Publication Date: 05/04/2024

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 *Geniostoma huttonii*, B.J.Conn as a CRITICALLY endangered species in Part 1 of Schedule 1 of the Act and, as a consequence, to omit reference to *Geniostoma huttonii*, B.J.Conn from 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

Geniostoma huttonii, B.J.Conn (Loganiaceae) was found to be Critically Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clauses 4.3 (a)(d)(e) (i, iii) and 4.4 (a)(e(i, iiB)). The main reasons for this listing are: 1) the species has a very highly restricted geographic range; 2) the total number of mature individuals is very low; 3) it is found at only a single location; 4) there is inferred continuing decline in habitat quality as a consequence of increased aridity driven by climate change, ongoing weed invasion, and changes in community structure and disturbance regimes; and 5) there is ongoing decline in the number of mature individuals as a consequence of increased competition driven by changes in ecological community structure and disturbance regimes.

The NSW Threatened Species Scientific Committee has found that:

1. *Geniostoma huttonii* was discovered in 1991 (Conn, 1993; Green, 1993) and is formally described by Conn (1993) as a 'Scrambling shrub to 1 m high. *Branches* slightly compressed laterally on distal internodes; distal internodes with 2 pairs of lateral ridges extending from between the leaf bases to the next more basal node; glabrous; stipules interpetiolar, depressed triangular to collar-like, 1–1.4 mm long, glabrous, distally rounded. *Leaves* glossy mid-green, glabrous; petiole 4–6 mm long; lamina ovate, 20–30 mm long, (9–)14–16 mm wide [length to width ratio 1.5–1.91; base acute to shortly subattenuate; margin entire; apex subacute to subacuminate; midrib raised on lower surface, slightly sunken on upper surface, veins indistinct. *Inflorescence* axillary, 1–3-flowered, possibly to 5-flowered…less than 10 mm long; peduncle absent or up to 1 mm long; pedicels c. 2 mm long, glabrous; bracts ovate, c. 0.5 mm long, glabrous, with margin shortly fimbriate. *Calyx* 1.3–1.5 mm long; outer surface glabrous; inner surface moderately hairy, hairs minute, to c. 0.1 mm long; lobes ovate-triangular, 0.6–1 mm long, margin shortly fimbriate, apex acute; veins not distinct. *Corolla* 5(or 6)-merous, campanulate, 2.5–3.5 mm long; outer surface glabrous; tube 0.8–1 mm long, with inner surface glabrous; lobes 2.5–3 mm long, glabrous basally, papillose distally; margin papillose to shortly fimbriate (hairs <0.05 mm long); venation complex, each lobe supplied by one vein which has usually divided in the upper part of the tube to produce 2 lateral branches which ascend into the lobe, with short to long divergent branchlets usually present. *Staminal filaments* narrowly ovoid to slightly ligulate, c. 1 mm long, c. 0.4 mm wide, moderately hairy on ventral surface, hairs to 0.1 mm long, glabrous dorsally; anthers ovate, slightly incurved distally, 0.5–0.6 mm long, basal lobes obtuse, glabrous, apex sparsely to moderately covered with

patent hairs to 0.1 mm long, connective slightly extended to form a minute triangular, apical appendage c. 0.1 mm long. *Pistil* 1.4–2 mm long; ovary glabrous, c. 0.5 mm long; style 0.2–0.6 mm long, moderately hairy with patent hairs to 0.1 mm long; stigma ellipsoid, 0.3–0.7 mm long. *Capsule* globular to slightly ellipsoid, 5–6 mm diameter…Although the inflorescence is usually uniflorous or triadic, it is either derived from a botryoidal or metabotryoidal inflorescence because of the prophylls and metaxyphylls (together there are usually 2 pairs, rarely 3 pairs)'. There have been no subsequent taxonomic revisions.

2. *Geniostoma huttonii* is endemic to Lord Howe Island, the largest of a collection of small volcanic islands in the Tasman Sea, 760 km northeast of Sydney (Department of Environment and Climate Change (NSW), 2007; NSW Government Office of Environment and Heritage, 2016). *Geniostoma huttonii* is restricted to the Southern Mountains region of Lord Howe Island, encompassing Mount Lidgbird (777 m elevation) and Mount Gower (875 m elevation) (NSW Government Office of Environment and Heritage, 2017). *Geniostoma huttonii* plants are scattered across cliff faces and rocky ridges at these sites, generally occurring as single plants, or in small patches (NSW Government Office of Environment and Heritage, 2017). The maximum distance between Mount Gower and Mount Lidgbird sites is around 2 km (C. Stehn pers. comm. 2022).

