, AK102058, 102057; Waikato, Hamilton Basin, McGregor Road, Rukuhia Peat Bog, *P.J. de Lange 14891 & T.J.P. de Lange*, 10 Oct 2020, UNITEC 12422 (Duplicate: AK); Waikato, Kaimai Ranges, Tuahu (Killarney) Lakes, *P.J. de Lange 15058 & L.M.H. Schmid*, 4 vi. 2021, UNITEC 12852 (Duplicate: AK); Waikato, Kaimai Range, Ngatamahinerua Plateau, north of Kauritahi Hut, *P.B. Cashmore s.n., M. Renner & C. Bycroft*, 22 Mar 2009, AK360761; Waikato, Hamilton Basin, Lake Serpentine (Southern Lake), *P.J. de Lange s.n.*, 11 Dec 1989, AK191319 (Duplicate: WAIK); Waikato, Mamaku Forest, Waihou River, Lake Rotohoko, *P.J. de Lange 6899*, 16 Mar 2006, AK298498; Bay of Plenty, Waihi Estuary, *E.K. Cameron 16090*, 10 Jan 2013, AK336532; Bay of Plenty, Kaituna River, Kaituna Wetland, *P.J. de Lange 13204 & F.J.T. de Lange*, 27 Sep 2016, AK362919 (NZFRI); Bay of Plenty (Rotorua Lakes), Lake Rotoiti, Hinehopu, Hinehopu Mire, *P.J. de Lange 6818*, 13 Mar 2006, AK298001.

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Distribution: Endemic to Te Ika a Maui / North Island of Aotearoa / New Zealand, where *Leptospermum repo* is known mainly from peat bogs, notably those dominated by the restiads *Empodisma robustum* and *Sporadanthus ferrugineus* de Lange, Heenan & B.D.Clarkson in the Waikato lowlands (Hamilton and Huntly Basins and the lower Hauraki Plains) (Fig. 5). East of these stations there are sporadic occurrences in the wetlands of the Coromandel Peninsula (Matarangi, Whangamata), the Kaimai Range (Tuahu Lakes), the southern Mamaku Plateau (Lake Rotohoko), at Hinehopu Mire (Lake Rotoiti), and the Kaituna wetlands, Bay of Plenty (Fig. 5). With the exception of the Kaituna occurrence, which correlates to a remnant of a formerly much larger peat bog system, and possibly Hinehopu Mire, the Mamaku Plateau, Kaimai and Coromandel Peninsula occurrences are seen as outliers of a species otherwise consistently associated with restiad bogs of the greater Waikato and possibly, historically, the Bay of Plenty lowlands.

Etymology: The epithet "*repo*" is taken from Te Reo Māori (Māori Language) word for "swamp" (Ngata, 1993: 467; Ryan, 1995: 218); it refers to the wetland habitat in which this species usually grows.

Habitats and co-associated flora species: *Leptospermum repo* is now virtually confined to restiad peat bogs within the greater Waikato (Fig. 5). These bogs, formerly exceeded 100 000 ha in extent (Davoren et al., 1978; de Lange et al., 1999) and outside the Waikato were well developed in the far north of Northland around Kaitaia and Te Aupouri, near Whangarei (Hikurangi Swamp) and also in the lowlands of the Bay of Plenty between and presence of suitable habitat in Northland, there are no known observations or herbarium specimens of *Leptospermum repo* from this region.

Within this species stronghold, the restiad bogs of the Waikato lowlands, *Leptospermum repo* is a key woody shrub to small tree component of both low and high moor bogs. In these habitats, *L. repo* extends from the lag zone towards the bog centre (Fig. 4, A), reaching its greatest abundance between the lag and the upper rand of the high moor peat bogs. Within low moor systems, *L. repo* is found virtually throughout, including the fringes of peat lakes and sites frequently flooded either from associated water courses or during periods of high rainfall.

