Syzygium nebulosum L.Weber, a novel and narrowly endemic species from the high-elevation cloud rainforests of the Wollumbin (Mt Warning) – Tweed volcanic caldera on the New South Wales – Queensland border, Australia

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Summary

Weber, L.C. & Forster, P.I. (2025). *Syzygium nebulosum* L.Weber, a novel and narrowly endemic species from the high-elevation cloud rainforests of the Wollumbin (Mt Warning) – Tweed volcanic caldera on the New South Wales – Queensland border, Australia. ***Austrobaileya* 15: 1–27**. Analysis of morphological variation for plants previously confused with *Syzygium crebrinerve* (C.T.White) L.A.S.Johnson due to similar bark and leaf appearance, or *S. oleosum* (F.Muell.) B.Hyland due to similar fruit appearance, has revealed that a novel species is present in the high elevation (800–1200m) cloud rainforests of the Tweed Range and Springbrook, Lamington plateaux. These plateaux form the northern and western erosional remnants of the ~ 20 million-year-old Wollumbin (Mt Warning) – Tweed volcano. The new species *S. nebulosum* L.Weber is described with notes on morphology, distribution, habitat, dispersal ecology and conservation status. The biogeographic context and potential threats and conservation status for this species are discussed.

Key Words: Myrtaceae; *Syzygium*; *Syzygium crebrinerve*; *Syzygium johnsonii*; *Syzygium nebulosum*; *Syzygium oleosum*; flora of New South Wales; flora of Queensland; new species; conservation status; Wollumbin (Mt Warning) – Tweed Volcanic Caldera; biogeography; myrtle rust; refugia

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Introduction

Syzygium P.Browne ex Gaertn. (Myrtaceae) *s.l.* is a genus of approximately 1200 species from Madagascar to Africa through Southern Asia to Australia and the Pacific Islands and is one of the world's larger plant genera, notably with the most tree species (Low *et al*. 2023). Centres of diversity for *Syzygium* lie in Malesia/SE Asia and tropical north Queensland. Genomic data indicates that the genus originated in Australia and New Guinea (Sahul) about 50 million years ago and that there have been at least a dozen migration events from Sahul to Asia and rapid evolution and diversification thereafter (Low *et al.* 2023). A broad taxonomic view of *Syzygium* based primarily on molecular sequencing (Biffin *et al*. 2006; Low *et al*. 2023), has seen the incorporation of species from the genera *Acmena* DC., *Acmenosperma* Kausel, *Anetholea* Peter G. Wilson, *Cleistocalyx* Blume, *Piliocalyx* Brong. & Gris. and *Waterhousea* B.Hyland (Craven & Biffin 2005, 2010; Craven *et al*. 2006), although this has not been currently adopted by state herbaria in New South Wales (NSW) and Queensland (Qld) (CHAH 2009). If the broad view is adopted, there are approximately 75 species in Australia of which 62 occur in tropical Qld and 50 are endemic to Australia (Hyland 1983; Zich *et al*. 2020).

The genus has been taxonomically revised for several countries or regions; however, no modern monograph exists (Ahmad *et al*. 2016). The genus was last comprehensively revised for Australia by Hyland (1983), with subsequent additions of new species or

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transfer of species from smaller allied genera (Craven 2003; Craven & Biffin 2005, 2010; Craven *et al*. 2006).

The Wollumbin (Mt Warning) – Tweed volcanic erosion caldera (WTVC) (Solomon 1964) is a widely recognized biodiversity hotspot and centre of endemism for rainforest flora, with approximately 100 species endemic to this landform spanning from Mt Tamborine to the Alstonville plateau (Weber *et al*. 2014). The higher elevation (500–1200 m altitude) rainforests of the WTVC are particularly rich in endemic flora, for example *Eucryphia jinksii* P.I.Forst., *Helmholtzia glaberrima* (Hook.f.) Caruel, *Lenwebbia prominens* N.Snow & Guymer, *Pararistolochia laheyana* (F.M.Bailey) Michael J.Parsons, *Parsonsia tenuis* S.T.Blake, *Pittosporum oreillyanum* C.T.White, *Uromyrtus lamingtonensis* N.Snow & Guymer. While there is considerable sharing of species between the lowland (below *c*. 500 m elevation) and higher elevation rainforests of the WTVC, the overall percentage of endemism becomes more prevalent with elevation, particularly within cloud rainforests (900–1200 m elevation) associated with Antarctic Beech (*Nothofagus moorei* (F.Muell.) Krasser) that occur predominantly on mountain summits.

It has become clear in recent years that endemic tree species can be "hiding in plain sight" or in unexplored parts of the WTVC e.g. *Eidothea hardeniana* P.H.Weston & Kooyman (Weston & Kooyman 2002), *Endiandra wongawallanensis* L.Weber (Weber & Forster 2021), *Eucryphia jinksii* (Forster & Hyland 1997), *Mischocarpus ailae* Guymer (Guymer 2009). This may be due to multiple reasons, such as the presence of the state border running along the summits of the mountain range, with botanists assuming that plants are just an "odd form" or "montane form" of a more widespread species, lack of exploration away from areas of easy accessibility, long-term status as National Park and World Heritage Area preventing opportunistic collecting, and the difficulty of collecting canopy species resulting in a lack of comprehensive fertile collections in herbaria.

Within the cloud rainforests of the Lamington and Springbrook plateaux there is an uncommon *Syzygium* that grows to about 25 m tall and 1 m trunk diameter, with pink flaky bark and often with abundant coppice shoots at the trunk base. The flowers and fruit of this *Syzygium* have remained virtually unknown. Field identifications, including those in numerous plots for graduate studies and the IBISCA altitude study (https://odnature.naturalsciences.be/ibisca/), either assumed this species was a high elevation form of *S. crebrinerve* (Laidlaw *et al*. 2011; Riordan *et al*. 2020) or allied to *S. oleosum* (F.Muell.) B.Hyland (W.J.F. McDonald, pers. comm.). This is in contradiction to the known habitat of *S. crebrinerve* which is described as Subtropical Rainforest (equivalent to lowland rainforest here), with the species not recorded from Cool Temperate Rainforest (equivalent to cloud rainforests here) (Harden *et al.* 2018, 2023). Higher elevation *Syzygium* collections from the WTVC have been previously identified in herbaria as *S. corynanthum* (F.Muell.) L.A.S.Johnson (not considered further here, refer to key below), *S. crebrinerve* or *S. oleosum*. *Syzygium moorei* (F.Muell.) L.A.S.Johnson is endemic to this area and *S. hodgkinsoniae* (F.Muell.) L.A.S.Johnson is near endemic with only one other population in the Blackall Range near the town of Maleny in Qld. Both *Syzygium moorei* and *S. hodgkinsoniae* are restricted to the lowland rainforests of the WTVC.

Remarkably only a single herbarium specimen has been previously collected for this taxon (CANB [CBG 8404058.1]) by botanist Ian Telford in 1984 at Dacelo Lookout near Mt Hobwee in Lamington NP/Limpinwood NR. The specimen was labelled "Tree 12m fruit purple" and identified as *S. oleosum* by the collector. The habitat was "Ridge top red brown clay loam on basalt. Closed forest *Nothofagus moorei* dominant with *Trochocarpa laurina*." As of early 2023 the Queensland Herbarium had no specimens of this taxon in its collection.

