

# NSW Threatened Species Scientific Committee

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## Conservation Assessment of *Lenwebbia* sp. Main Range

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NSW Threatened Species Scientific Committee

### ***Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) (Myrtaceae)**

Distribution: Found in both NSW and Qld.

Current EPBC Act Status: Not listed

Current NSW BC Act Status: Listed as Critically Endangered on an emergency basis.

Proposed listing on NSW BC Act and EPBC Act: Critically Endangered.

### **Conservation Advice: *Lenwebbia* sp. Main Range**

#### **Summary of Conservation Assessment**

*Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) was found to be eligible for listing as Critically Endangered under IUCN Criteria A3(c)(e); C1, C2(a)(i) and D1.

The main reason for this species being eligible for listing as Critically Endangered are: a very large reduction in population size; an extremely low number of mature individuals in combination with a very large ongoing decline.

#### **Description and Taxonomy**

*Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is described on PlantNET as a:

“Small tree to 4 m high with brownish, fibrous bark; branchlets densely covered with short, ascending fawn hairs. Leaves with lamina elliptical to obovate, usually 3–12 cm long and 10–25 mm wide; oil glands prominent; secondary venation obscure. Leaves sparingly hairy above with appressed hairs, glabrescent below except on the midvein; apex acute; petiole 3–9 mm long. Flowers axillary, solitary; pedicels 6–7 mm long. Hypanthium sparingly hairy. Sepals triangular, obtuse, to 2 mm long. Other details unknown. Mature fruits 5–7 mm diam., black.”

*Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) differs morphologically from *L. prominens* in its generally smaller leaves, lack of impressed prominent veins on the upper leaf surface and its shiny lamina (Luis Weber *in litt.* May 2018). Most specimens of *L. sp. Main Range* (P.R.Sharpe+ 4877) generally have hairless leaf undersides, however, one collection from the Mount Cordeaux area of Main Range National Park possesses a pubescent underside. Other specimen collections notes report a blue-green colour of the leaf undersides. The flowers are smaller than *L. prominens* but both have four petals and the calyx is less hairy or hairless in *L. sp. Main Range* (P.R.Sharpe+ 4877). Fruits are smaller than *L. prominens* and are less hairy or hairless. *L. sp. Main Range* (P.R.Sharpe+ 4877) was previously included in *L. lasioclada* which is now known to be endemic to the Wet Tropics Bioregion (Luis

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Weber *in litt.* May 2018). Hybridisation with *L. prominens* is appearing to occur in the eastern population (Luis Weber, *pers. comm.* July 2020).

Harden *et al.* (2015) also note that the species can be distinguished from co-occurring *L. prominens* by the lower surface of the leaves being hairless except for the midvein (finely pubescent in *L. prominens*) and the far less prominent lateral veins on the underside of the leaf.

## **Distribution and abundance**

*Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) occurs in high altitude areas in rainforest vegetation on and around the New South Wales (NSW)-Queensland (Qld) border. The species is known from two isolated subpopulations on the volcanic escarpments of the Main Range National Park in south-eastern Qld (approximately 50 km east of Warwick) and in the McPherson Range, which spans the border between Qld and NSW, and occurs within the Limpinwood Nature Reserve (NSW) and Lamington National Park (Qld) (Luis Weber *in litt.* May 2018).

The population in Main Range National Park occurs between Wilsons Peak (28.25° S, 152.49° E) and Mount Cordeaux (28.05° S, 152.40° E), north of Cunninghams Gap. The population in the McPherson Range is scattered along the border between Limpinwood Nature Reserve (NSW) and Lamington National Park (Qld) on and around Mount Wagawn in suitable habitats on the escarpment to Echo Point (Luis Weber *in litt.* May 2018).

Isolated trees are known from Joalah Lookout in Lamington National Park in Qld and Mount Lindesay in an area of the Border Ranges National Park burnt during the 2019-20 wildfire. The status of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) at Mount Lindesay following the fires is currently unknown although reports from rock climbers have indicated that the summit did not burn (Luis Weber *pers. comm.* July 2020). There may be other individuals present along the escarpment away from tracks between Joalah Lookout and Mount Wagawn (Luis Weber *in litt.* May 2018).