In these habitats *Leptospermum repo* is commonly associated with the following species: within the lag zone – *Carex secta* Boott, *C. maorica* Hamlin, *C. virgata* Sol. ex Boott, *Machaerina rubiginosa* (Spreng.) T.Koyama, *M. tenax* (Hook.f.) T.Koyama, *M. teretifolia*

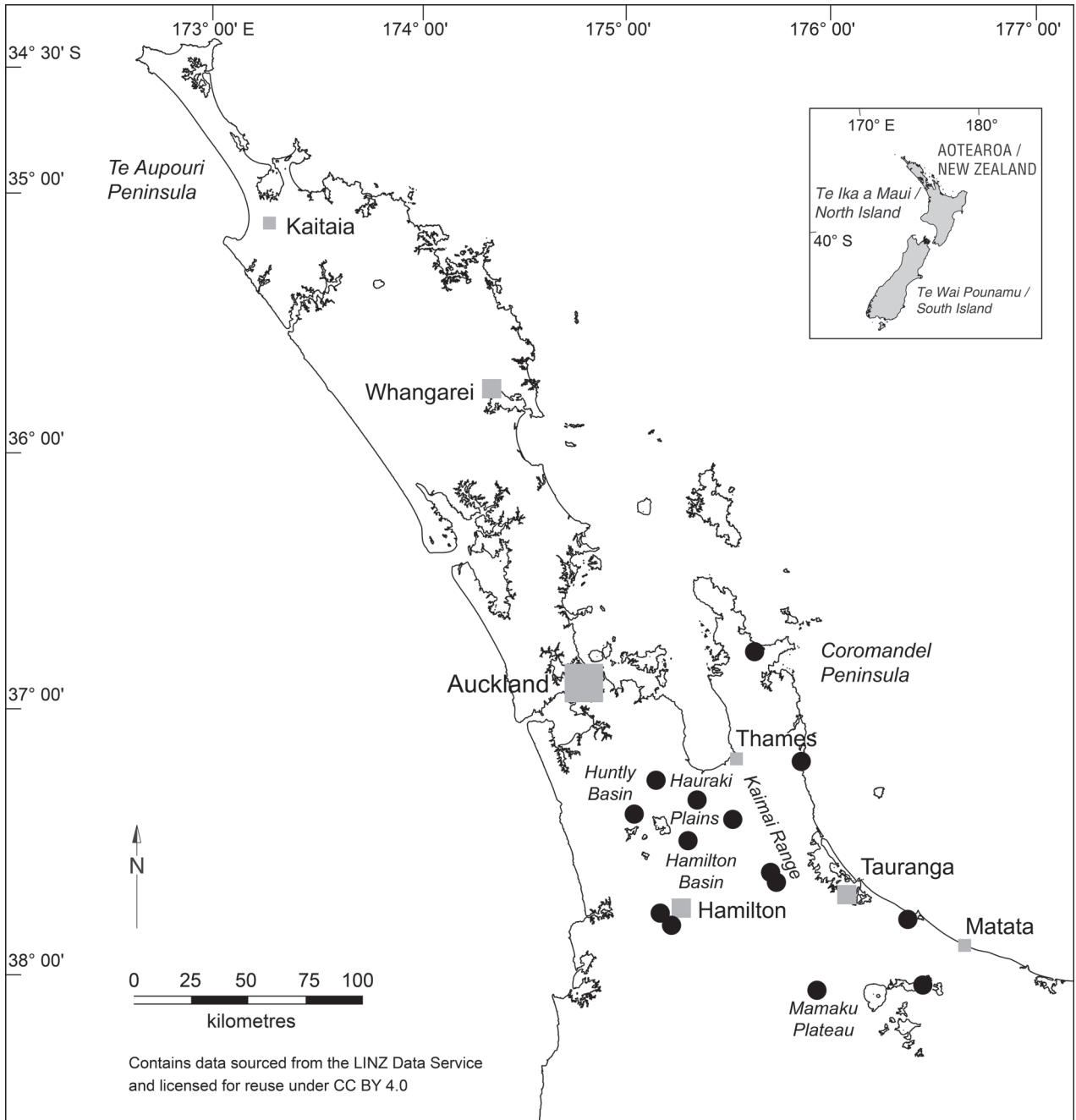


Fig. 5. Distribution of *Leptospermum repo* (black circles) which is confined to the northern portion of Te Ika a Maui / North Island of Aotearoa / New Zealand