Syzygium crebrinerve sensu stricto was first named *Eugenia crebrinervis* C.T.White with a type specimen "QUEENSLAND.– Moreton District: Lamington National Park, alt. 3,000 ft., *D.A. & L.S. Smith* (TYPE: fls.), 31-12-1943" (White 1946). Later the species was transferred into the genus *Syzygium* by Johnson (1962) who made the new combination *S. crebrinerve* (C.T.White) L.A.S.Johnson.

Syzygium oleosum has a more complex taxonomic history and was first named *Eugenia oleosa* F.Muell. with a type specimen from Rockingham Bay in north Queensland collected by John Dallachy "*Ad amnes sinui Rockingham's Bay adfluentis. Dallachy.*" (Mueller 1865). Further south *Eugenia coolminiana* C.Moore was named with a type specimen from "Brush forests on the Richmond and Tweed rivers."(Moore 1893). Still further south *Eugenia cyanocarpa* F.Muell. was named with a type "*ad Botany-Bay extendit fide collectionis Gulliveri, nec non ad Hastings-River sec. Henderson et in Novam Angliam sec. Stuart.*" (Mueller 1875). Johnson (1962) transferred *E. coolminiana* to *S. coolminianum* (C.Moore) L.A.S.Johnson, and Hyland later placed all these names into synonymy when making the combination *Syzygium oleosum* (F.Muell.) B.Hyland (Hyland 1983).

In 2019, one of the authors (LW) being very familiar with *Syzygium crebrinerve* from NSW and lower elevation parts of Lamington NP, observed and photographed on the Springbrook Plateau flowering specimens of a *Syzygium* allied to that species, but with significantly different floral morphology. These plants grew in higher elevation, cool mossy rainforest often shrouded in cloud, and with a different floristic composition to the forests where typical *S. crebrinerve* occurs. Late in 2021, a single immature fallen fruit resembling those from *S. oleosum*, but more elongated in shape, was observed near Best of All Lookout, Springbrook, associated with *Nothofagus moorei* and "*S. crebrinerve"* trees, but with no *S. oleosum* in the area. In August 2022 the first author (LW) was working with Craig Stehn from New South Wales National Park and Wildlife Service near Best of All Lookout when he again saw the *Syzygium* species, now infected with myrtle rust and sporting unusual, golden green new foliage which is not present in *S. crebrinerve.* The possibility that an undescribed species of *Syzygium* was being encountered, was further bolstered by the observation of Bill McDonald (a long-time researcher at Lamington NP and one of the authors from Harden *et al*. 2018, 2023) in late 2022 "I have seen that one …. at Springbrook and I am calling it *Syzygium* aff. *oleosum*, it is possibly a different species, but I am not sure".

In 2023 and 2024 flowering and fruiting material was collected from this species at Bar Mountain in NSW and Springbrook in Qld. This material presented different floral morphology to *Syzygium oleosum* and *S. crebrinerve* and together with the vegetative and fruit differences documented, confirmed the identity of a separate unnamed species that also had some similarities with *S. johnsonii* (F.Muell.) B.Hyland that occurs north from the Coolooa Coast. The new species *Syzygium nebulosum* L.Weber is described in this paper. It is endemic to south-east Queensland and northern New South Wales in a small geographic area within the WTVC and this distribution is discussed further below in relation to its biogeographical context, conservation status and threats to the species.

Materials and methods

This paper is based on herbarium specimens at the Queensland Herbarium (BRI) that were examined under a binocular dissecting microscope (Olympus Corporation, Japan) and living plants in habitat in NSW and Qld. Leaves, fruit and flowers were measured with hand calipers. Field observations by LW were carried out at all known sites for *Syzygium nebulosum* (together with approximate counts of individuals) and for *S. crebrinerve s.s.* at Springbrook, Lamington, Huonbrook Road, Richmond Range and Coffs Harbour.

The type collection of *Syzygium crebrinerve*, plus representative specimens from across the species range from Kempsey NSW to Bulburin Qld were viewed on

Australia's Virtual Herbarium and in the Queensland Herbarium. This process was repeated for *S. johnsonii* (see Notes section below) and *S. oleosum* including type material for these names. The aim was to uncover any other populations of the proposed novel species that are represented in herbarium specimens. The morphological features and pictures of the new species were also carefully compared to the descriptions and images for all known tropical Australian *Syzygium* species to rule out the plants representing a new, outlying southerly population of a known species (Zich *et al*. 2020).

Published descriptions and herbarium specimens of *Syzygium crebrinerve*, *S. johnsonii* and *S. oleosum* (Hyland 1983; Floyd 2008; Harden *et. al* 2018, 2023) were compared to the new species. A comparison of key diagnostic features of the two closely allopatric species is provided in **Table 1** and a species key to enable recognition in habitat, regenerative plantings or cultivation.

Taxonomy

Identification key to Syzygium spp. south of Brisbane >-27° to southern range extent of genus in Victoria (excludes Acmena spp., Anetholea anisata and Waterhousea floribunda, adapted from Plantnet 2024)

1 Leafy twigs 4-angled to shortly 4-winged, wings joining above each node to produce a small pocket . . . . . **Syzygium australe**
1. Leafy twigs terete to 4-angled, pockets never forming above the node **2**

2 Leaves with intramarginal vein poorly developed, main lateral veins irregularly looping well inside the undulate margins . . . . . **Syzygium hodgkinsoniae**
2. Leaves with intramarginal veins close to the margins, usually well-developed **3**

3 Petals cohering and shed as a unified calyptra **4**

3. Petals four or five, free and spreading **5**

4 Leaves thin and flexible, < 8 cm long, with undulate margins and a narrow apex; inflorescences terminal and axillary; flowers cream or white; fruit purplish blue. . . . . **Syzygium francisii**
4. Leaves thick, coriaceous and large, > 9–16 cm long, margins straight and with a blunt apex; inflorescences produced on the older branches below the leaves; flowers pink to magenta; fruit white to cream. . . . .**Syzygium moorei**

5 Branchlets fawn; fruit pink to red **6**
5. Branchlets brown with green ends, green, orange or red; fruit bluish to purple or magenta **7**

6 Leaves elliptical with an acuminate apex, 2.5–7 cm long, 1–3 cm wide; hypanthium 3–6 mm long; fruit 9–12 mm long, 7–11 mm diam. . **Syzygium luehmannii**
6. Leaves ovate to obovate with a bluntly obtuse apex, 4–12 cm long, 2–5.5 cm wide; hypanthium 6–14 mm long; fruit 13–20 mm long, 11–18 mm diam . . . . . **Syzygium corynanthum**

7 Oil glands in leaves numerous, large and visible to the naked eye. **8**
7. Oil glands small and scattered, or obscure, not readily visible with the naked eye **9**

8 Leaf lamina with a pronounced long-acuminate apex (drip tip); oil glands obvious and of two types, larger and yellow, interspersed with smaller and translucent (possibly druses), both numerous; secondary lateral veins impressed above and dark green below. Restricted to high elevations 800–1200 m on the McPherson Range, Tweed Range and Mt Wollumbin (Mt Warning) . . . . . **Syzygium nebulosum**