The abundance of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) across its range is reasonably suspected to be extremely low. Sites surveyed for *L. sp.* Main Range (P.R.Sharpe+ 4877) typically contain <10 individuals. The observed number of individuals across the known range of *L. sp.* Main Range (P.R.Sharpe+ 4877) is approximately 20-30 in NSW and 5-10 in Qld (Luis Weber *in litt.* May 2018). The abundance of the species could be higher given the extent of extremely remote similar habitat across its range and the difficulty in accurately surveying these areas but is still reasonably suspected to be <100 individuals (Luis Weber *in litt.* May 2018). This abundance estimate is inferred from the limited presence of preferred habitat for the species. Surveys indicate that, across the several kilometres of escarpment where *L. sp.* Main Range (P.R.Sharpe+ 4877) is found, suitable habitats are highly fragmented and rare (Luis Weber *in litt.* May 2018). Populations from Qld have only ever had single, mature individuals recorded (Luis Weber *in litt.* May 2018). Several seedlings and juvenile plants have been recorded at Echo Point in NSW (Weber and Box 2016).

Sites in Main Range National Park in Qld have not been surveyed since the 1994/5 collections for the Qld Herbarium. The individual plant at Joalah Lookout in Lamington

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National Park has been inspected twice, once by botanist Rob Price in 2004 and again by Paul Forster from the Qld Herbarium and botanist Luis Weber where it was assessed as being healthy and in flower on 28/10/2013 (Luis Weber, May 2018, *pers. comm.* to the Nominator). The Lamington National Park-Limpinwood Nature Reserve sites were extensively surveyed over six days in 2016 by botanists Luis Weber and Phil Box on behalf of NSW National Parks and Wildlife Service (NPWS), including abseiling to survey the cliff lines containing suitable habitat along the escarpments of the McPherson Range (Weber and Box 2016). These surveys uncovered eight plants between Dacelo Lookout and Niamully Lookout, and six plants between Niamully Lookout and Echo Point. The Echo Point site was resurveyed on 7/9/2017 by botanists Luis Weber and Justin Mallee from NSW NPWS and several (<10) new individuals were identified. Lamington National Park-Limpinwood Nature Reserve sites were resurveyed on the 24/3/2018 by Luis Weber and Gavin Phillips from the Royal Botanic Gardens, Mount Annan and 100% mortality was observed at Dacelo Lookout, Mount Merino and 90% defoliation with only a single living branch observed at Joalah Lookout (L. Weber *in litt.* 2018).

## **Occurrence data**

There are two populations across sixteen known sites for *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) (Table 1) which occur at a single location as they are all at risk of infection by *Austropuccinia psidii* (myrtle rust).

Note that not all known occurrences of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) are vouchered. The population at Echo Point was sampled on the 7/9/2017 for cuttings to be used in *ex situ* conservation at NSW PlantBank, though no vouchers were made due to a lack of plant tissue. Cuttings have been propagated in an *ex situ* collection from all subpopulations of *L. sp.* Main Range present in NSW at the Mt Annan and Limpinwood Gardens Nurseries (Gavin Phillips *in litt.* July 2020).

## **Populations and evidence of decline**

There are thought to be two populations of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877), as identified from herbarium specimen data and survey information (Gavin Phillips *in litt.* May 2018; STC 2020). One population occurs across four sites in Main Range National Park in Qld. The second population occurs across ten sites in Limpinwood Nature Reserve and Lamington National Park in NSW and there is a single individual in the Border Ranges National Park at Mount Lindesay (see Table 1 below).

*Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is naturally found in small, isolated subpopulations across the restricted range of mossy cloud thicket habitat within the larger populations (Luis Weber *in litt.* May 2018). The two larger populations are also currently separated from each other by a distance of c. 68 km restricting the likelihood of gene flow.

By 2017/18, the four sites where repeat surveys of subpopulations of *L. sp.* Main Range (P.R.Sharpe+ 4877) have been conducted (Table 1) showed significant rates of decline in the species. Of 13 individuals assessed in repeat censuses in 2016 and 2019, 12 (92%) have likely died, including six confirmed dead and six in poor health

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now likely to be dead; Table 1). This decline is attributed to infection by the rust-fungus *Austropuccinia psidii* (myrtle rust) – see **Threats** section for details. It is reasonably suspected that this population will continue to decline rapidly because of infection by *A. psidii*. Surveys of populations in the Main Range National Park are also required to assess decline as this population has not been re-surveyed since 1994.

