

Notice of and reasons for the Final Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to list the shrub *Homoranthus croftianus* J.T.Hunter as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act and, as a consequence, to omit reference to *Homoranthus croftianus* J.T.Hunter in Part 2 of Schedule 1 (Endangered Species) of the Act. Listing of Critically Endangered species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Homoranthus croftianus J.T.Hunter was found to be Critically Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3 (a) (d) (e i, iii) because: (i) *H. croftianus* has a highly restricted Extent of Occurrence (EEO) and Area of Occurrence (AOO) of 4 km²; (ii) *H. croftianus* is known from a single threat-defined location; and (iii) continuing decline has been observed and is projected to continue in the area, extent and/or quality of habitat and number of mature individuals due to the combined effects of increased frequency and duration of drought due to climate change, adverse fire regimes and browsing by feral and native herbivores.

The NSW Threatened Species Scientific Committee has found that:

1. *Homoranthus croftianus* is described by Hunter (1998) as an “erect shrub to 2 m tall by 1.5 m wide. Stems yellow to orange when young, turning brown with age. Leaves opposite, decussate, 2.5–8 mm long, 0.4–0.7 mm wide, 0.6–0.9 mm thick; blade incurved or rarely straight or recurved, linear, in transverse section subobtriangular, abaxially flat or concave, dark green to pale green; apex curved or straight, acuminate to cuspidate; petiole 0.1–0.5 mm long. Flowers solitary in axils on undifferentiated branchlets, greenish to cream. Peduncles 0.7–1.4 mm long, crowned between bracteoles, bracteoles caducous, gland dotted, 3.5–4.5 mm long, red-brown. Hypanthium 5-costate, with multicellular trichomes between the rounded costae on the ovary region, 1.5–3 mm long, 1–1.5 mm wide. Sepals 2–3 mm long, 0.3–0.6 mm wide, margins variously divided on individual flowers from undivided to 3-laciniate, gland-dotted. Petals orbicular to widely ovate, 1–1.2 mm long, 1–1.4 mm wide, margins entire. Stamens 10; filaments 0.1–0.3 mm long; anthers 0.3–0.5 mm long; staminodes 20, free, 0.3–0.5 mm long. Style 1.5–2.5 mm long, swollen basally, with long trichomes on the top third; stigma papillate. Fruit simple, dry indehiscent nut, 3.5–4 mm long, 1.2–1.5 mm wide, caducous after seed set, orange-brown.”
2. *Homoranthus croftianus* is a naturally rare species (*sensu* Harrison *et al.* 2008) endemic to the Bolivia Hill Range south of Tenterfield in northern NSW. It is restricted to a small section of the Bolivia Hill Range growing in exposed situations on and around granite outcrops up to approximately 1200 m elevation (Hunter 1998; Copeland *et al.* 2011; T. Soderquist *in litt.* January 2023). All known stands of *H. croftianus* occur within the National Parks and Wildlife Service managed Bolivia Hill Nature Reserve (Copeland *et al.* 2011).

