Conservation Assessment of *Homoranthus bruhlii*

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***Homoranthus bruhlii* L.M.Copel. (Myrtaceae)**
Distribution: Endemic to NSW
Current EPBC Act Status: Not listed
Current NSW BC Act Status: Not listed

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

Conservation Advice: *Homoranthus bruhlii*

Summary of Conservation Assessment

Homoranthus bruhlii was found to be eligible for listing as Critically Endangered under Criterion D. The main reason for this species being eligible is: i) the species is known from a single population with an extremely low population size. Total population is estimated to be approximately 20 plants.

Description and Taxonomy

Homoranthus bruhlii was described by Copeland *et al.* (2011) as an "*Erect shrub*, 0.4–0.7m tall, 0.3–0.6m wide, glabrous. *Leaves* opposite, decussate, punctate, aromatic, laterally compressed, 7–12mm long, 0.2–0.4mm wide, 0.8–1.3mm thick, linear, mucronate, petiolate, pale green; blade in side view incurved linear to narrow-elliptic; petiole 0.5–0.8mm long. *Flowering branchlets* undifferentiated, with (2–)3–4 flowers held erect in leaf axils at branchlet apex. *Inflorescence* a monad; peduncles 0.9–1.3mm long; bracteoles caducous, 4–7mm long, pale yellow–green, slightly glaucous. *Hypanthium* cylindrical, 5-costate, smooth between the ribs, glabrous, 4.5–6.5mm long, pale yellow–green. *Sepals* 5, 3–4mm long, pale yellow turning bright red with age, the apex distally laciniate with (2–)3(–4) slender processes. *Petals* 5, pale yellow, broadly obovate, obtuse, 2.0–2.5mm long, the margin entire. *Stamens* 10; filaments ~0.7mm long; anthers globose, basifixed, yellow. *Staminodes* 10, alternating with the stamens, distinctly adnate to the adjacent antepetalous stamen. *Style* 8–11mm long, exceeding the hypanthium by 4–6mm at anthesis, minutely hirsute below the papillose stigma, pale yellow. *Ovary* unilocular; placenta sessile, axile-basal, bearing 7–8(–10) ovules. *Fruit* a dry, indehiscent nut, brown."

Copeland *et al.* (2011) also note that "*Homoranthus bruhlii* is most similar to *H. elusus* from which it can be distinguished by its thicker leaves (0.8–1.4mm in *H. bruhlii* compared with 0.4–0.8mm in *H. elusus*). Flowers of *H. bruhlii* also have a smooth, glabrous hypanthium that lacks the rounded, multicellular trichomes of *H. elusus. H. bruhlii* is also similar to *H. croftianus* but that species has conspicuous, thin, unicellular trichomes between the hypanthium costae."

Distribution and Abundance

The description of the species by Copeland *et al.* (2011) states that it is "Currently known from a single population ~10 km west of Tenterfield [NSW]" and that "The species is currently known from a single population of ~20 plants over an area of <1 ha." Intensive botanical surveys (Hunter 2000, Hunter 2012) in two nearby Nature Reserves on similar geological substrates did not identify the species as present. *Homoranthus bruhlii* has only been recorded on private land and has not been recorded in the nearby Doctors Nose Mountain Nature Reserve, despite the presence of potentially suitable habitat there (Copeland *et al*. 2011).

The current status of the population of *Homoranthus bruhlii* is unknown, however the species is likely to persist, albeit in very low numbers (L. Copeland, pers. comm. May 2018). The geographic distribution of *H. bruhlii* is highly restricted. The area of occupancy was estimated to be 4 km^2, based on the species' occupying a single 2 x 2 km grid cell, the spatial scale of assessment recommended by IUCN (2019). The extent of occurrence (EOO) is also 4km^2. The EOO is reported as equal to AOO, despite the range of the species, measured by a minimum convex polygon containing all the known sites of occurrence, being less than AOO. The two figures are reported as equal in order to ensure consistency with the definition of AOO as an area within EOO, following IUCN Guidelines (2019).
The best estimate of abundance remains the 2011 estimate of approximately 20 individuals (Copeland *et al*. 2011).

Ecology

The description of the species by Copeland *et al.* (2011) states that "Plants grow in skeletal, sandy soil among crevices of a granite outcrop. Associated species include *Eucalyptus campanulata*, *E. scoparia*, *Boronia ledifolia s.l*., *Hibbertia acicularis s.l*. and *Lomandra longifolia*" and that "Flowers have been recorded in October and November, with fruits forming shortly afterwards."