Rates of mortality and decline of multiple individuals in the Limpinwood Nature Reserve-Lamington National Park population of *L. sp.* Main Range (P.R.Sharpe+ 4877) have been documented over a short period of time relative to the generation time for the species (i.e. 59% mortality or serious defoliation over a period of three years (2016-2019)); see Table 1 below. The generation length of *L. sp.* Main Range (P.R.Sharpe+ 4877) is inferred to be 40 years based on expert-derived conservative assumptions of life span (up to 100 years) and observations of growth rate in cultivated specimens (at least 20 years to flower and fruit) (Luis Weber May 2018 *pers. comm.* to the Nominator). Soil-stored seed banks are unlikely to be present for this species given its affinity for rainforest environments. It is unlikely that the small, bony seeds of *Lenwebbia* species would survive more than a couple of seasons in the soil seed bank (Graeme Errington, May 2018, *pers. comm.* to the Nominator).

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Table 1: *Lenwebbia* sp. Main Range sites and rates of decline

Site/ (Popn)	Site name	Initial known numbers [year]	Most recent observed numbers (Adult/Juv) [year]	Observed decline	Obs. period	Putative status of popn.
1 (1)	Mt Cordeaux (Qld)	~1 [1994]	Unknown	Unknown	N/A	Unknown
2 (1)	Spicers Peak (Qld)	~1 [1995]	0 [2020]	100%	N/A	Unknown
3 (1)	Mt Steamer (Qld)	~1	Unknown	Unknown	N/A	Unknown
4 (1)	Mt Roberts (Qld)	~1	Unknown	Unknown	N/A	Unknown
5 (1)	Wilsons Peak (Qld)	8 [1994]	8Ad/5Juv [2019]	Only one healthy individual with >90 canopy cover remains	25 yrs	Unknown
6	Mt Lindesay (NSW)	~1 [2019]	1Ad [2019]	Unknown	N/A	Critical
7 (2)	Echo Point (NSW)	6 [2016]	10 (2017, 1 healthy) 8Ad/3Juv [2019]	Only two healthy individuals with >90 canopy cover remain	3 yrs	Critical
8 (2)	Cominan Lookout (NSW)	1 [2019]	1Juv [2019]	0%	N/A	Unknown
9 (2)	Mt Wupawn (NSW)	4 [2019]	3Ad/1Juv [2019]	Only one healthy individual with >90 canopy cover remains	N/A	Unknown
10 (2)	Mt Worendo (NSW)	4 [2019]	3Ad/1Juv [2019]	Only one healthy individual with >90 canopy cover remains	N/A	Unknown
11(2)	Mt Wanungara (NSW)	1 [2016]	1 [2019 juvenile plant]	Unknown	3 yrs	Critical

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12(2)	Border Track (NSW)	4 [2019]	4Juv [2019]	0%	N/A	Unknown
13(2)	Dacelo Point (NSW)	5 [2016]	1 [2019]	100%	3 yrs	Critical
14(2)	Mt Merino (NSW)	1 [2016]	1Ad/2 Juv [2019]	0% (1 healthy individual with immature fruit)	3 yrs	Critical
15(2)	Mt Wagawn (NSW/Qld)	Unknown	0Ad/0Juv	Unknown	N/A	Unknown
16(2)	Joalah Lookout (Qld)	1 [2004, healthy]	1, [2013 healthy; 2016 80% defoliated; 2018 90% defoliated; 2019 dead]	100%	15 yrs	Extinct

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Under these reported rates of decline in the eastern population of *L. sp.* Main Range (P.R.Sharpe+ 4877) it is reasonably suspected that it may undergo a 100% reduction in size within 3 three generations. If the Limpinwood Nature Reserve and Lamington National Park population declines to extinction, which is reasonably inferred from observations, this could result in an overall reduction of known individuals of *L. sp.* Main Range (P.R.Sharpe+ 4877) from 28 to 17 (62%) provided that the Main Range National Park population is not suffering similar decline.

## **AOO and EOO estimates**

*Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) has a highly restricted geographic distribution.

The extent of occurrence (EOO) is estimated to be 1934 km<sup>2</sup>. The EOO is estimated based on a minimum convex polygon enclosing all mapped and known occurrences of the species, the method of assessment recommended by IUCN (2019).

The area of occupancy (AOO) was estimated to be 52 km<sup>2</sup>. This calculation was based on the species occupying 13 (2 x 2 km) grid cells, the spatial scale of assessment recommended by IUCN (2019).

The AOO and EOO of *L. sp.* Main Range (P.R.Sharpe+ 4877) may also undergo dramatic decline within one generation. Extinction of the Limpinwood Nature Reserve-Lamington National Park population would result in a reduction in EOO to 262 km<sup>2</sup> and in AOO to 20 km<sup>2</sup>. This would represent an 86% reduction of EOO and 62% reduction of AOO.