(R.Br.) T.Koyama, *Empodisma robustum*, *Coprosma propinqua* A.Cunn. var. *propinqua*, *C. tenuicaulis*, *Salix cinerea*, *Gleichenia dicarpa*, *Hiya distans* (Hook.) Brownsey & Perrie, and *Osmunda regalis* L., and, on the rand, or within the inner bog – *Empodisma robustum*, *Sporadanthus ferrugineus*, *Dracophyllum lessonianum*

A.Rich., *Epacris pauciflora*, *Schoenus brevifolius*, *Machaerina teretifolia*, and *Netrostylis capillaris* (F.Muell.) R.L.Barrett, J.J.Bruhl & K.L.Wilson.

Phenology: *Leptospermum repo*, unusually for the Aotearoa / New Zealand members of the *L. scoparium* complex, has a rather short flowering season. While

sporadic flowering may occur throughout the year, this is very unusual. In this species flowering is mostly observed between October and January, peaking in late November through December, specimens often so heavily laden with bloom, that the foliage is almost completely obscured (Fig. 4, C). Andromonoecious flowers, first reported for New Zealand populations of *Leptospermum scoparium* s. l. by Primack & Lloyd (1980) are also present in *L. repo*, though we have seen insufficient bisexual and male flowers as yet to draw any conclusions about their frequency within *L. repo* populations, and whether there are any notable size differences between them, or indeed other members of the *L. scoparium* complex. Fruits develop over a period of several months, and in this species rarely open unless the supporting branchlet has died, such as when plants have been killed by fire. Due to this growth habit it is not uncommon to find unopened capsules holding viable seed, partially immersed in bark on the older branches and trunk. In common with other members of the *Leptospermum scoparium* complex, *L. repo*, is capable of flowering in extremely reduced states when stressed, for example with specimens of less than 50 mm tall, growing in open extremely acidic and/or flooded peat, frequently flowering.

Affinities: *Leptospermum repo* belongs to the northern Te Ika a Maui / North Island clade of *L. scoparium* s. l. (Buys et al., 2019; Koot et al. *in sub.*). Those plants (*L. scoparium* var. *incanum*, *L. aff. scoparium* (a), and *L. aff. scoparium* (b) (Figures 6–8)) differ from the type of *Leptospermum scoparium* by their consistently longer, lanceolate, elliptic-lanceolate to linear leaves, larger, often more highly coloured flowers, and larger, often globose capsules. Within the northern Te Ika a Maui / North Island clade, *Leptospermum repo* is ecologically partitioned from the other associated *Leptospermum scoparium* taxa (*L. scoparium* var. *incanum*, *L. aff. scoparium* (a), and *L. aff. scoparium* (b)) by its restriction to peat bog habitats, especially those dominated by *Empodisma robustum* and/or *Sporadanthus ferrugineus*. Morphologically the plants differ from the other allied *L. scoparium* in the northern Te Ika a Maui / North Island clade by their rather openly branched, spindly, gracile growth habit and by the widely divergent (mature leaves aligned 85°–90° to branchlet axis), distinctly finer, linear, linear-lanceolate, narrowly lanceolate, (occasionally filiform), minutely cuspidate leaves. The flowers of *Leptospermum repo* are also smaller than those in *L. scoparium* var. *incanum* and *L. aff. scoparium* (b), (10–11 (–15) mm cf. (18–) 20–25 mm in diameter), with the petals consistently white (never pink, or pink-

