Publication date: 30/10/2020

Notice and reasons for the Final Determination

The NSW Threatened Species Scientific Committee, established by the Biodiversity Conservation Act 2016 (the Act), has made a Final Determination to list the tree *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act. Listing of Critically Endangered species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Lenwebbia sp. Main Range (P.R.Sharpe+ 4877) Qld herbarium was found to be eligible for listing as Critically Endangered under Clauses 4.2 (1)(a)(2)(c) (e), 4.4 (a)(d)(i)(e)(i)(ii)(A)(i) and 4.5 (a). The main reasons for this species being eligible are: i) the species has a highly restricted geographical distribution; ii) there is estimated to be a low number of mature individuals; iii) subpopulation sizes are estimated to be very low; iv) there is continuing severe decline in Area Of Occupancy, Extent Of Occurrence, the number of subpopulations, and the number of mature individuals due to the impact of *Austropuccinia psidii* (myrtle rust).

The Scientific Committee has found that:

1. *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is described on PlantNET (2020) 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.” *L.* 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 collection notes mention 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. Lenwebbia sp. Main Range (P.R.Sharpe+ 4877) was previously included in *L. lasioclada* which is now known to be a distinct species and endemic to the Wet Tropics Bioregion (Luis Weber *in litt.* May 2018). 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.

2. *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is currently known to occur on volcanic escarpments between Wilsons Peak and Mount Cordeaux, north of Cunninghams Gap in the Main Range National Park in south-eastern Qld (approximately 50 km east of Warwick), and also at Mount Lindesay and along the New South Wales (NSW)-Queensland (Qld) 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. *L*. sp. Main Range (P.R.Sharpe+ 4877) occurs at a single location with all sites at risk of infection by *Austropuccinia psidii* (myrtle rust).

3. *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is a narrow-range endemic which occurs in high altitude vegetation (900-1200m a.s.l) 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, exposed aspects. Suitable habitat for *L.* sp. Main Range (P.R.Sharpe+ 4877) primarily occurs in Microphyll Fern Mossy Thickets, and Nanophyll Mossy Thickets (Webb 1959). A small number of herbarium collections note the species growing on the margins of Sclerophyll Montane Shrubland (Webb 1959). One collection in the Main Range National Park in Qld notes Complex Notophyll Vine Forest (Webb 1959) as habitat. Notes recorded with herbarium specimens of *L.* sp. Main Range (P.R.Sharpe+ 4877) state that it occurs in association with *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*.

4. *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is a slow growing species, with cultivated specimens taking considerable time to produce new growth or coppice suckering. The fruit are purple-black and fleshy and contain small, bony seeds like other *Lenwebbia* species (PlantNET 2020). The seeds display a morphophysiological dormancy which is little understood (G. Errington May 2018 *pers. comm.* to the nominator) and it is likely they are dispersed over large distances by vertebrates. *L.* sp. Main Range (P.R.Sharpe+ 4877) is thought to be an obligate seeder due to the lack of a significant soil seedbank at sites where it is known to occur.

5. The abundance of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) across its range is unknown but is reasonably inferred 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 the species is approximately 20-30 in NSW and 5-10 in Qld (L. 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. 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 (Weber and Box, 2016). 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 northern NSW (Weber and Box 2016).

6. Two populations of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) are currently documented, identified from herbarium specimen data and survey information (G. Phillips *in litt*. May 2018). One population occurs across five sites Limpinwood Nature Reserve and Lamington National Park in NSW. There is also a single individual in the Border Ranges National Park at Mount Lindesay. The two populations are isolated from each other by a minimum distance of c. 68 km which reduces the likelihood of gene flow. Despite this, the two populations are considered a single location as they are at risk from the common threat of infection by *Austropuccinia psidii* (myrtle rust) which has the potential to eliminate or severely reduce both populations within a single generation of approximately 40 years.

7. *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) has a highly restricted geographic distribution. The extent of occurrence (EOO) is estimated to be 1,934 km^2. 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^2. This calculation was based on the species occupying 13 (2 x 2 km) grid cells, the spatial scale of assessment recommended by IUCN (2019).

8. *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is severely threatened by infection from the exotic rust fungus *Austropuccinia psidii* (myrtle rust). 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 Act. *A. psidii* was first detected in Australia on the NSW Central Coast in April 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).

9. Species in the genus *Lenwebbia* are known hosts of *Austropuccinia psidii* and are characterised as both 'Highly Susceptible' (*L. prominens*) to 'Relatively Tolerant' (*L. lasioclada*, *L. sp. Blackall Range*) to infection (Pegg *et al*. 2014). Plants have been documented as being affected by *A. psidii* infection by botanists surveying *L.* sp. Main Range (P.R.Sharpe+ 4877) populations (Weber and Box, 2016).