## **Ecology**

*Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is a narrow-range endemic, restricted to the Border Ranges region on the NSW-Qld border from 900-1200 m a.s.l (Luis Weber *in litt.* May 2018). The species is a shrub or small tree which occurs in high altitude rainforest in microphyll mossy thickets on steep slopes (PlantNET 2020) and in stunted cloud forest thickets (Gavin Phillips *in litt.* May 2018). Under the Webb (1959) rainforest classification, the vegetation communities the species is known to occur in are classified as Microphyll Mossy Fern Thickets and Nanophyll Mossy Thickets Luis Weber *in litt.* May 201). Additionally, a small number of herbarium collections note the species growing on the margins of Sclerophyll Montane Shrubland (heath) including *Leptospermum* and *Pomaderris* species. One collection in the Main Range National Park in Qld notes Complex Notophyll Vine Forest (subtropical rainforest) as habitat. All known occurrences are on rocky outcrops along exposed escarpment cliff lines and on the wet cliffs or steep slopes immediately below. The substrate is typically skeletal peaty deposits on volcanics (either basalt or rhyolite), with most sites being on south facing, aspects.

Associated species at the Limpinwood Nature Reserve-Lamington National Park population include *Archirhodomyrtus beckleri*, *Acmena smithii*, *Cassinia compacta*, *Leptospermum petersonii*, *Leucopogon spathaceus*, *Leucopogon* sp. Lamington (G.Leiper AQ633386), *Olearia elliptica*, *Prostanthera ovalifolia*, *Tristaniopsis collina*, *Uromyrtus lamingtonensis* and *Xanthorrhoea latifolia* subsp. *maxima*. (Mallee 2017).

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The species has also been found with *Leptospermum petersonii* at Wilsons Peak in Main Range National Park (Luis Weber *in litt.* May 2018).

*Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is a slow growing species, with cultivated specimens taking considerable time to sprout either new growth or coppice suckering. One transplanted individual grew approximately 15 cm in an 18-month period and no cultivated plants have been seen to flower or fruit, with these only ever being observed on larger, healthy individuals in the wild (Luis Weber May 2018 *pers. comm.* to the Nominator).

*Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) has purple-black, fleshy fruits about 5-7 mm diameter (Harden *et al.* 2015) which contain small, bony seeds like other *Lenwebbia* species (PlantNET 2020). It is probable that these fruits are bird or animal dispersed, so the likelihood of wide-ranging dispersal is high where bird/animal movement occurs across similar habitat. The seeds also display a morphophysiological dormancy which is little understood (Graeme Errington *in litt.* May 2018). Morphophysiological dormant seeds require both time after seeds are released for the embryo to grow and a physiological cue to break dormancy (Willis *et al.* 2014). The seeds are known to respond to treatment by gibberellic acid in germination trials, so it is likely a biotic factor is involved in inducing seed aspiration but the identity of this factor is currently unknown (N. Emery *in litt.* May 2018).

## Threats

### Myrtle Rust – current threat

The ‘Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae’ is listed as a Key Threatening Process under the Biodiversity Conservation Act (listed 15/4/2011). *Austropuccinia psidii* (Myrtle Rust) was first detected in Australia on the NSW Central Coast in May 2010 and has since established in natural ecosystems throughout coastal NSW, south-east Queensland, and far north Queensland (Carnegie and Lidbetter 2012; Pegg *et al.* 2014). *A. psidii* also has a limited distribution in Victoria, Tasmania and the Northern Territory (Carnegie *et al.* 2016). Species in the genus *Lenwebbia* are known hosts of *A. psidii* (Pegg *et al.* 2014).

Severe infection of *L. sp.* Main Range (P.R.Sharpe+ 4877) by *Austropuccinia psidii* has been seen by expert botanists conducting surveys of the species (Weber 2016, 2018). Mortality and severe decline as a result of *A. psidii* infection have been documented in the Limpinwood Nature Reserve-Lamington National Park population (see Table 1 - Rates of decline in *L. sp.* Main Range (P.R.Sharpe+ 4877)). Most plants observed have been seen to be heavily infected and defoliated from the rust, with some of the healthiest individuals having a complete defoliation observed in less than 5 years (Weber 2018). Almost all currently known plants are in some stage of myrtle rust induced defoliation (Weber 2016, 2018) and currently none have been observed to show any recovery. Recruitment is likely to be heavily affected by myrtle rust preventing the formation of fruits and flowers as it appears to do in the related



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*Lenwebbia* sp. Blackall Range (P.R.Sharpe 5387) (Weber and Box 2016; G. Leiper, *in litt.* May 2018).