8. Leaf lamina with an acute to acuminate apex (drip tip); oil glands large and of one type, translucent (not coloured), numerous; secondary lateral veins not notably impressed above and obscure below. Widely distributed at a variety of elevations from sea level to 900 m in NSW and Qld . . . . . **Syzygium oleosum**

9 Branchlets green; fruit more or less ovoid to globose; seeds with 2 or more embryos of various sizes . . . . . **Syzygium paniculatum**

9. Branchlets and leaf petioles red on the upper surface, green on the lower surface; fruit depressed-globose pink to magenta with an exserted calyx; seeds with only one embryo . . . . . **Syzygium crebrinerve**

Syzygium nebulosum L.Weber **sp. nov.**

Similar to *S. crebrinerve* (C.T.White) L.A.S.Johnson but differing in having smooth to flaky, pinkish bark, often with numerous coppice shoots at the base of the trunk (vs scaly fissured, fawn to pale pink bark without coppice shoots at the base of the trunk in *S. crebrinerve*); fresh mature leaves with 14–24 pairs of dark green looping secondary lateral veins (vs fresh mature leaves with 22–35 pairs that are usually the same colour as the lamina and not prominently visible on *S. crebrinerve*); oil glands are of two types: larger golden glands interspersed with smaller translucent glands (vs one type of translucent gland in *S. crebrinerve*); new flush of leaves often has a distinctive golden green colour (vs pink to wine red and maturing orange in *S. crebrinerve*); twigs are covered in smooth peeling maroon to orange bark just below the leaves (vs pinkish non peeling bark in *S. crebrinerve*); inflorescences are borne in the leaf axils (vs terminal and multi branched in *S. crebrinerve*); flowers with four creamy-golden petals (vs four white or pinkish-white petals for *S. crebrinerve*); hypanthium (floral tube) broadly campanulate and golden brown to maroon (vs slender fusiform and green fading into pink when fresh for *S. crebrinerve*), with four small equal sized, maroon triangular sepals giving a square appearance when viewed apically (vs two enlarged and two smaller pink sepals with rounded apices in *S. crebrinerve* giving a diamond shaped appearance when viewed apically); stamens with anthers 4–6 mm long (vs *c*. 5–10 mm long in *S. crebrinerve*); fruit obconical, bluish purple when ripe with an impressed calyx (vs depressed globose and pink when ripe with an exserted calyx in *S. crebrinerve*). **Type:** Queensland. Moreton District: Repeater Station Road, Springbrook, near Old Mountain Lodge, 18 km SW of Mudgeeraba, 24 November 2023, *Lui Weber, Rachel Bird, Liam Weber, Glenn Leiper & Robert Price LCW2048* (holo: BRI [AQ1050312, comprising 2 sheets plus spirit]; iso: CNS, L, MEL, NSW, US *distribuendi*).

Tree to 25 m tall with a spreading canopy. Trunk up to 100 cm diameter at breast height, often buttressed; base of trunk commonly with numerous smaller coppice shoots and occasionally aerial roots. Bark smooth flaky with dimples, depressions and swirls, pale pink to fawn (appearing dark pink and orange when wet). **Branchlets** oval shaped in cross section, not winged, the few youngest internodes with median grooves running above and below perpendicular to the leaf pairs, swollen at leaf nodes with petioles joining at a 45° angle towards the growing tip; bark of small branchlets orange and smooth and peeling in leafy sections with darker maroon colour on the growing tip.

Leaves opposite, petiolate; petioles 5–10 mm long, maroon or orange fading to mid green, slightly curved, terete with a shallow groove on top; lamina coriaceous, flexible, ovate to elliptical, occasionally obovate to orbicular, 3.5–8(–12) cm long, 2–4(–9) cm broad, with the broadest point being usually closer to the petiole or occasionally at or slightly above the middle and then gradually tapering towards apex; base cuneate to occasionally obtuse; apex short to long-acuminate and blunt tipped, 0.5–2 cm; slightly glossy, dark-green above, sometimes with numerous slightly raised oil glands (dots), paler green below, glabrous; fresh leaves with the sides of the lamina and drip tip curved down. **Venation** comprising a midvein (1°), lateral veins (2°) and interlateral veins (3°); midvein impressed/channelled above and raised below, straight, golden yellow; lateral veins pinnate, 14–24 per side, impressed above and dark green, easily visible below, looping with a strongly developed intramarginal vein that is visible above and very obvious below; interlateral venation (3°) forming a coarse network joining and anastomosing between lateral veins on acute diagonal angles and visible on leaf undersides. **New growth** golden green to golden yellow and before becoming green, the maturing leaves turn dark golden yellow. **Oil glands** numerous, easily visible to the naked eye and of two sizes: larger and yellowish, interspersed with smaller and translucent (these are possibly druses). **Crushed leaves** aromatic and resinous, resembling Mango (*Mangifera indica* L., Anacardiaceae) skin-like smell. **Inflorescence** borne from the leaf axils, a panicle 3–5 cm long, usually single but sometimes paired, usually unbranched until near apex, with usually 3 flowers, rarely 4. **Flowers** 4-merous, not strongly scented; pedicels 3–5 mm long; buds, globose with 4 claw-like sepals, dull golden to maroon; hypanthium broadly campanulate, 4–7 mm long, *c*. 2 mm thick near base, dull golden brown to maroon, rapidly widening into a *c*. 10 mm diameter floral tube; petals obovate, *c*. 5 mm long × 7 mm wide and widely opening, recurved behind calyptra margin, creamy pale golden with cream margins, *c*. 0.5 mm thick; stamens numerous and > 50, arranged in a staminal ring around the base of the petals, anthers globose, *c*. 1 mm wide, white, centrally grooved; stigma thickened, *c*. 10 mm long, 1–1.5 mm thick, tapering towards the base, dark golden; central part of flower inside staminal ring forms a circular depression (sometimes a squarish circle) around the stigma and this is pale golden green to golden yellow. **Fruit** a single seeded berry, obovoid or obconical to turbinate, 15–26 mm long, and 9–12 mm wide; skin thin (*c*. 0.5 mm), sometimes magenta when immature then ripening to bluish purple, glossy with dimpled surface; excavated at apex with a depressed calyx in the bottom, surrounded by persistent fleshy sepals, sometimes also with persistent dried stamens and stigma attached; flesh 3–4 mm thick, white with a sparkling, cellular and aerated texture; pedicel 0.5–1 cm long, thin. **Seed** globular to ovoid, 6–8 mm long and *c*. 8 mm diameter, surface pale greenish white with several light veins with darker borders wrapping around; embryo with greenish cotyledons with interlocking lobes. **Figs. 1–15.** ***Suggested Vernacular Name*****:** Caldera Satinash

Additional specimens examined**: Queensland.** Moreton District: Repeater Station Road, Springbrook, near Old Mountain Lodge, 18 km SW of Mudgeeraba, Jan 2024, *Leiper s.n.* (BRI [AQ1049980]); *ibid*, Mar 2024, *Leiper s.n.* (BRI [AQ1049979]); *ibid*, Mar 2024, *Weber s.n.* (BRI [AQ1049978]); Best of All Lookout, next to lower carpark, end of Repeater Station Road, Springbrook, Jan 2024, *Leiper et al. s.n.* (BRI [AQ1049981]); Lamington NP, Border Walk near Mt Merino, Jul 2023, *Weber & Mallee s.n.* (BRI [AQ1049975]). **New South Wales.** McPherson Range, Mt Hobwee, Dacelo Lookout, Apr 1984, *Telford 9743* (CANB); Border Ranges NP, near Mt Throakban, McPherson Range, Jan 2019, *Weber & Mallee s.n.* (BRI [AQ1049976]); Pseudopinnacle, Border Ranges NP, Tweed Range, May 2023, *Weber & Mallee s.n.* (BRI [AQ1049977]); Bar Mountain, Border Ranges NP, Jun 2023, *Price & Weber s.n.* (BRI [AQ1050311], NSW).