The life history of H. bruhlii is not documented but other species of *Homoranthus* are known to be killed by fire (obligate seeders) which regenerate post-fire from persistent soil-stored seed banks (Fire Ecology Unit OEH 2010). The single known population of this species occurs in association with granite outcrops, which are associated with species typically killed by fire (Hunter 1999, Clarke 2002, Benwell 2007). Five congeneric species of *Homoranthus* are listed as sensitive to high frequency fire (return interval of <10 years) in the NSW Flora Fire Response Database (Fire Ecology Unit OEH 2010). Factors that govern recruitment after fire in *Homoranthus* are unknown, although fire cues such as heat shock (which promotes germination in the closely related *Darwinia* species, Auld & Ooi 2009) and smoke, along with temperature and rainfall, are likely to be important. The dispersal ability, life span and generation length are unknown for this species.

Threats

The description of the species by Copeland *et al.* (2011) states that "The species is threatened by an inappropriate fire regime, grazing by feral goats (*Capra hircus*) and critically low numbers."

Feral goats are present in the region and may pose a threat through trampling and browsing of plants and seedlings, although they have not been observed in the area where *H. bruhlii* has been recorded (L. Copeland, pers. comm. May 2018). Inappropriate fire regimes (i.e. too frequent: <5-10 years; or too infrequent: > life span of the species) also represent a threat to *H. bruhlii* (L. Copeland, pers. comm. May 2018), as obligate seeders are sensitive to fire that occurs too frequently or infrequently. The fire regime at the site of the only known population is unknown.

Assessment against IUCN Red List criteria

For this assessment, it is considered that the survey of *Homoranthus bruhlii* has been adequate and there is sufficient scientific evidence to support the listing outcome.

Criterion A Population Size reduction

Assessment Outcome: Data Deficient

Justification: There are insufficient data to assess population size reduction.

Criterion B Geographic range

Assessment Outcome: Near Threatened.

Justification: *Homoranthus bruhlii* is known only from a single location. The geographic distribution of *H. bruhlii* is very highly restricted. The area of occupancy is estimated to be 4 km^2, based on the species' occupying a single 2 x 2 km grid cell, the spatial scale of assessment recommended by IUCN (2019). The extent of occurrence (EOO) is also 4 km^2. The EOO is reported as equal to AOO, despite the range of the species, measured by a minimum convex polygon containing all the known sites of occurrence, being less than AOO. This is to ensure consistency with the definition of AOO as an area within EOO, following IUCN Guidelines (2019). Both EOO and AOO estimates fall below the thresholds for Critically Endangered (<100 km^2 and <10 km^2 respectively).

While there have been declines in the area, extent and quality of similar habitat in the surrounding area in the past, the species is not known to be experiencing a continuing decline. However, should further land clearing occur in habitat suitable for the species, this would constitute a continuing decline and the species would be eligible for listing as Critically Endangered under B1ab(iii)+2ab(iii).

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 there is 1 (CR), ≤5 (EN) or ≤10 (VU) locations.

   Assessment Outcome: Sub criterion met at Critically Endangered threshold.

   Justification: The species is known from a single population at one location. All plants could be impacted by a single threat such as a short fire return interval (<5-10 years) or a lack of fire during the entire life cycle or browsing by feral goats.

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: Data Deficient.

   Justification: While there have been past declines in area, extent and quality of habitat in the vicinity of the species only known population, there are no data available to assess if the species is currently experiencing a continuing decline.

c) Extreme fluctuations.

   Assessment Outcome: Sub criterion not met

Justification: There is no evidence at present to suggest the species undergoes extreme fluctuations.

Criterion C Small population size and decline

Assessment Outcome: Near Threatened

Justification: The most recent (2011) estimate of abundance found approximately 20 individuals. This falls below the threshold for Critically Endangered (<250 mature individuals) even if allowing an order of magnitude for survey error or population increase since the last observation. The species does not, however, qualify as Critically Endangered under the other conditions of this criterion because there are insufficient data to determine whether there has been or will be any continuing decline. There are a number of potential threats to the species that could be contributing to such declines, however due to the limited knowledge of its ecology and absence of population trajectory data, decline is currently unknown.