The presence of *Austropuccinia psidii* infection in the Main Range population is unknown but given the known presence of *A. psidii* in this region surveys are urgently needed to assess likely rates of decline or mortality. All known populations of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) are considered to be at risk from *A. psidii* infection with all known occurrences located within 10 km from recorded myrtle rust (STC 2020).

The susceptibility of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) has not been established in experimental trials, however one member of the genus (*L. prominens*) is categorised as 'Highly Susceptible' to *Austropuccinia psidii* infection and two others (*L. lasioclada*, *L. sp.* Blackall Range (P.R.Sharpe 5387)) are considered 'relatively tolerant' (Pegg *et al.* 2014). *L. sp.* hybrids appear to be less susceptible to Myrtle Rust infection (Luis Weber, *pers. comm.* July 2020).

It is reasonably suspected that current documented rates of mortality due to *Austropuccinia psidii* infection will continue across the Limpinwood Nature Reserve-Lamington National Park population which may eventually restrict the geographic distribution, habitat quality or diversity, or genetic diversity of populations. Multiple factors indicate that the rapid decline of *L. sp.* Main Range (P.R.Sharpe+ 4877) is likely to continue. These factors include:

### ***Lack of effective or practical control***

No effective or practical chemical, biological or management control is currently available for protecting populations of *Lenwebbia* sp. Main Range (P.R.Sharpe +4877) in natural ecosystems from *Austropuccinia psidii* infection. Repeated monthly application of registered fungicides (e.g. triadimenol) for extremely high value assets concentrated in small local areas may be feasible but is impractical for widespread control. Where triadimenol has been used in experimental trials of *A. psidii* control in natural populations of other myrtaceous species applications repeated at longer than a monthly interval did not control infection (Carnegie *et al.* 2016). In the absence of an effective control strategy for *A. psidii* further rapid reductions of *L. sp.* Main Range (P.R.Sharpe+ 4877) populations and individuals are highly likely.

The ubiquity of susceptible species in the family Myrtaceae in the Australian landscape makes broad-scale eradication or containment of *Austropuccinia psidii* unlikely (Glen *et al.* 2007). Surviving plants and populations of *L. sp.* Main Range (P.R.Sharpe+ 4877) will continue to be subject to spore load (whether as wind-borne spores or by other vectors) from other species which severely reduces the likelihood of population recovery. Whilst some biological control agents have been trialled in other countries to control *A. psidii* in *Eucalyptus* plantations the likelihood that these controls will become viable options for eradication in Australia in the time frame relevant to the regeneration capacity of *L. sp.* Main Range (P.R.Sharpe+ 4877) are negligible (Glen *et al.* 2007). Manipulation of the environment via management actions (e.g. fire

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management) to control *A. psidii* on established trees would likely lead to high infection rates on highly susceptible resprouting leaf material (Carnegie *et al.* 2016).

## **Inadequate ex-situ collections**

No adequate *ex-situ* collections of *L. sp.* Main Range (P.R.Sharpe+ 4877) exist (Gavin Phillips *in litt.* April 2018). There are no current holdings of wild-collected seed at the NSW Seedbank at Mt Annan, and myrtaceous taxa from rainforest environments are characterised by seeds which are desiccation-intolerant and, therefore, not suited to long-term conservation storage (Sommerville and Offord 2014). Remaining healthy branches were sampled from the Limpinwood Nature Reserve-Lamington National Park population in 2018 for tissue culture collections which are currently held within the NSW PlantBank at the Australian Botanic Garden, Mount Annan NSW.

## **Trampling – current threat**

Trampling of individuals has been observed on juvenile plants at Echo Point Lookout causing minor damage (Mallee 2017).

## **Inappropriate fire regimes**

Fires may encroach into the wetter rainforest, mossy thickets and cloud forest areas where *Lenwebbia sp.* Main Range (P.R.Sharpe+ 4877) occurs. The 2019-20 wildfire burnt the Mount Lindesay area and a second event sparked from a campfire, in August 2019, burnt Echo Point (Buch, *pers. comm.* Jun 2020). These fires are not believed to have burnt *L. sp.* Main Range (P.R.Sharpe+ 4877) at these sites (Weber, *pers. comm.* July 2020). The impact of *Austropuccinia psidii* is known to be exacerbated after fire with regenerating seedlings and resprouting shoots often being highly susceptible to infection (Fernandez Winzer *et al.* 2018).