Fig. 1. ***Syzygium nebulosum***. Trunk base (Best of All Lookout, Springbrook; population voucher: *Leiper et al. s.n.*, BRI [AQ1049981]). Photo: L. Weber.

Fig. 2. ***Syzygium nebulosum***. Bark showing flaky, pinkish smooth patches (Best of All Lookout, Springbrook; population voucher: *Leiper et al. s.n.*, BRI [AQ1049981]). Photo: L. Weber.

Fig. 3. ***Syzygium nebulosum***. Coppice growth on lower trunk. (Best of All Lookout, Springbrook; population voucher: *Leiper et al. s.n.*, BRI [AQ1049981]). Photo: L. Weber.

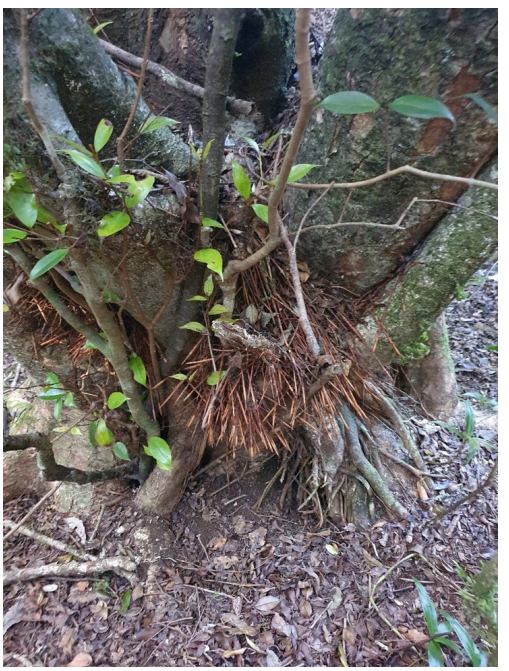

Fig. 4. ***Syzygium nebulosum***. Trunk base with aerial roots (Mt Thillinmam, Springbrook; unvouchered). Photo: L. Weber.

Fig. 5. ***Syzygium nebulosum*.** Branchlet with new expanding golden yellow foliage (Best of All Lookout, Springbrook; population voucher: *Leiper et al. s.n.*, BRI [AQ1049981]). Photo: L. Weber.

Fig. 6. ***Syzygium nebulosum***. Branchlet showing red stems and petioles, upper surfaces of leaves and long acuminate, deflexed leaf apices (drip tips) (Repeater Station Road, Springbrook; *Weber 2048 et al.* (BRI). L. Weber.

***Distribution and habitat*:** *Syzygium nebulosum* is narrowly endemic to the highest parts of the Eastern McPherson and Tweed Ranges in the WTVC (Map 1). Presently the species is known from the three highest peaks on the Springbrook Plateau above 900 m (Mt Thrillinmam, Springbrook Mountain and Mt Mumjin in Springbrook NP) and with a small population along the creeks, including Boy-Ull Creek below the peaks at 800 m. It is also present in the adjacent Numinbah NR in NSW. The species is then known further to the west of the Numinbah Gap (a narrow 400 m elevation pass) and border gate on Mt Hobwee. It is then commonly encountered on the higher peaks and cliffs of Lamington NP in Qld and adjacent Limpinwood NR in NSW from Mt Merino to Mt Wanungara, Mt Bithongabel, Mt Durigan, Mt Worendo, Mt Wupawn and Mt Throakban. There are further occurrences of the species in the Lost World Wilderness from Cockscomb Point, Lamington NP and Tweed Range from Pinnacle Hill to Bar Mountain in Border Ranges NP. The species is not known from the western McPherson Range, Main Range or Nightcap Ranges and its distribution generally closely follows that of Nothofagus moorei with the exception of the Mt Ballow – Mt Nothofagus area. The only population of this species that is not associated with Nothofagus is at Wollumbin where *Ripogonum sp. aff. fawcettianum and Acianthus saxatilis* D.L.Jones & M.A.Clem. also grow, both are usually *Nothofagus* associates. The known distribution is only 30 km north to south and 20 km east to west or 600 km². A full list and details of known subpopulations are given in **Table 1**.

Syzygium nebulosum occurs in high elevation rainforest communities between 800 and 1200 m elevation on loams or peaty deposits derived from volcanic activity, including boulders and rock outcrops originating from the Wollumbin (Mt Warning) – Tweed Volcano, especially the upper most flows termed Hobwee or Blue Knob Basalt lavas (Ewart *et al*. 1987) that formed basalt or porphyritic basalt derived substrates. On Wollumbin the soils are derived from plutonic volcanic rocks and scree of trachyandesite, possibly with some syenite at lower elevations (Ewart *et al*. 1987). In some creeks the species occurs on underlying rhyolite geology but where there is still an influence from more recent overlying volcanic flows such as the basalts.

The cloud rainforest types where *Syzygium nebulosum* has been observed are variously classified as “Cool Temperate Rainforest” (Harden *et al*. 2023) or “Microphyll Mossy Fern Forest”, “Nanophyll Mossy Thickets” and “Simple Notophyll Vine Forest” (Webb 1968). All these vegetation types are forms of “Subtropical Montane Cloud Forest” dependent on frequent cloud and mist (Bruijnzeel *et al*. 2011; Narsey *et al*. 2020). Commonly associated tree species include: *Ackama paniculosa* (F.Muell.) Heslewood, *Alloxylon pinnatum* (Maiden & Betche) P.H.Weston & Crisp, *Callicoma serratifolia* Andrews, *Cryptocarya foveolata* C.T.White & W.D.Francis, *Doryphora sassafras* Endl., *Endiandra crassiflora* C.T.White & Francis, *Eucryphia jinksii*, *Nothofagus moorei*, *Orites excelsus* R.Br., *Quintinia sieberi* A.DC. and *Tristaniopsis collina* Peter G.Wilson & J.T.Waterh. The shrubs *Ardisia bakeri* C.T.White, *Rhodamnia maideniana* C.T.White and *Symplocos baeuerlenii* R.T.Baker occur with *S. nebulosum* only on the Springbrook Plateau and not in the other populations. Where *Syzygium nebulosum* occurs in riparian situations, it is most commonly associated with tree species such as *Acmena ingens* (F.Muell. ex C.Moore) Guymer & B.Hyland, *Ceratopetalum apetalum* D.Don (this species often dominant), *Cryptocarya erythroxylon* Maiden & Betche ex Maiden, *C. foveolata*, *Daphnandra* sp. nov., *Dysoxylum fraserianum* (A.Juss.) Benth., *Orites excelsus* and *Quintinia sieberi* A.DC. One site is known in Boy-ull Swamp at Springbrook where the species grows in groundwater springs in peaty saturated soils where associated species include *Dicksonia youngiae* C.Moore ex Baker, *Helmholtzia glaberrima* and *Blechnum* spp. Hanging mosses in the genus *Papillaria* (Müll.Hal.) Lorentz and other bryophytes such as liverworts are abundant and obvious, hanging in the tree canopies of

all of these communities due to the frequent cloud exposure (Pearce *et al*. 2015).