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tinged), and the stigma and style are green (very rarely pink), rather than dark brown-green, amber, pink or carmine. The stamen filaments of *L. repo* are for the most part white; at only one location, Matarangi, Whangapoua (36.735622° S 175.647857° E) a few plants had occasional pink-tinged stamens. The stamen filaments of *L. scoparium* var. *incanum* and *L. aff. scoparium* (b) are usually pink-tinged or pink, very rarely completely white. From *Leptospermum aff. scoparium* (b), *L. repo* is also easily distinguished by its erect rather than decumbent to prostrate growth habit.

As far as is known *Leptospermum repo* is allopatric from populations of *L. scoparium* var. *incanum* and *L. aff. scoparium* (b). Throughout its range, *Leptospermum repo* is, however, broadly sympatric with *L. aff. scoparium* (a), and in a few places, such as Island Block Road and Falls Road, Whangamarino (37.344970° S, 175.141959° E and 37.346643° S, 175.183479° E respectively), and Tainui Road, Hoe-o-Tainui (37.557858° S, 175.397995° E) where the road skirts a series of low clay / tephra covered hills running along the margin of the peat bogs or where low-lying hills are exposed above the surrounding peat, both taxa can be found growing syntopically without any evidence of hybridisation.

Morphologically *Leptospermum aff. scoparium* (a) differs from *L. repo* by its more heavily branched growth habit and wider (4–6 mm c.f. 0.3–2.0 mm wide) lanceolate, elliptic-lanceolate, sharply acute, often distinctly cuspidate leaves. These when fully expanded are set at 60°–80° rather than 85°–90° to the branch axis, and due to their width, often obscure the branchlets internodes, such that the branchlets appear to be "leafier" than they actually are. This contrasts with finer, more divergent leaves of *L. repo*, whose positioning exposes the branchlets internodes, imparting the impression that this species has less leaves than it actually does. The mature leaves of *Leptospermum aff. scoparium* (a) are also more consistently hairy, along the leaf margins, midrib and particularly near the leaf base, whereas those of *L. repo* are glabrous or nearly so. The flowers of *Leptospermum aff. scoparium* (a) are usually larger than those of *L. repo* (up to 22 mm diameter, as compared to 15 mm in *L. repo*), and whilst usually white, may also be pink or pink-tinged. Another difference is that the stamen filaments of *Leptospermum aff. scoparium* (a) whilst often white, may be greenish or pink tinged, or on occasion completely pink, whilst the stigma and style mature brown-green, amber, pink or carmine, rather than uniformly green in *L. repo*. Finally, though more samples are needed ($n = 10$ per *Leptospermum*) *Leptospermum*



Fig. 6. *Leptospermum scoparium* var. *incanum* plant from Te Aupouri, Te Ika a Maui / North Island, Aotearoa / New Zealand. A: Foliage, flowers, immature and developing capsules, note the hairy leaves, which are a feature of this *Leptospermum*. B: Flower of *L. scoparium* var. *incanum* with pink-tinged petals (in this variety petals are sometimes completely pink (or even red) however, white-flowered plants are also known). C: Immature and mature capsules (all images: J.R. Rolfe)



Fig. 7. *Leptospermum* aff. *scoparium* (a), a potentially distinct race allied to *L. scoparium* var. *incanum* with which it is broadly sympatric. This race is also sympatric with *L. repo*. A: Growth habit, gumland scrub, Whangateau Harbour, Te Ika a Maui / North Island. B: Foliage, Falls Road, Whangamarino, Te Ika a Maui / North Island. C: Close up of foliage, Mataia, Glorit, Kaipara, Te Ika a Maui / North Island. D: Flowers, Matarangi Loop Track, Matarangi, Coromandel Peninsula, Te Ika a Maui / North Island. E: Mature capsules, Miranda Back Road, Miranda, Te Ika a Maui / North Island (all images: P.J. de Lange)