## **Climate Change – future potential threat**

'*Anthropogenic Climate Change*' is listed as a Key Threatening Process under the Act (listed 3/11/2000). Changes to temperate and rainfall patterns predicted under climate change (Whetton *et al.* 2015; Adapt NSW 2020) have the potential to reduce the extent of the very restricted damp environments in which *L. sp.* Main Range (P.R.Sharpe+ 4877) occurs. Reductions in the amount of cloud moisture/rain days or increases in damaging storm activity have the potential to adversely alter the habitat available to *Lenwebbia sp.* Main Range (P.R.Sharpe+ 4877) at all known sites. With an expected increase in temperature, the elevation where there is cloud cover is predicted to rise (Pounds *et al.* 1999; Richardson *et al.* 2003; Laidlaw *et al.* 2011; Tanner-McAllister *et al.* 2018) exposing the habitat of *L. sp.* Main Range (P.R.Sharpe+ 4877) to extended periods of drier conditions and diminishing habitat for the species over time. An increase in spring and autumn rainfall and a decrease in winter rainfall are predicted for the North Coast (Adapt NSW 2020). The area at Mount Merino is prone to landslide and cliff collapse and the risk of this occurring would be highest following very heavy rainfall events such as cyclones and east coast lows. The proportion of east coast lows that are of high intensity is expected to increase (Tanner-McAllister *et al.* 2018; Adapt NSW 2020; Dowdy *et al.* 2015), potentially increasing the risk of land slips.

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## **Assessment against IUCN Red List criteria**

For this assessment is it considered that the survey of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) has been adequate and there is sufficient scientific evidence to support the assessment outcome.

### Criterion A Population size reduction

Assessment Outcome: Critically Endangered under Criterion A3(c)(e).

Justification: To be listed as Critically Endangered under Criterion A the species must have experienced a population reduction of > 80% over three generations or 10 years (whichever is longer) up to a maximum of 100 years (IUCN 2019). The generation length is reasonably inferred to be 40 years in this species which is likely to undergo population reduction of 100% (Critically Endangered threshold) over 100 years. A decline of 59% of individuals has been documented over a three-year period in one of the two known populations.

### Criterion B Geographic range

Assessment Outcome: Endangered under Criterion B1(a)(b)(i-v) and B2(a)(b)(i-v).

Justification: *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) has a highly restricted geographic range.

Extent of Occurrence: The extent of occurrence (EOO) for *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is estimated to be 1934 km<sup>2</sup> which meets the EOO threshold for Endangered under Criterion B1.

Area of Occupancy: The area of occupancy (AOO) for *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is estimated to be 52 km<sup>2</sup> (based on the species occupying 13 (2 x 2 km) cells, the scale of measurement recommended by IUCN (2019)). To be listed as Endangered under Criterion B2 a species must have an AOO of <500 km<sup>2</sup> and >10 km<sup>2</sup>. *L. sp. Main Range* (P.R.Sharpe+ 4877) meets the AOO threshold for Endangered under Criterion B2.

In addition to these thresholds, at least two of three other conditions must be met.

These conditions are:

- a) The population or habitat is observed or inferred to be severely fragmented or number of locations = 1 (CR), ≤5 (EN) or ≤ 10 (VU).

Assessment Outcome: Sub criterion met at Critically Endangered threshold.

Justification: *Lenwebbia* sp. Main Range (P.R.Sharpe 4877+) population is found at a single location. All subpopulations are at risk from the single threat

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of infection by myrtle rust which has the potential to eliminate or severely reduce the population within a single generation of approximately 40 years. The *L. sp. Main Range* (P.R.Sharpe+ 4877) population is also considered to be severely fragmented with the two main populations being separated by 68 km.

- b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals

Assessment Outcome: Sub criterion (i)(ii)(iii)(iv)(v) met.

Justification: *Lenwebbia sp. Main Range* (P.R.Sharpe+ 4877) is projected to have a continued decline in extent of occurrence, area of occupancy, extent and quality of habitat, number of subpopulations and number of mature individuals. The loss of the Limpinwood-Lamington populations represents an overall estimated decline in AOO of 62% and EOO of 86%. The area and extent of suitable habitat is projected to decline due to the impact of anthropogenic climate change through reductions in the amount of cloud moisture/rain days. The number of subpopulations of *L. sp. Main Range* (P.R.Sharpe+ 4877) is projected to decline based on mortality from the impact of myrtle rust infection as evidenced by the number of mature individuals observed to have died or to have significant canopy decline.

- c) Extreme fluctuations.

Assessment Outcome: Data deficient.