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 generations (whichever is longer) (CE); 20% in 5 years or 2 generations (whichever is longer) (EN); or 10% in 10 years or 3 generations (whichever is longer) (VU).

Assessment Outcome: Data Deficient.

Justification: The species has not been observed enough to assess the magnitude of any potential declines.

C2. An observed, estimated, projected or inferred continuing decline in number of mature individuals.

Assessment Outcome: Data Deficient.

Justification: There has only been a single count of the species population and there is little evidence to infer any past or future continuing declines in population size at present.

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 at CR threshold

Justification: Only 20 individuals have ever been observed.

a (ii). % of mature individuals in one subpopulation is 90-100% (CR); 95-100% (EN) or 100% (VU)

Assessment Outcome: Sub criterion met at Critically Endangered threshold.

Justification: All known individuals occur in a single population.

b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Sub criterion not met.

Justification: There is no evidence at present to suggest the species undergoes extreme fluctuations.

Criterion D Very small or restricted population

Assessment Outcome: Critically Endangered under Criterion D.

Justification: The population of the species is estimated to be 20 individuals based on surveys conducted in 2010-2011; this falls below the threshold for Critically Endangered (<50 mature individuals).

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient

Justification: There are insufficient data to quantify the Extinction Risk for this species.

Conservation and Management Actions

There is no National Recovery Plan and no NSW Saving our Species program for this species. The following is derived from the threat information. The species is known only from privately owned lands, and any conservation and management actions on this land will require agreement from and negotiation with the relevant landowners/managers.

Stakeholders

- Inform and consult with land owners/managers of the area containing the single known population, regarding options for conservation management and protection of the species.

Habitat loss, disturbance and modification

- Ensure appropriate fire regimes are maintained based on prioritised scientific research. Prevent high fire frequency (i.e. maintain fire interval of > 15 yrs), avoid out-of-season fires (i.e. during mid-autumn to spring), protect from post-fire grazing (e.g. through goat control measures), protect from fire suppression impacts (i.e. exclude vehicles and machinery from site, exclude from fire retardant).While lifespan, primary juvenile period and fire response are unknown for this species, its restriction to a granite outcrop suggests it may require long fire intervals of perhaps decades in order to persist. Two fires in quick succession are likely to cause declines and should be avoided. Any hazard reduction burns undertaken in the vicinity of the population should be timed to maximise likelihood of post-fire recovery, i.e. during the wetter parts of the year when rainfall is more likely (October to March).

Invasive species

- Monitor for the presence of feral herbivores such as goats; if such species are detected in or near the known site, undertake control of feral animals including shooting and/or exclusion fencing.

Ex situ conservation

- Develop a targeted seed collection program for *ex situ* seed banking.
- Identify appropriate sites for potential translocation/s.
- Develop an *ex situ* living collection in collaboration with botanic gardens as an insurance against possible failure of any attempts at translocation, and against stochastic events, which pose a high risk given the species' highly restricted distribution and small population size.

Survey and Monitoring priorities

- Monitor individual *Homoranthus bruhlii* plants for survival, growth and seed production.
- Monitor surrounding habitat for any recruitment of juvenile *H. bruhlii* plants, and changes in vegetation structure and composition in relation to weather (including drought), fire and grazing.
- Monitor after planned and unplanned fires (where they occur) to improve understanding of the fire response of the species.

Information and Research priorities

- Investigate life history attributes, recruitment, seedling survival and survival, growth, fecundity and mortality of adult plants.
- Investigate seed ecology, particularly levels of viability, fecundity and dormancy and germination mechanisms and dispersal ability.
- Determine the fire response of both mature plants and seeds.
- Improve understanding of the response of the species to different fire regimes and identify appropriate fire regimes for its conservation by undertaking appropriately designed experiments in the field and/or laboratory.
- Use understanding and research on fire responses among the congeneric species of *Homoranthus* that are listed as obligate seeders to develop fire management strategies for conservation.
- Examine the tolerance of the species to drought conditions.
- Investigate the cultivation requirements of the species.

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Expert Communications

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Assessment against BC Act criteria

Overall Assessment Outcome (Clause(s) with the highest category of threat)
Critically Endangered under Clause 4.5(a)

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Data Deficient.

(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: Not Met.

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 Clause C)
Assessment Outcome: Not Met.

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–vulnerable 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.