Fig. 8. *Leptospermum* aff. *scoparium* (b), a potentially distinct race allied to *L. scoparium* var. *incanum* and *L. aff. scoparium* (a), taxa with which it is broadly sympatric. This race is not known to be sympatric with *L. repo*. A: Flowering specimen growing on sandstone, Kauere Coast Track, Otaipango, Te Aupouri, Te Ika a Maui / North Island. B: Flowering specimen growing on ultramafic rock, North Cape, Te Paki, Te Ika a Maui / North Island. C: Growth habit at Kauere Coast Track, Otaipango, Te Aupouri, Te Ika a Maui / North Island. D: Close up of flowers Coast Track, Otaipango, Te Aupouri, Te Ika a Maui / North Island. E: Flowering branches, Maungaraho Rock, Tokatoka, Te Ika a Maui / North Island. F: Flowering branches Kauere Coast Track, Otaipango, Te Aupouri, Te Ika a Maui / North Island (all images: P.J. de Lange)

repo capsules contain more seeds, (180–300 cf. 120–164 in *L. aff. scoparium* (a)).

From *Leptospermum scoparium* s. str., *L. repo* differs ecologically by its restriction to peat bog habitats, and morphologically by its gracile growth habit; longer, finer, linear, linear-lanceolate leaves, and larger flowers which white petals, usually white stamen filaments and usually green style and stigma. *Leptospermum scoparium* s. str. has smaller flowers, which may have pink-tinged petals, usually pink-tinged or pink stamen filaments, and pink-tinged, pink or carmine coloured style and stigma; the leaves of *L. scoparium* s. str. are broadly ovate, oval to orbicular and sharply acuminate (Fig. 9).

Conservation Status: *Leptospermum repo*, as *Leptospermum aff. scoparium* (c) (AK191319; "Waikato peat bog"), has been listed by de Lange et al. (2018) as "Threatened / Nationally Critical" qualified "DP [Data Poor]", "De [Designated]" using the New Zealand Threat Classification System (Townsend et al., 2008). This high threat status was triggered by the threat listing panel's decision to invoke criteria "C – population (irrespective of size or number of subpopulations) with a very high ongoing or predicted decline of >70%" using the option to "Designate" a threat status. Designation is undertaken when a taxon does not necessarily meet all the necessary requirements but, in the panel's, consensus view a high threat listing is merited (Townsend et al., 2008).

This step was taken because of the perceived threat of myrtle rust disease, caused by the rust fungus *Austropuccinia psidii* (G. Winter) Beenken. This rust was first reported from Aotearoa / New Zealand in May 2017, after which it has spread rapidly throughout the North Island and northern South Island (Galbraith, Large, 2017; Beresford et al., 2018). At the time the threat listings for the New Zealand Vascular Floras were being finalised (May 2017) the detection of the rust was considered sufficient to review the threat status of all New Zealand *Myrtaceae* (see Introduction above). *Leptospermum scoparium* s. l. was suspected of being susceptible on the basis of attacks on plants of this species cultivated in Australia (MPI n.d. <https://www.myrtlerust.org.nz/assets/Uploads/Susceptible-MR-Species.pdf> – accessed 25 May 2021). Subsequent research has now confirmed that *Leptospermum scoparium* s. l. is susceptible (Grant et al., 2020) though attacks on the Aotearoa / New Zealand members of this species complex are so far uncommon, outside cultivation (see <https://inaturalist.nz/taxa/549208-Austropuccinia-psidii> – accessed 25 May 2021).

Whether or not the high threat listing allocated by de Lange et al. (2018) is appropriate still remains to be seen, particularly as *Austropuccinia* is still expanding its range and widening its host range in Aotearoa / New Zealand. Irrespective, the potential range of *Leptospermum repo* through peat bog clearance and drainage has shrunk from an estimated 100 000 ha to c.10 000 ha (10% of its former range) in less than 100 years. Further throughout the lowlands of the Bay of Plenty and the Coromandel Peninsula, the species is now functionally extinct. Within the Hamilton Basin, the species is been lost from 90% of its former range and of the existing remnants most are likely to disappear through ongoing drainage and land clearance within the next decade.