Justification: Currently there is no available data to assess the likelihood of extreme fluctuations in *Lenwebbia sp. Main Range* (P.R.Sharpe+ 4877).

## Criterion C Small population size and decline

Assessment Outcome: Critically Endangered under Criterion C1 and C2(a)(i).

Justification: Although the total population of *Lenwebbia sp. Main Range* (P.R.Sharpe+ 4877) is unknown, it is estimated to be less than 100 mature plants. The observed number of individuals across the known range of *L. sp. Main Range* (P.R.Sharpe+ 4877) is approximately 20-30 in NSW and 5-10 in Qld. *L. sp. Main Range* (P.R.Sharpe+ 4877) meets the total population threshold for listing as Critically Endangered.

At least one of two additional conditions must be met. These are:

- C1. An observed, estimated or projected continuing decline of at least 25% in 3 years or 1 generation (up to a max. of 100 years in future).

Assessment Outcome: Criterion met at Critically Endangered threshold.

Justification: The observed impact of infection from myrtle rust has led to a 59% decline (exceeding the >25% Critically Endangered threshold) in the number of mature individuals in the Limpinwood Nature Reserve-Lamington National Park population between 2016 and 2019 and the generation time of *L. sp. Main Range* (P.R.Sharpe+ 4877) is reasonably inferred to be 40 years.

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C2. An observed, estimated, projected or inferred continuing decline

Assessment Outcome: Criterion met (IUCN C2(a)(i).

Justification: The observed impact of infection from myrtle rust has led to a decline in the number of mature individuals in the Limpinwood Nature Reserve-Lamington National Park population since 2013 and 2016 surveys.

In addition, at least 1 of the following 3 conditions:

- a (i) Number of mature individuals in each subpopulation <50 (CR), <250 (EN) or <1000 (VU).

Assessment Outcome: Sub criterion met Critically Endangered threshold.

Justification: There are no recorded populations that have more than 50 mature plants.

- a (ii). % of mature individuals in one subpopulation = 90-100% (CR), 95-100% (EN), 100% (VU).

Assessment Outcome: Sub criterion not met.

Justification: Individuals are spread over two populations. *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) does not meet this criterion.

- b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Data Deficient.

Justification: Currently there is no available data to assess the likelihood of extreme fluctuations in *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877).

Criterion D Very small or restricted population

To be listed as Vulnerable, a species must meet at least one of the two following conditions:

D1. Population size estimated to number fewer than 1,000 mature individuals

D2. Restricted area of occupancy (typically <20 km<sup>2</sup>) or number of locations (typically <5) with a plausible future threat that could drive the taxon to CR or EX in a very short time.

Assessment Outcome: Critically Endangered under Criterion D1.

Justification: The total number of mature individuals of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is estimated to be approximately 40 individuals and the number of wild individuals with some resistance to myrtle rust that are actually able to reproduce is probably less than 10 (Gavin Phillips *in litt.* July 2020). To be listed under Criterion D1 as Critically Endangered species must have <50 mature individuals. While there is the potential for the population to be larger, up to 100 individuals, due to the extent of suitable remote habitat across its range and difficulty in accurately surveying, this upper bound cannot be used for assessing

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the IUCN criteria. Many of the existing populations in Limpinwood Nature Reserve-Lamington National Park have experienced defoliation of up to 90%. Severe *Austropuccinia psidii* infection prevents the formation of fruits and flowers so these infected adult plants cannot be counted as mature individuals because they will never produce new recruits (IUCN 2019).

Assessment Outcome: Vulnerable under Criterion D2.

Justification: *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) meets the Vulnerable threshold under Criterion D2 as it occurs at only a single location at risk from infection by myrtle rust which could drive the taxon to Critically Endangered or Extinct within a single generation of approximately 40 years.

## Criterion E Quantitative analysis

Assessment Outcome: Data Deficient.

Justification: Currently there is not enough data to undertake a quantitative analysis to determine the extinction probability of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877).

## Conservation and Management Actions

There is currently no NSW Saving Our Species site-managed program for *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877). The following actions are derived from threat information.

### Habitat loss, disturbance and modification

- Develop hygiene protocols to minimise spread of Myrtle Rust following guidance in the Myrtle Rust Action Plan (Makinson 2018).

### Invasive species

- Weed control measures at known sites must ensure adequate hygiene protocols to minimise spread of Myrtle Rust.

### Ex situ conservation

- Support establishment of *ex situ* living collection that is geographically and genetically representative.
- Secure germplasm of any detected or suspected resistant individuals.