3. The total population of 160–200 plants has been estimated based on surveys from 2017 to 2021, including both mature and juvenile individuals (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021b). While individuals likely to be saplings and juveniles have been observed, the stunted nature of some communities can make estimation of age and maturity difficult (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021b; C. Stehn pers. comm. 2022). Population estimates are based on monitoring plot data extrapolated across the area over which *Geniostoma huttonii* is believed to occur (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021b). Monitoring site selection is primarily determined by accessibility, with much of the habitat being challenging to access, and some areas almost entirely inaccessible (Hutton, 2005; NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021b; Sheringham *et al*., 2020). However, likely *G. huttonii* habitat is well documented and distribution and population estimates are likely to be reliable (NSW Government Office of Environment and Heritage, 2016, 2017; Sheringham *et al*., 2020; NSW Government Saving our Species, 2021b).

4. *Geniostoma huttonii* has a highly restricted range, with both an Extent of Occurrence (EOO) and Area of Occupancy (AOO) of only 12 km^2. Area of Occupancy (AOO) was calculated by overlaying 2 km x 2 km grid cells over the known occurrence and is the spatial scale of assessment recommended by IUCN (IUCN Standards and Petitions Committee, 2022). *Geniostoma huttonii* is restricted to small lengths of cliff and exposed ridgeline on Mount Gower and Mount Lidgbird, and as a result EOO (1.81 km^2) is less than the estimated AOO (12 km^2). 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 Standards and Petitions Committee, 2022). As such, the EOO for *G. huttonii* is also 12 km^2.

5. *Geniostoma huttonii* is restricted to sunny, exposed, north and west facing cliff faces and ridges, generally above 400 m elevation (NSW Government Office of Environment and Heritage, 2016). *Geniostoma huttonii* occurs in sites without canopy cover, and does not tolerate crowding (NSW Government Office of Environment and Heritage, 2016; C. Stehn pers. comm. 2022). The species shares general habitat and features of ecology with three other threatened plants, *Carmichaelia exsul, Xylosma parvifolium*, and *Coprosma inopinata*, along with more common species (Hutton, 2001, 2005; NSW Government Office of Environment and Heritage, 2016).

6. There has been no formal study into life history or dispersal mechanisms for *Geniostoma huttonii*. *Geniostoma huttonii* produces small white flowers singly or in pairs at the base of the leaf stem from January to March (NSW Government Office of Environment and Heritage, 2016). *Geniostoma* species are often insect pollinated, although may also be visited by birds, and this is likely to also be true of *G. huttonii* (Newstrom & Robertson, 2005; Papadopulos *et al*., 2011). *Geniostoma huttonii* produces small (~6 mm), green capsules that split open to expose black seeds (NSW Government Office of Environment and Heritage, 2016). These seeds may be bird- or ant-dispersed, or dispersed by abiotic factors like rain or wind (Newstrom & Robertson, 2005; Papadopulos et al., 2011). The population appears to be unfragmented, with pollinators likely able to access individuals across its very highly restricted range, and birds able to disperse seed across suitable habitat. However, during two decades of monitoring, *Geniostoma huttonii* has not been observed to colonise any adjacent habitat, and while it persists well at sites where it is already established it appears to struggle to compete with other endemic or invasive species for new space (C. Stehn pers. comm. 2022).

7. The main threats to *Geniostoma huttonii* are increasing aridity and habitat loss as a result of climate change, pathogen infection, land slips, and changes in patterns of disturbance regimes and recruitment. 'Anthropogenic Climate Change', 'Infection of Native Plants by *Phytophthora cinnamomi'*, and 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants' are listed as Key Threatening Processes under the Act.

8. Ongoing climate change poses a direct threat to *Geniostoma huttonii*. There has been an increase in temperature and a decrease in overall rainfall on Lord Howe Island over the last 50 years (Auld & Leishman 2015). Many plant species on Lord Howe Island depend on consistent and ongoing cloud formation to provide the high humidity and moisture on which they depend (Auld & Leishman, 2015). Cloud forests serve as a 'bucket', absorbing rain and atmospheric moisture at the summit, which then flows down to provide moisture for species below the cloud line, including *G. huttonii* (Foster, 2001). Increases in sea temperature is likely to increase the altitude at which clouds form and therefore aridity at lower altitudes, thereby reducing the quality and availability of habitat for species like *G. huttonii*, and pushing dependent species further towards the summit (Auld & Leishman, 2015). As *G. huttonii* is confined to cliffs and ridges at relatively high elevations, the general lack of exposed cliffs and ridgelines at higher elevations means that

there is no suitable habitat into which *G. huttonii* can retreat (C. Stehn pers. comm. 2022). Furthermore, as a poor competitor, *G. huttonii* is likely to struggle to colonise new habitat. Even if resident plant communities are pushed from habitat potentially suitable for *G. huttonii*, components of these communities, such as established trees or generalist weed species, are likely to persist and present an ongoing barrier to colonisation.

9. *Phytophthora cinnamomi* is an introduced water mould (oomycetes) pathogen that has had a devastating effect on plant communities worldwide, causing catastrophic dieback in many species. *Phytophthora cinnamomi* affects a huge variety of plants across families, including Loganiaceae, and so may pose a considerable threat to *Geniostoma huttonii* (Government of South Australia Phytophthora Technical Group, 2006; NSW Department of Environment and Climate Change, 2008; Podger & Newhook, 1971). *Phytophthora cinnamomi* was detected in a small orchard on Lord Howe Island in 2003 and is now considered a resident threat on the island (Auld & Hutton, 2004). While it has so far been contained, the movement of residents and tourists across the island risk its spread in the future.