In the interim then, pending the next national threat listing of the Aotearoa / New Zealand indigenous vascular flora (due 2022), cognisant of the ongoing spread of *Austropuccinia psidii*, we see no reason to contest the current threat status, beyond adjustment to the new species name formalised here.

Currently, *Leptospermum repo* remains secure as a functional species only within the Whangamarino and Opuatia wetlands of the Huntly Basin; the Torehape and Kopouatai Peat Bogs of the Hauraki Plains, and in those small remnants that persist around the peat lakes of the Hamilton Basin. The scattered occurrences in the Kaimai, Mamaku Ranges and Hinehopu mire, often of fewer than 10 individuals contribute little to the species' long term conservation security.

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Fig. 9. *Leptospermum scoparium* s. str. A: Andromonecious shrub with bisexual and male flowers in coastal shrubland, Motupohue (Bluff Hill), Southland, Te Waipounamu / South Island. B & C: leaves Motupohue (Bluff Hill), Southland, Te Waipounamu / South Island. D: Male flowers, Monument Hill, Waitangi West, Rekohu / Chatham Island, Chatham Islands. E: Bisexual flowers, Motupohue (Bluff Hill), Southland, Te Waipounamu / South Island (all images: P.J. de Lange)

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Реферат. Описано новий вид *Leptospermum repo* de Lange & L.M.H.Schmid sp. nov. (Myrtaceae), виокремлений з *L. scoparium* J.R.Forst. & G.Forst. (sensu lato). Новий вид є ендеміком торфових боліт Вайкато, регіон Бей-оф-Пленті (Затока Достатку), та прилеглих східних хребтів північної частини Північного острова Нової Зеландії. Цей вид належить до новозеландської (Північний острів) кладі у групі *L. scoparium* s. l.; від інших представників цієї кладі він морфологічно відрізняється витонченим, веретеноподібним, розгалуженим габітусом; лінійними, лінійно-ланцетними (рідше ниткоподібними), короткозагостреними, довшими листками, які широко розходяться; квітками з білими пелюстками, тичинками переважно з білими тичинковими нитками (дуже зрідка з рожевим відтінком біля основи), а також маточкою і приймочкою, які зазвичай є зеленими (дуже зрідка рожевими). Зараз *Leptospermum repo* трапляється на території близько 10% колишніх оселищ, у яких, окрім кількох торфових боліт, що знаходяться під охороною, відбувається скорочення чисельності виду через втрату середовища його існування. Ще однією потенційною загрозою для *L. repo* віднедавна стала хвороба мирту, спричинена *Austropuccinia psidii*, адвентивним іржастим грибом, уперше виявленим в Аотеароа / Новій Зеландії в травні 2017 р. Ця іржа, з якою наразі немає засобів боротьби і запобігання загибелі інфікованих рослин, становить серйозну загрозу для видів родини Myrtaceae Аотеароа / Нової Зеландії. Оскільки через історичну втрату оселищ існує загроза скорочення багатьох популяцій *L. repo*, а також через потенційну загрозу з боку *Austropuccinia psidii*, у статті цілком підтримується запропонована Групою з природоохоронної оцінки судинних рослин природної флори Нової Зеландії оцінка цього виду (під попередньою назвою *Leptospermum* aff. *scoparium* (c) (AK191319; Waikato peat bog)) як такого, що перебуває "Під загрозою / Під національно критичною загрозою".

Ключові слова: *Leptospermum*, *Leptospermum repo* sp. nov., *Leptospermum scoparium*, Myrtaceae, Аотеароа / Нова Зеландія, новий вид, таксономія