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- Inform landowners and managers of sites where there are known populations and consult with these groups regarding options for conservation management and protection of the species and identification of occurrence of myrtle rust.
- Provide up to date information on best phytosanitary practices for reducing risk of spread of myrtle rust.

## Survey and Monitoring priorities

- Establish permanent monitoring sites to track decline (utilising Carnegie *et al.* (2016) sites and permanent plot/transect sites).
- Conduct field survey for any new populations or individuals of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877).
- Conduct survey and monitoring of known populations for any populations exhibiting low levels of Myrtle Rust infection or resistance.

## Information and Research priorities

- Seek resources for genetic and physiological research into the resistance and susceptibility of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) to Myrtle Rust.
- Understand the best techniques for long term seed and/or tissue storage. Investigate and implement options for tissue culture and/or inter-situ live collections (in sites amenable to fungicidal management), as alternatives to seed banking if the species proves storage-intolerant, and/or as resources for seed production and resistance studies.
- Conduct research into Myrtle Rust disease control.
- Conduct research into the species recruitment, seed bank dynamics and seed dormancy, seed dispersal mechanics and distances, pollinators, life history and generation lengths.
- Collect material to conduct genetic studies to determine the infrageneric position of the species and the degree to which it may be suffering from hybridisation with *L. prominens*.

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## Appendix 1

### Assessment against the Act criteria

The Clauses used for assessment are listed below for reference.

#### Overall Assessment Outcome:

*Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) was found to be Critically Endangered under Clause(s) 4.2(1)(a)(2)(c)(e), 4.4(a)(d)(i)(e)(i)(ii)(A)(i) and 4.5(a).

#### Clause 4.2 – Reduction in population size of species

(Equivalent to IUCN criterion A)

**Assessment Outcome: Critically Endangered under Clause 4.2(1)(a)(2)(c)(e).**

<b>(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:</b>			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or
	(c)	for vulnerable species	a moderate reduction in population size.
<b>(2) - The determination of that criteria is to be based on any of the following:</b>			
	(a)	direct observation,	
	(b)	an index of abundance appropriate to the taxon,	
	(c)	a decline in the geographic distribution or habitat quality,	
	(d)	the actual or potential levels of exploitation of the species,	
	(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.	

#### Clause 4.3 - Restricted geographic distribution of species and other conditions (Equivalent to IUCN criterion B)

**Assessment Outcome: Endangered under Clause 4.3(b)(d)(e) (i)(ii)(iii)(iv).**

<b>The geographic distribution of the species is:</b>			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
<b>and at least 2 of the following 3 conditions apply:</b>			
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,	
	(e)	there is a projected or continuing decline in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	habitat area, extent or quality,
		(iv)	the number of locations in which the species occurs or of populations of the species,

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	(f)	extreme fluctuations occur in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	the number of locations in which the species occur or of populations of the species.

**Clause 4.4 - Low numbers of mature individuals of species and other conditions**

**(Equivalent to IUCN criterion C)**

**Assessment Outcome: Critically Endangered under Clause 4.4(a)(d)(i)(e)(i)(ii)(A)(i).**

<b>The estimated total number of mature individuals of the species is:</b>			
	(a)	for critically endangered species	very low, or
	(b)	for endangered species	low, or
	(c)	for vulnerable species	moderately low,
<b>and either of the following 2 conditions apply:</b>			
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):	
		(i)	for critically endangered species very large, or
		(ii)	for endangered species large, or
		(iii)	for vulnerable species moderate,
	(e)	both of the following apply:	
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and
		(ii)	at least one of the following applies:
		(A)	the number of individuals in each population of the species is:
			(i) for critically endangered species extremely low, or
			(ii) for endangered species very low, or
			(iii) for vulnerable species low,
		(B)	all or nearly all mature individuals of the species occur within one population,
		(C)	extreme fluctuations occur in an index of abundance appropriate to the species.

**Clause 4.5 - Low total numbers of mature individuals of species**

**(Equivalent to IUCN criterion D)**

**Assessment Outcome: Critically Endangered under Clause 4.5(a).**

<b>The total number of mature individuals of the species is:</b>			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

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## **Clause 4.6 - Quantitative analysis of extinction probability (Equivalent to IUCN criterion E)**

**Assessment Outcome: Data deficient**

<b>The probability of extinction of the species is estimated to be:</b>			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

## **Clause 4.7 - Very highly restricted geographic distribution of species (Equivalent to IUCN criterion D2)**

**Assessment Outcome: Vulnerable under Clause 4.7.**

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.
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