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3. *Homoranthus croftianus* is highly localised geographically, with all known plants occurring in an area of approximately 26 ha (DPE 2022a). Currently, the population is considered to consist of five discrete stands within this small area (DPE 2022a), which are separated by areas of largely unvegetated granite slabs that can be several hundred metres across (G. Phillips pers. obs. January 2021). Given these distances are less than the foraging ranges of insect pollinators that have been observed visiting the plants, including European Honeybees (*Apis mellifera*) (Beekman and Ratnieks 2001; T. Soderquist *in litt.* August 2022), the population is considered to consist of a single subpopulation as defined by IUCN (2022).
4. Prior to the drought of 2017–2019, the total population of *Homoranthus croftianus* was estimated to be a maximum of 1,500 mature individuals (DPE 2022a). Following the drought, the population of mature individuals appears to have reduced by 10–15% (T. Soderquist *in litt.* August 2022). Post-drought surveys in October 2020 estimated a maximum of 1,360 individuals, though a proportion of this estimate consists of juvenile plants (Hunter 2022). Recruitment since the breaking of the drought has been variable between stands, with some stands being observed to have relatively strong recruitment (G. Phillips pers. obs. January 2021; J. Hunter *in litt.* July 2022) and others with limited recruitment or with lowered seedling success due to mortality from herbivore browsing (T. Soderquist *in litt.* August 2022). Additionally, some stands still possess a portion of heavily drought affected individuals, which are not recovering and may yet die (DPE 2022a; Hunter 2022). This variability in seedling success and likely ongoing mortality means that recovery to pre-drought numbers is unlikely to occur. Thus, the population is currently considered as a maximum of 1,275–1,360 mature individuals, with the upper bound defined by the upper post-drought survey estimate assuming all recorded juveniles grow to maturity, and the lower bound defined by assuming maximum estimated mortality following the 2017–2019 drought with total recruitment failure.
5. The geographic distribution of *Homoranthus croftianus* is very highly restricted. The Area of Occupancy (AOO) of *H. croftianus* is estimated to be 4 km², calculated using 2 x 2 km grid cells, the scale recommended by IUCN (2022). The Extent of Occurrence (EOO) is estimated to be 0.26 km² based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2022). However, where EOO is less than or equal to AOO then IUCN guidelines recommend EOO estimates be changed to be equal to AOO to ensure consistency with the definition of AOO as an area that fits within EOO (IUCN 2022). Therefore, the EOO for *H. croftianus* is also estimated to be 4 km².
6. When the most serious plausible threat of increased frequency, intensity and duration of drought due to climate change is considered, the sole subpopulation of *Homoranthus croftianus* can be considered a single threat-defined location, as per the IUCN definition (IUCN 2022). Given the effects of drought are likely to be consistent across the full range of the species, drought could plausibly affect any or all of the population in a single event, resulting in decline.

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7. *Homoranthus croftianus* grows in shrubland and low woodlands in exposed situations from on and around the vast granite outcrops of the unique granitic intrusion known as the Bolivia Hill Leucomonzogranite (Hunter 1998; Copeland *et al.* 2011; Geoscience Australia 2022; T. Soderquist *in litt.* January 2023). The species is typically found in shallow, sandy soils in depressions and erosional fissures on the outcrops, which are known to be high in sodium and potassium and are acidic in nature with a pH of 3.8–4.8 (Hunter 1998; Copeland *et al.* 2011; Bui *et al.* 2017). Given the open, desiccating environments typically found on the outcrops, species such as *H. croftianus* are limited by space, water, and nutrient availability, and these, along with soil chemistry, are the likely drivers of habitat specificity in the species (Hunter 2003).
8. *Homoranthus croftianus* commonly co-occurs with *Callitris endlicheri*, *Eucalyptus prava*, *E. dealbata*, *Leucopogon neoanglicus*, *Micromyrtus sessilis*, *Kunzea bracteolata*, *Boronia anethifolia*, *Leptospermum nova-angliae*, *Acacia viscidula* and *Cryptandra lanosiflora* (Hunter 1998). Other threatened species listed on the NSW Biodiversity Conservation Act 2016 also associate with *H. croftianus*, with *Acacia pycnostachya* commonly co-occurring, and *Boronia boliviensis* and *Eucalyptus boliviana* co-occurring in certain stands (Hunter 1998, 2002, 2022; G. Phillips pers. obs. January 2021). Based on plot data and plant community type (PCT) mapping, *Homoranthus croftianus* is almost completely restricted to New England Rockplate Shrubland (PCT 3854) (Hunter 2002; DPE 2022b). The species may also occur in other low forest PCTs that fringe the outcrops.
9. While the post-fire response of *Homoranthus croftianus* has not been directly recorded, it is assumed to be an obligate seeder (Hunter 2002; OEH 2020). Obligate seeding species of rock outcrops are often long-lived, have low turnover of individuals, and maximise their use of limited soil resources as these traits enable competitive advantages in the dry, harsh environments of the outcrops (Hunter 2003). *Homoranthus croftianus* has an expected lifespan of over 30 years (Hunter 2002), rare but consistent germination outside of mass disturbance events (DPE 2022a), and dense, even-aged stands (G. Phillips pers. obs. January 2021). The species' soil seedbank is also likely to be relatively short-lived, with above-ground persistence favoured (Hunter 2003).
10. Some *Homoranthus croftianus* seed appears to germinate without disturbance following sufficient rainfall *in situ* (G. Phillips pers. obs. January 2021; J. Hunter *in litt.* July 2022). However, it is expected that a portion of *H. croftianus* seeds are physiologically dormant, with dormancy released by favourable environmental conditions. Seed dormancy in *H. croftianus* is strongly suspected to be relieved by a treatment such as heat shock, as found in obligate-seeding *Darwinia* species (Auld and Ooi 2009). Ideal temperatures for heat shock treatment to relieve dormancy in such species are typically 80–100° C (Auld and Ooi 2009), similar to conditions found at burial depths of 1–2 cm during a bushfire (Bradstock and Auld 1995). This indicates that intermittent wildfire likely plays a key role in the recruitment cycle and maintenance of *H. croftianus* stands. However, hotter fires producing soil temperatures above 100° C will likely result in increased seed mortality (Auld and Ooi 2009) and the subsequent decline or loss of stands.