10. Infection by *Austropuccinia psidii* (myrtle rust) has led to a rapid decline of the population of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) in Limpinwood Nature Reserve-Lamington National Park between botanical surveys in 2013, 2016 and 2018. It is reasonably suspected that this population will continue to decline rapidly because of infection by *A. psidii* as the number of individuals of reproductive age with some resistance to myrtle rust is probably <10 (G. Phillips *in litt*. July 2020). Surveys of populations in the Main Range National Park Qld are required to assess decline there.

11. Rates of mortality and decline of multiple individuals as a result of the impact of myrtle rust infection in the Limpinwood Nature Reserve-Lamington National Park

population of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) have been documented over a short period of time relative to the generation length of the species (i.e. 59% mortality or serious defoliation over a period of three years (2016-2019)). 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) (L. Weber May 2018 *pers. comm.* to the nominator). Soil-stored seed banks are unlikely to be extensive for this species given its affinity for rainforest environments with high litter decomposition rates. It is unlikely that the small, bony seeds of *Lenwebbia* species would survive more than a couple of seasons in the soil seedbank (G. Errington, May 2018, *pers. comm.* to the nominator).

12. Under these reported rates of decline in one of the two only known populations of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) it is to reasonable to infer the species will undergo a 100% reduction in size within three generations (up to a maximum of one hundred years). If this 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) of approximately 62% (provided the Main Range National Park population is not suffering similar decline). 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^2 (86%) and in AOO to 20 km^2 (62%).

13. 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. pisdii* control in natural populations of other myrtaceous species, applications repeated at longer than a monthly interval did not control infection (Carnegie *et al*. 2016). Whilst some biological control agents have been trialled to control *A. psidii* in eucalyptus plantations overseas 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) is negligible (Glen *et al*. 2007). 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.

14. 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). The predominantly airborne nature of the rust spores and inadvertent dispersal by human activity (Carnegie and Cooper 2011) infers that *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) populations and individuals in conservation reserves may be no more secure than any other land tenure. It is expected that surviving plants and populations of *L.* sp. Main Range (P.R.Sharpe+ 4877) will continue to be subject to a significant spore load, whether as wind-borne

spores or by other vectors. This continued exposure severely reduces the likelihood of population recovery in *L.* sp. Main Range (P.R.Sharpe+ 4877).

15. No adequate *ex-situ* collections of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) (G. Phillips *in litt.* April 2018). There are no current holdings of wild-collected seed at the NSW Seedbank 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.

16. Individual plants of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) in the Limpinwood Nature Reserve-Lamington National Park population are also threatened by trampling from park visitors. Trampling of individuals has been observed on juvenile plants at Echo Point Lookout causing minor damage (Mallee 2017).

17. The long-term persistence of *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is threatened by predicted changes to temperature and rainfall patterns under climate change (Whetton 2015; Adapt NSW 2020). Changing weather patterns have the potential to reduce the extent of the already restricted damp environments in which *L. sp*. Main Range (P.R.Sharpe+ 4877) occurs. Projected changes in the amount of rainfall or increase in damaging storm activity have the potential to adversely alter *L.* sp. Main Range (P.R.Sharpe+ 4877) habitat at all known locations where it occurs. '*Anthropogenic Climate Change'* is listed as a Key Threatening Process under the Act.

18. *Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) is eligible to be listed as a Critically Endangered species as, in the opinion of the Scientific Committee, it is facing a very high risk of extinction in Australia in the immediate future as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017:*

Appendix 1
Assessment against Biodiversity Conservation Act criteria
The Clauses used for assessment are listed below for reference.

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).

(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:			
	(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.
(2) - The determination of that criteria is to be based on any of the following:			
	(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).

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
and at least 2 of the following 3 conditions apply:			
	(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,
	(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).

The estimated total number of mature individuals of the species is:						
	(a)	for critically endangered species			very low, or	
	(b)	for endangered species			low, or	
	(c)	for vulnerable species			moderately low,	
and either of the following 2 conditions apply:						
	(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).

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

Clause 4.6 - Quantitative analysis of extinction probability
(Equivalent to IUCN criterion E)
Assessment Outcome: Data deficient

The probability of extinction of the species is estimated to be:			
	(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.

Dr Anne Kerle
Chairperson
NSW Scientific Committee

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A notice of determination to provisionally list this species as a critically endangered species was gazetted on 09/11/2018