Climates are cool, being 7° cooler on average than the surrounding lowlands, and mean annual rainfall is very high, exceeding 3000 mm annually at Springbrook, 2700 mm at Wollumbin, 2500 mm at Lamington and 2300 mm at Border Ranges (Xu & Hutchinson 2013). Canopy level clouds and fogs are most common in summer and least common in spring. There is diurnal variation in fog frequency with a decline in cloudiness around midday. This occult precipitation is intercepted by the cloud forest and can result in an additional 40% moisture above normal rainfall (based on Hutley *et al*. 1997 from sites in Main Range NP).

Syzygium nebulosum is apparently absent from similar, cool subtropical rainforest habitats on the same geological substrates in the lower elevation Nightcap Range which forms the southern part of the WTVC erosional landscape. The highest peak of Nightcap Range is Blue Knob/Mt Burrell at 930 m which is the lower elevation limit currently of *S. nebulosum* and just 11 km to the south-east of the known population at Bar Mountain, but across the Nimbin Gap, a broad valley with a low point of 220 m. The first author has surveyed the Mt Neville to Sphinx Rock portion of the Nightcap Range through the Kungur Flying Fox Track and did not locate the species despite some apparently suitable habitat.

Syzygium nebulosum also appears to be entirely absent from the western Border Ranges and Main Range in Qld, despite numerous peaks over 1100 m with both Mt Ballow and Mt Superbus exceeding 1300 m. The first author has surveyed a number of peaks in this area (as part of a survey for *Lenwebbia* sp. (Main Range P.R.Sharpe+ 4877)) including Mt Lindesay, Mt Clunie, Wilsons Peak and parts of Mt Ballow – Mt Nothofagus.

The Mt Ballow – Mt Nothofagus massif is potential habitat for *Syzygium nebulosum* as it is the western most known location for *Nothofagus moorei*; however, all other endemic species associated with *S. nebulosum* from the Caldera including *Pittosporum oreillyanum, Uromyrtus lamingtonensis*, *Leucopogon excelsus* A.R. Bean and *Parsonsia tenuis* are absent from the Mt Ballow area despite the presence of *Nothofagus* (Bale & Williams 1993). Hence, the absence of *S. nebulosum* is not particularly surprising. The first author did not record the species up to 1320 m on Mt Ballow in 2024, although both *S. australe* (J.C.Wendl. ex Link) B.Hyland and *S. crebrinerve* were recorded between 800 and 1200 m.

***Phenology*:** Flowering period late spring to early summer from November to January. Fruiting season from Late Summer to Winter (March to July).

***Notes*:** A full comparison of morphological features between *Syzygium nebulosum*, *S. crebrinerve* and *S. oleosum* is provided in **Table 1**. It is important when examining material, that for some characters, more than single leaves are studied, as lamina shape varies depending on age and light environment. We have characterised the leaf lamina of *S. nebulosum* as having two sizes of oil glands (**Fig. 8**); however, anatomical examination is required to determine if the smaller ones are actually druses as found in other species of the genus (Soh & Parnell 2011; Smitha & Anto 2022).

The outlying and putative southern subpopulation of *Syzygium nebulosum* at Wollumbin (currently unvouchered) has some minor morphological differences to the northern and western subpopulations. The leaves are slightly broader and more ovate to orbicular than other populations, the flowers and fruit of this population are not yet known.

Table 1. Morphological comparison of *Syzygium nebulosum, S. crebrinerve* and *S. oleosum,* most useful diagnostic characters in bold

Character	*S. crebrinerve*	*S. oleosum*	*S. nebulosum*
Bark	flaky with longitudinal fissures and numerous depressions from detached flakes, grey to brownish	fissured and scaly, shedding in narrow longitudinal scales, reddish-brown	smooth with flakes, plates depressions, swirls and fissures, pale pink
New growth flush colour	purple to orange	red to orange	pale orange to golden yellow green
Leaf laminae	oblanceolate, oblong-elliptic to narrowly oblong-elliptic or ovate; dark green and shiny above, **paler green** below	oblong-elliptic or lanceolate; dark green and shiny above, **paler green** below	ovate elliptic to obovate, dark green, matt to slightly shiny above, **pale yellow green** below
Laminae apex (drip tip)	**short acuminate**, but not strongly pronounced, **not strongly deflexed**	**short acuminate**, but not strongly pronounced, **not strongly deflexed**	**short to long acuminate**, strongly pronounced and **strongly deflexed at up to 80°**
Secondary lateral veins	22–37 pairs, faint in fresh leaves on both surfaces, more obvious on dried leaves.	8–20 pairs, faint in fresh and dried leaves on both surfaces	14–24 pairs looping at margins, dark green obvious on underside in fresh leaves, impressed above in fresh leaves
Petioles	4–12 mm long, often dark red, weakly channelled above or terete	2–10 mm long, green, channelled above	4–6 mm long, dark maroon to orange, channelled above
Oil glands	**one size**: translucent, distinctly widely spaced across the lamina, just visible to the naked eye when held against the light, easily visible with a lens	**one size**: strongly translucent, numerous and spread across the lamina, obvious to the naked eye when held against the light	**two sizes**: larger yellow and smaller (that are possibly druses) translucent, both numerous and spread across the lamina, obvious to the naked eye when held against the light

Table 1 (continued). Morphological comparison of *Syzygium nebulosum, S. crebrinerve* and *S. oleosum*

Character	*S. crebrinerve*	*S. oleosum*	*S. nebulosum*
Crushed leaf scent	moderately aromatic, the smell with a hint of eucalyptus; crushed leaves not sticky to touch	a mixture of strong and acrid, the smell resembling a mixture of mango skin and eucalyptus; crushed leaves resinous to touch	aromatic and resinous, the smell resembling mango skin; crushed leaves resinous to touch
Flowers	pedicels 6–11 mm long; petals orbicular, **cream to white**	pedicels 3–6 mm long; petals orbicular to oval, **cream to white**	pedicels 3–5 mm long; petals obovate, **creamy golden yellow**
Fruit	**depressed globose**, 17–25 mm diameter; shiny magenta purple; flesh floury, white	**ovoid to globose or depressed globose**, 13–40 mm diameter; purple red turning bluish purple when ripe; flesh with sparkling aerated structure, white and often with bluish purple streaks	**oblong to obconical or turbinate**, 6–12 mm wide. magenta then ripening to dark purple; flesh with sparkling aerated structure, white

Fig. 7. ***Syzygium nebulosum***. Leaf undersurface showing venation (Best of All Lookout, Springbrook; population voucher: *Leiper et al. s.n.*, BRI [AQ1049981]). Photo: L. Weber.