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11. The main threats to *Homoranthus croftianus* include increased frequency and duration of drought due to climate change and adverse fire regimes, with herbivore browsing also noted as adversely affecting recruitment and growth in the species (OEH 2020; DPE 2022a; J. Hunter *in litt.* July 2022; T. Soderquist *in litt.* August 2022). 'Anthropogenic Climate Change', 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' and 'Competition and habitat degradation by feral goats (*Capra hircus*)' are listed as Key Threatening Processes under the Act.
12. Decline has been observed and is strongly inferred to continue in the area, extent and quality of habitat and number of mature individuals of *Homoranthus croftianus* due to the combined effects of increased frequency and duration of drought due to climate change, adverse fire regimes, and browsing by feral and native herbivores. Some small stands of *H. croftianus* previously identified by botanists no longer appear to be extant, having not been observed for some time (T. Soderquist pers. comm. August 2022). Additionally, during and following the 2017–2019 drought, a reduction has occurred in the *H. croftianus* population, with the number of mature individuals estimated to have declined by up to 15% (T. Soderquist *in litt.* August 2022). Under projected future climate conditions for the region, drought is expected to increase in frequency and duration (Reichstein *et al.* 2013; Trenberth *et al.* 2013; Allen *et al.* 2015; AdaptNSW 2023). Therefore, it can be reasonably inferred that future *H. croftianus* mortality events, such as that seen in 2017–2019, will become more common, exacerbating observed declines. A warming climate also creates a situation whereby the prevailing environmental conditions that obligate-seeding rocky outcrop species require to retain competitive advantages are reduced (McGann 2002; Hunter 2003). Warmer air temperatures also increase the risk of more frequent severe fires breaching the outcrops, which may destroy significant portions of soil seedbanks in obligate-seeding species (Auld and Ooi 2009), thus inducing rapid decline. Conversely, recruitment episodes to replenish senescent stands of rocky outcrop species such as *H. croftianus* may be limited if appropriate fire is excluded for too long (McGann 2002; Hunter 2003). The combination of these threats indicates that the quality and availability of habitat and number of mature individuals of *H. croftianus* are likely to remain under pressure, and currently observed declines are strongly inferred to continue into the future.
13. *Homoranthus croftianus* J.T.Hunter is eligible to be listed as a Critically Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing an extremely 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*:

Assessment against *Biodiversity Conservation Regulation 2017* criteria

The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: Critically Endangered under Clause 4.3 (a)(d)(e i, iii).

Clause 4.2 – Reduction in population size of species (Equivalent to IUCN criterion A)

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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: Critically Endangered under Clause 4.3 (a)(d)(e i, iii)

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: Vulnerable under Clause 4.4 (c)(d iii)(e i, ii(B)).

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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: Not met.

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.

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Clause 4.7 - Very highly restricted geographic distribution of species–vulnerable species

(Equivalent to IUCN criterion D2)

Assessment Outcome: Met.

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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Supporting Documentation:

Phillips G.P. (2023) Conservation Assessment of *Homoranthus croftianus* J.T.Hunter (Myrtaceae). NSW Threatened Species Scientific Committee.

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