10. *Geniostoma huttonii* is restricted to rocky ridgelines and exposed cliff faces that are susceptible to collapse and slips, particularly following heavy rain (NSW Government Saving our Species, 2021; C. Stehn pers. comm. 2022). Landslips resulted in the loss of four mature plants from one site in 2021/22, and continue to make surveys impossible at several others (NSW Government Saving our Species, 2021b). There is currently no way to prevent or mitigate the threat of landslips at *G. huttonii* sites, however, efforts are underway to develop new methods to address this challenge (C. Stehn pers. comm. 2022).

11. Invasive weeds pose a severe and ongoing threat to *Geniostoma huttonii* (Lord Howe Island Board, 2016; NSW Government Office of Environment and Heritage, 2017). Weeds encroach on *G. huttonii* habitat, outcompeting existing plants for resources and space and inhibiting recruitment by reducing the likelihood that *G. huttonii* seeds will find sufficient space and resources to germinate (Lord Howe Island Board, 2016; T. Auld pers. comm. 2022). Of particular concern are *Ageratina adenophora* (Crofton Weed), *Lilium formosanum* (Formosan Lily), *Cenchrus clandestinus* (Kikuyu Grass), *Asparagus aethiopicus* (Ground Asparagus), and *Psidium cattleyanum* var. *cattleyanum* (Cherry Guava) (Lord Howe Island Board, 2016; T. Auld pers. comm. 2022). These weed species remain common across Lord Howe Island and threaten multiple endemic plants and communities, including *G. huttonii* (Lord Howe Island Board, 2016; NSW Government Saving our Species, 2021; T. Auld pers. comm. 2022). Despite an ongoing intensive weed eradication program, the overall number of juvenile weeds may be increasing (NSW Government Saving our Species, 2021a). This increase is possibly driven by drought and increasing aridity, with generalist weed species on Lord Howe Island likely more successful than endemics in changing environments, and by the removal of rats (discussed below) (Lord Howe Island Board, 2016; NSW Government Saving our Species, 2021b).

12. Introduced rodents, in particular the *Rattus rattus* (Ship Rat) and *Mus musculus* (House Mouse), have had a devastating effect on the native flora of Lord Howe Island and have been the driving factor in the extinction of at least two Lord Howe

Island plant species (Department of Environment and Climate Change (NSW), 2007). An extensive rodent eradication program on the main island began in 2019 and appears to have been successful in eradicating rats and mice (Harper et al., 2020). However, the program has not yet been officially declared successful and ongoing monitoring is in place, both for rodents and to quantify the resulting benefits and/or ecosystem changes. Historically rodents have not been considered a direct threat to *G. huttonii* because of its inaccessible habitat (Lord Howe Island Board, 2017). However, there are indications that rodent control has inadvertently removed predation pressures from both weeds and native vegetation. In the absence of rodents, weed populations may increase and spread, posing a more significant threat to *G. huttonii* (NSW Government Saving our Species, 2021; C. Stehn pers. comm. 2022).

13. Similarly, the eradication of feral goats from Lord Howe Island in the late 1990s and early 2000s has resulted in plant height and cover increasing in some areas where *Geniostoma huttonii* occurs, with a corresponding decline in the health of the species. This is likely a consequence of *G. huttonii* being crowded out by more competitive species as sites succeed to a climax community in the absence of continued disturbance from goats. Seven mature plants were lost from a single monitoring plot between 2016/17 and 2020/21, a decline inferred to be a result of crowding and competition with other plant species following the removal of heavy browsing pressure from goats (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021b; C. Stehn pers. comm 2022).

14. There is inferred decline in the quality of *Geniostoma huttonii* habitat as a consequence of changes in disturbance regimes, exclusion by weeds, and ongoing shifts in community structure, resulting in a decline in recruitment and mature individuals. *Geniostoma huttonii* no longer appears to colonise new sites, likely driven by an inability to compete with invasive weeds, and possible changes in habitat as a result of climate change (Department of Environment and Climate Change (NSW), 2007; Lord Howe Island Board, 2016; NSW Government Saving our Species, 2021b; C. Stehn pers. comm. 2022). As a consequence, *G. huttonii* is confined to sites at which it is currently established, the habitat quality of which is in decline due to the aforementioned threats.

15. *Geniostoma huttonii,* B.J.Conn (Loganiaceae) 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 Clauses 4.3 (a)(d)(e) (i, iii) and 4.4 (a)(e(i, iiB)).

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: Critically Endangered 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: Critically Endangered 4.4 (a)(e(i, iiB)).

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: Endangered 4.5 (b)

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: Not 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.

Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Rowell, T. (2022) Conservation Assessment of *Geniostoma huttonii,* B.J.Conn (Loganiaceae). NSW Threatened Species Scientific Committee.

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