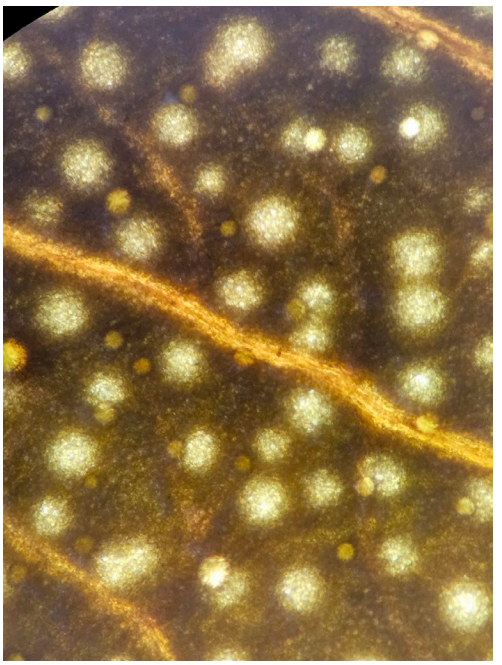

Fig. 8. ***Syzygium nebulosum***. Close up detail of undersurface of leaf lamina showing two types of oil dots (Repeater Station Road, Springbrook; *Weber 2048 et al.*, BRI). Photo: L. Weber.

Fig. 9. Comparison of undersurface of backlit leaves for ***Syzygium nebulosum*** (left, Repeater Station Road, Springbrook (left); *Weber 2048 et al*., BRI), ***S. crebrinerve*** (Lyrebird Ridge Road, Springbrook; unvouchered) (middle) and ***S. oleosum*** (Burleigh Heads, Qld; unvouchered) (right). Photos: L. Weber.

Fig. 10. ***Syzygium nebulosum***. Branchlet with flowers (Repeater Station Road, Springbrook; *Weber 2048 et al*., BRI). Photo: G. Leiper.

Fig 11. ***Syzygium nebulosum***. Group of three flowers showing creamy golden petals, maroon calyx, exserted cream stamens and golden yellow style and stigma (Repeater Station Road, Springbrook; *Weber 2048 et al.*, BRI). Photo: G. Leiper.

Fig. 12. ***Syzygium nebulosum***. Group of three flowers viewed from below showing reddish calyx and pedicels (Repeater Station Road, Springbrook; *Weber 2048 et al.*, BRI). Photo: G. Leiper.

Fig. 13. ***Syzygium nebulosum***. Branchlet with fruit, note dimpled surface (Repeater Station Road, Springbrook; *Leiper et al. s.n.*, BRI [AQ1049981]). Photo: G. Leiper.

Fig. 14. Comparison of fruit for ***Syzygium nebulosum*** (Bar Mountain, NSW; *Price & Weber s.n.,* BRI [AQ1050311]) (left), ***S. crebinerve*** (Huonbrook Road, NSW; unvouchered) (centre) and ***S. oleosum*** from Rous River, Tweed Valley, NSW; unvouchered) (right). Photos: L. Weber.

Fig. 15. ***Syzygium nebulosum***. Transverse section of seed showing embryo (Bar Mountain, NSW; *Price & Weber s.n.*, BRI [AQ1050311]). Photo: L. Weber.

Apart from the species of *Syzygium* that occur in close geographical proximity to *S. nebulosum*, the new species also shares features with *S. johnsonii* which occurs from the Cooloola/Fraser Island area north of Brisbane and at Kroombit Tops in south-east Qld, north to the Wet Tropics. Shared features are the elongated purple fruits with an excavated apex, the crushed leaves aromatic and resinous (resembling mango skin smell), adventitious roots on the trunk and similar bark characteristics. However, *S. nebulosum* differs from *S. johnsonii* in having dark green, obvious, secondary lateral veins on the leaf lamina undersides (vs scarcely visible in *S. johnsonii*); inflorescences are borne in the leaf axils (vs terminal for *S. johnsonii*); flower buds golden to maroon (vs pale creamy green in *S. johnsonii*); flower petals golden to creamy gold (vs. cream to white in *S. johnsonii*) (Whiffin & Kerrigan 2020c).

It is possible *Syzygium nebulosum* is a southern relative of *S. johnsonii* that has allopatrically speciated on the WTVC and a future genetic study involving these taxa would help infer the new species' closest relatives. Genetic study of other Australian *Syzygium* species have revealed surprising inferred evolutionary histories, with *S. paniculatum* in NSW demonstrating complex tetraploidy and five separate linages including true *S. paniculatum* south of Sydney and four lineages further north derived from hybrid admixtures with *S. oleosum* (Thurlby *et al*. 2012).

Some morphological features unique to *Syzygium nebulosum* (e.g. thick leathery leaves, golden green new growth and extended drip tips) may have been selected for in its wetter, frequently cloudy habitat. Despite only 1 km separating the most southern location of *S. crebrinerve* on Springbrook and the most northern location of *S. nebulosum* and similar distances separating the two taxa at Lamington and Tweed Range, no putative hybrids have been found. Wild hybrids in *Syzygium* are rare, or poorly documented (see Thurlby *et al*. 2012; Low *et al.* 2023; Lu & Li 2024).

This is the first narrowly endemic, cloud rainforest *Syzygium* species from subtropical Australia. There are a number of narrowly endemic species in the Australian Wet Tropics, for example *S. dansiei* B.Hyland from Windsor Tableland and Mt Spurgeon at 950–1200 m elevation (Whiffin & Kerrigan 2020b), while *S. fratris* Craven is restricted

to Queensland's highest mountain Mt Bartle Frere in very wet, cloud rainforests around 1500 m elevation. Remarkably *S. fratris* has a similar golden flower colour and leaf shape to *S. nebulosum* (Craven 2003; Whiffin & Kerrigan 2020a) and these traits may be adaptive for very wet, cool and cloudy environments. It is possible that pollinating insects or birds find white or cream flowers difficult to see in mist or cloud so golden flowers may offer better contrast and visibility to pollinators; however, any generalisation in the absence of observational data can only be speculative (*cf.* Chittka *et al*. 2001). Yellow flowers are significantly less common (<10%) than white (79% of all species) in Australian rainforest species, although it is not yet known if there is any correlation with altitude and precipitation (Delmas *et al*. 2020). Abiotic variables of habitats including precipitation have been shown to significantly shape Australian flower colours as well as pollinator assemblages (Dalrymple *et al*. 2020).

The extended drip tips on leaf apices in many cloud rainforest species may help to shed rain and cloud precipitation and reduce the growth of epiphyllous bryophytes and lichens on the leaf lamina surfaces (Ivey & DeSilva 2001), with the feature being more prevalent in species from wetter forests at higher altitudes (Malhado *et al*. 2012). Experimental testing of these hypotheses found that extended drip tips shed water more quickly and decreased debris accumulation (Lücking & Bernecker-Lücking 2005).

***Etymology*:** The specific epithet is derived from the Latin adjective *nebulosus* – subject to cloud and mist or hazy, foggy or obscure. Named for the cloud rainforest environment on the Wollumbin (Mt Warning) – Tweed caldera above 800 m from which the species is restricted to and that is frequently shrouded in mist for up to 70% of the year, and the obscure hazy identity of the species not uncovered for nearly half a century after its first collection.

***Conservation status*:** *Syzygium nebulosum* is currently not listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999, the NSW *Biodiversity Conservation Act* 2016 or the Qld *Nature Conservation Act* 1992 and its recognition as a distinct species from *S. crebrinerve* and *S. oleosum* has significant implications for the conservation of the new taxon.

Syzygium nebulosum is known from three main subpopulations or locations, Springbrook Plateau, Lamington Plateau and Tweed Range (**Map 1**). There is a fourth, isolated and much smaller subpopulation below the summit of Wollumbin (Mt Warning). The species is susceptible to myrtle rust and exhibits foliage damage. As myrtle rust is spread by wind, all locations can be impacted by this single threat making only effectively one location.

The species total estimated Extent of occurrence (EOO) is 91.5 km^2 and total. Area of Occupancy (AOO) is much smaller at 76.0 km^2 based on the number of occupied 4 km^2 grid cells, as per IUCN (2019) recommendations for assessing conservation status of species.

The estimated mapped habitat polygon area of the Springbrook subpopulation is 0.88 km^2 at Mt Thillinmam, Boy-ull Creek and 1.14 km^2 at Mt Munjin, the Lamington subpopulation is 18.7 km^2 and the Border Ranges NP subpopulation is 6.63 km^2. In total all known population habitat polygons cover 27.35 km^2. The total population size is estimated to be 850–1000 mature plants.

With an estimated *c*. 830 known adult plants across all subpopulations and less than 100 mature individuals in any one of the subpopulations (**Table 2**), *Syzygium nebulosum* is most likely to meet the IUCN red list criteria for **Endangered**.

With an EOO of less than 100 km² *Syzygium nebulosum* qualifies for **Critically Endangered** under Red List criterion B1a,b(i-v). Based on the Extent of Occurrence, Area of Occupancy, and an estimated 1000 mature individuals, it easily qualifies for **Endangered** based on criteria B1a,b(i-v); 2a,b(i-v)2; C2a(ii) (IUCN 2019). A formal nomination for listing under the Qld *Nature Conservation Act* 1992 will be made elsewhere.

Table 2. Numeric population estimates for all known extant locations of *Syzygium nebulosum*

Location	Herbarium Voucher	Land Tenure	Estimated number of Adult Trees
Mt Thillinmam (Billborough Lookout) -28.235257° 153.287872°	unvouchered	Springbrook NP Numinbah NR	10 mature trees
Springbrook Mountain-28.233839° 153.278441°	unvouchered	Springbrook NP Numinbah NR	*c.* 15 mature trees
Boy Ull Swamp, Springbrook -28.228227° 153.280407°	unvouchered	National Park Recovery	5 mature trees
Springbrook Mountain Manor Creek -28.231531° 153.270046°	unvouchered	State Government Qld	10 mature trees
Repeater Station Road Springbrook (Type Locality)	*Weber et al. 2048*	National Park Recovery and Private Property	*c.* 20 mature trees
Mt Mumjin (= Best of All Lookout) -28.240696° 153.266473°	*Leiper et al. s.n.* (BRI [AQ1049981])	Springbrook NP Numinbah NR	*c.* 50 mature trees
Mt Hobwee -28.253822° 153.207966°	unvouchered	Lamington NP Limpinwood NR	*c.* 50 mature trees
Dacelo Lookout -28.256189° 153.201310°	*Telford 9743* (CANB)	Lamington NP Limpinwood NR	*c.* 20 mature trees
Mt Merino -28.247255° 153.188071°	*Weber & Mallee s.n.* (BRI [AQ1049975])	Lamington NP Limpinwood NR	*c.* 100 mature trees
Mt Wunungara -28.250983° 153.175163°	unvouchered	Lamington NP Limpinwood NR	*c.* 100 mature trees
Mt Tooloona -28.259279° 153.173287°	unvouchered	Lamington NP Limpinwood NR	*c.* 20 mature trees
Mt Bithongabel -28.264134° 153.172615°	unvouchered	Lamington NP Limpinwood NR	*c.* 100 mature trees
Junction of Border Track and Albert River Circuit -28.259850° 153.162767°	unvouchered	Lamington NP	*c.* 40 mature trees
Mt Cominan -28.274619° 153.175389°	unvouchered	Lamington NP Limpinwood NR	*c.* 30 mature trees
Echo Point Gorge -28.276989° 153.170610°	unvouchered	Lamington NP Limpinwood NR	5 mature trees
Mt Worendo -28.279665° 153.160614°	unvouchered	Lamington NP Limpinwood NR	*c.* 50 mature trees
Mt Wupawn -28.285478° 153.166596°	unvouchered	Lamington NP Limpinwood NR	*c.* 30 mature trees

Table 2 (continued). Numeric population estimates for all known extant locations of *Syzygium nebulosum*

Location	Herbarium Voucher	Land Tenure	Estimated number of Adult Trees
Mt Durigan -28.293243° 153.169320°	unvouchered	Lamington NP Limpinwood NR	*c.* 20 mature trees
Mt Throakban -28.295303° 153.156229°	*Weber & Mallee s.n.* (BRI [AQ1049976])	Lamington NP Limpinwood NR	*c.* 50 mature trees
Cockscomb Point -28.341132° 153.124346°	unvouchered	Lamington NP Border Ranges NP	*c.* 20 mature trees
Pinnacle Hill – Pseudopinnacle -28.406207° 153.128742°	*Weber & Mallee s.n.*, (BRI [AQ1049977])	Border Ranges NP	*c.* 20 mature trees
South Pseudopinnacle (Near Blackbutts Lookout) -28.447488° 153.145379°	unvouchered	Border Ranges NP	*c.* 5 mature trees
Bar Mountain -28.459568° 153.128328°	*Price & Weber s.n.* (BRI [AQ1050311])	Border Ranges NP Mebbin NP	*c.* 50 mature trees
Mt Wollumbin below summit -28.398480° 153.271906°	unvouchered	Wollumbin NP	*c.* 30 mature trees
Total			*c.* < 830

Syzygium nebulosum subpopulations are mostly in formal protected areas or conservation reserves (National Parks, Nature Reserves and Nature Refuges), and these are included in the Gondwana Rainforests of Australia World Heritage Area (DEE 2021). The subpopulation around Repeater Station Road, Springbrook is on private land and National Park on multiple titles and is the one most at risk of clearing for road widening or house sites (**Tables 2 & 3**). However, other sites on National Park are also at risk of clearing for Radio Towers or access tracks to these assets and the species is not currently considered in environmental impact statements.

The species also occurs in areas where it may be dependent on groundwater such as stream margins, peat swamps and springs. These are potentially threatened by commercial groundwater extraction businesses especially on the Springbrook Plateau (**Table 3**).

Pollination Ecology and Dispersal

The breeding system and any associated pollinators of *Syzygium nebulosum* remain undocumented. Insects and birds all contribute to pollination of other *Syzygium* species (Hopper 1980; Crome & Irvine 1986; Boulter *et al*. 2005; Kuriakose *et al*. 2018) and the few studied species have demonstrated apomixis, self-compatibly or incompatibly (Kuriakose *et al*. 2018).

The modest amount of fruit produced by *Syzygium nebulosum* over three years (2021 to 2023) appears to be significantly less than that typically produced by *S. crebrinerve* which occurs nearby; however, this has not been quantified. Notwithstanding this observation, *S. nebulosum* may have mast years occasionally producing larger crops of fruit. The apparent paucity of flowering and fruiting of this species as well as the large stature of the trees is likely to have contributed to it not being previously identified as a separate species.

Table 3. Threat assessment table for *Syzygium nebulosum*

Threat	Impact on the species and/or its habitat	Sites affected	Is it a past, current or future threat	Current conservation management activities
Small population size	Loss of genetic fitness through inbreeding depression or loss of adults to natural disaster	Wollumbin subpopulation is disjunct and several other of the smaller subpopulations have few individuals	Past (ice age bottlenecks) and future	Nil
Climate Change	Lifting of cloud base resulting in more extreme droughts.	All subpopulations, as the species is restricted to 900–1200 m elevations and may be cloud water dependent.	Current and future	Nil
Myrtle Rust	Dieback of new foliage and death of trees, possible infections of flowers and fruits causing reduced reproductive output.	Several sites especially Bar Mountain, Mt Throakban, Mt Merino and Mt Mumjin (Best of All Lookout). Other sites have minor impacts but La Nina events may have made impacts worse at many sites with monitoring needed	Current and future	Limited monitoring associated with *Lenwebbia* sp. Main Range conservation project
Lack of knowledge of the species	Species previously not recognised as distinctive	All sites	Past and Current	Identified as a novel species endemic to a small area
Lack of recruitment	Old trees that die from natural disturbance such as lightning or landslides or from myrtle rust are not replaced.	All sites	Past and Current	Information and survey required, seedlings are not especially common
Clearing for infrastructure, road widening and housing	Direct clearing of plants	Mt Thillinmam, Repeater Station Road and Best of All Lookout.	Past and Current	Nil as species is not listed as threatened
Water extraction	Loss or reduction of groundwater flow may reduce plant health in droughts.	Repeater Station Road and Best of All Lookout	Current and future	Groundwater is monitored by Council and Universities. Council has placed a temporary moratorium on new groundwater extraction projects

The coloured fleshy fruit of *Syzygium nebulosum* are presumed to be dispersed by animals; however, the small size of individual subpopulations indicates either that limited dispersal may be restricting distribution (Primack & Miao 1992; Rossetto *et al*. 2008), or that the suitable environmental envelope is already nearing its limits. Fruit eating bats and birds disperse fruit of other *Syzygium* species (Shapcott 1999; Cooper & Cooper 2004; Sinu *et al*. 2012; Tang *et al*. 2012). Seed germination is unstudied but is likely to resemble other species such as *Syzygium crebrinerve* or *S. oleosum*.

Juvenile plants or seedlings appear to be uncommon, but several seedlings and small juvenile plants are known from Mt Merino and Mt Worendo at Lamington and Repeater Station Road, Springbrook. Near Best of All Lookout, Springbrook, a patch of juvenile plants are known in a clearing ranging in height from less than a metre to 4 m (G. Leiper pers. comm. February, 2024). The species is potentially long lived, up to several hundred years. At Mt Wupawn in Lamington NP there are several trees that appear quite healthy despite their trunks being entirely hollow, indicating substantial age. Individuals of the associated *Nothofagus moorei* can live for at least 300 years (Smart 2020), if not for several millennia suckering from the trunk base with significant clonality often inferred, though not supported by genetic analysis (Taylor *et al*. 2004). *Syzygium nebulosum* appears to have similar suckering abilities and the possibility of clonality for closely associated individuals cannot be discounted.

Biogeography

The Border Ranges Refugium associated with the WTVC is one of the most significant refugia for rainforest on the Australian continent given its geographic location in the subtropics (Weber *et al*. 2014). Palaeoclimatic models predict rainforest habitat to have been highly stable for the past 120,000 years between Mt Tamborine and Ballina (Weber *et al*. 2014). Numerous rainforest plant species including one other *Syzygium* (*S. moorei*) are endemic to this refugium.

Past climate change in the area under discussion would have caused habitat fluctuations as the rainforests shifted in elevation on the volcanic caldera in response to ice ages and rainfall variation for probably over 20 million years (Weber *et al*. 2014). These rainforests may have functioned as refugia that both allowed the survival of relict Gondwanan paleoendemic taxa such as *Eucryphia jinksii* and facilitated the evolution and speciation of new taxa such as *Ardisia bakeri* from more recently arrived Asian lineages (Sniderman & Jordan 2011). It is not clear if *Syzygium nebulosum* falls into the palaeo-endemic or neo-endemic species category and genetic study comparing the new species to closely related species would be revealing to infer the age of the lineage.

The discovery of this novel endemic species further increases the already high floristic endemism of the subtropical cloud rainforests of the WTVC. It highlights how important, rigorous and basic botanical taxonomic practices are, such as waiting and revisiting a plant in different seasons and collecting flowers and fruit for comparison to other species and type specimens. Overall, this new species highlights that there is still much unknown and undocumented (by Western science) biodiversity to discover, even in well-studied rainforests close to capital cities in Australia.

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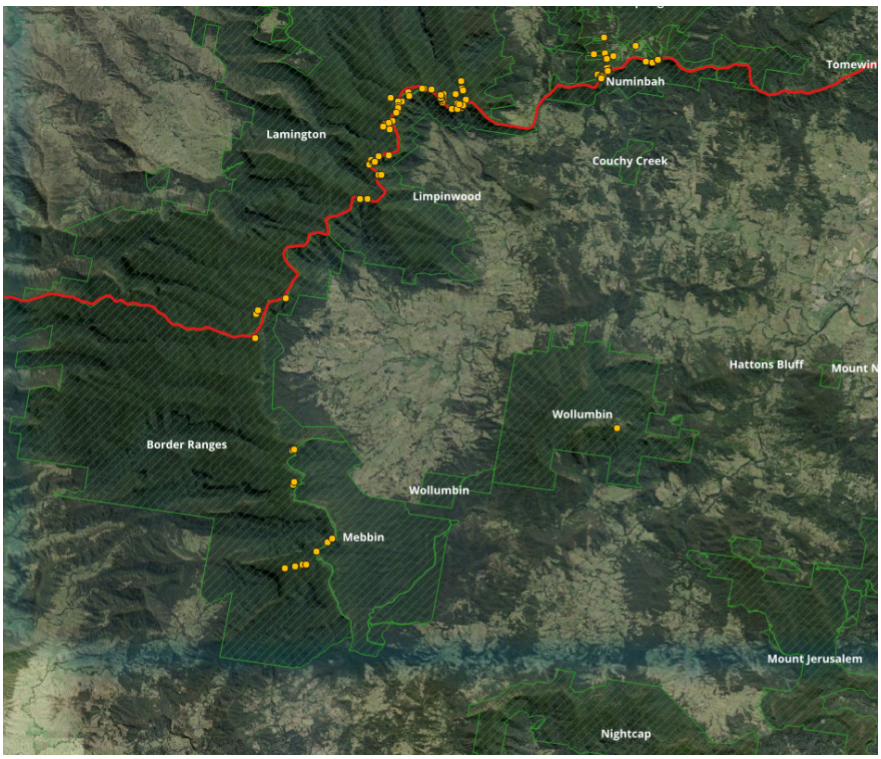

Map. 1. Distribution of ***Syzygium nebulosum***.

Author contributions

LCW − conceived project, collected plant specimens and undertook population estimates, wrote initial text and contributed figures, revised drafts.

PIF − supervised project, examined and measured herbarium collections, wrote sections of text, revised drafts.