

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 shrub *Boronia inflexa* subsp. *torringtonensis* Duretto 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

Boronia inflexa subsp. *torringtonensis* is eligible for listing as Critically Endangered, as the highest threat category met by the taxon across all categories, under Clauses 4.3 (a) (d) (e iii) and 4.5 (a), because: i) the distribution of the species is very highly restricted with an Extent of Occurrence of 57 km² and an Area of Occupancy of 20 km²; ii) the species is known from only one threat-defined location; iii) there is continuing decline in the quality of habitat due to grazing, human disturbance, inappropriate fire regimes and drought; and iv) the species has an extremely small population of <50 mature individuals.

The Scientific Committee has found that:

1. *Boronia inflexa* subsp. *torringtonensis* Duretto (Rutaceae) was described as a “Shrub to 1.5 m tall. Branchlets not glandular tuberculate, hispidulous between leaf decurrencies, hairs 0.25(–0.5) mm long. Leaves imparipinnate, 3(–5)-foliolate, entire leaf in outline (9–)16–25 mm long, (8–)17–30 mm wide, glabrous or glabrescent; petiole 4–9 mm long; rachis segments 4–5 mm long; terminal leaflets (4–)10–16 mm long, (0.75–)1–1.25 mm wide; lateral leaflets similar to terminal leaflets. Inflorescence 3-flowered, shorter than leaves; peduncles (2.5–)4–5 mm long; prophylls 1–2.5 mm long, glabrous; anthopodia 2–3 mm long. Sepals pink, deltate, 1.5–3 mm long, 1–1.5 mm wide, glabrous, tip acuminate due to involute margins. Petals white, 4.5–6 mm long, glabrous or minutely ciliate. Anther apicula with a few simple hairs. Style glabrescent to pilose. Cocci c. 3.5 mm long, c. 2 mm wide, glabrous. Seed c. 3 mm long, c. 1.5 mm wide.” (Duretto 2003). It is distinguishable from the type subspecies by the larger petals (4.5–6 mm long; cf. 2.5–3.5 mm long) and from *B. inflexa* subsp. *grandiflora* by the glabrous or glabrescent leaves (cf. minutely pilose) (Duretto 2003).
2. *Boronia inflexa* subsp. *torringtonensis* occurs in a small number of sites north and west of Torrington in the New England Tablelands bioregion close to the New South Wales (NSW) border with Queensland. The subspecies has only been recorded 12 times, three between 1911-1916 and the most recent in 2012. All except one of these records were made in the Torrington State Conservation Area, with the remaining record located approximately 1.5 km north of the northern border of Torrington State Conservation Area.
3. *Boronia inflexa* subsp. *torringtonensis* has a very highly restricted geographic distribution. Based on the recorded occurrences of the subspecies, an Extent of Occurrence (EOO) of 57 km² has been calculated, using a minimum convex polygon enclosing all mapped occurrences, the method of assessment recommended by IUCN (2017). The Area of Occupancy (AOO) is estimated to be 20 km², based on 2 km x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2017).

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4. The population size of *Boronia inflexa* subsp. *torringtonensis* is currently poorly known. There have been no recent targeted surveys to search for the subspecies. Four of the recent records note that *B. inflexa* subsp. *torringtonensis* is rare, with only three to five plants seen in each survey. Based on these numbers and the fact that vegetation surveys in the area have failed to find evidence of the species anywhere else, it is estimated that the total number of mature individuals is less than 50 (L. Copeland, pers. comm May 2019).
5. *Boronia inflexa* subsp. *torringtonensis* grows on granite-derived soils among granite outcrops, in heath and dry sclerophyll forests (Duretto 2003). Associated species, according to herbarium records, include *Eucalyptus andrewsii* (New England Blackbutt), *E. brunnea*, *E. caliginosa* (Broad-leaved Stringybark), *Eucalyptus prava* (Orange Gum), *E. subtilior*, *E. williamsiana*, *Acacia betchei* (Red-tip Wattle), *Boronia granitica* (Granite Boronia), *Brachyloma saxicola*, *Callitris endlicheri* (Black Cypress Pine), *Kunzea bracteolata*, *Leionema ambiens* (Forest Phebalium), *Leptospermum novae-angliae*, *Leucopogon* sp., *Persoonia cornifolia*, *Prostanthera staurophylla*, *Ricinocarpos pinifolius* (Wedding Bush), and *Xanthorrhoea johnsonii* (Johnson's Grass Tree).
6. Similar to other members of the genus, *Boronia inflexa* subsp. *torringtonensis* is likely to be insect pollinated (Armstrong 1979) and ant dispersed, following initial ballistic seed dispersal from fruits (e.g. Drake 1981, and see Berg 1975;). The magnitude and longevity of the seed bank are unknown. *Boronia granitica*, a sympatric granite outcrop species, has a soil seedbank which is thought to be moderately long-lived (Clarke and Fulloon 1999, cited in NPWS 2002). Seed germination in *Boronia* species may be promoted by fire cues, specifically through heat shock and smoke, while seed dormancy is controlled by seasonal temperature (Mackenzie *et al.* 2016).
7. The response of *Boronia inflexa* subsp. *torringtonensis* to fire is unknown. The closely related *B. bipinnata* (Duretto 2003) is known to be killed by fire (NSW Flora Fire Response Database V2.1), therefore it is considered most likely that *Boronia inflexa* subsp. *torringtonensis* is also fire-sensitive, an inference which is supported by the work of Clarke *et al.* (2009), who found that only 33% of shrubs in the New England Tablelands rocky outcrop communities had a resprouting capacity. The 2019/2020 wildfires appear to have burnt all known sites of *Boronia inflexa* subsp. *torringtonensis*, although field assessments are required to determine mortality and recruitment.
8. The main threats to *Boronia inflexa* subsp. *torringtonensis* are browsing, human disturbance, inappropriate fire regimes and drought. Browsing by feral goats can negatively affect plant species by preventing their establishment (Harrington 1976), contributing to soil erosion (Bayne *et al.* 2004), and dispersing the seeds of invasive species (DEWHA 2008). In the Torrington State Conservation Area, feral goats inhabit rocky outcrop areas throughout the reserve and the impacts of heavy browsing by feral goats has been observed on species of Rutaceae in close proximity to *Boronia inflexa* subsp. *torringtonensis* (L Copeland, pers. comm. Apr. 2019), although direct observations of the impacts on *B. inflexa* subsp. *torringtonensis* have not been made due to its rarity. There is also a large rabbit population close to one of the sites where *B. inflexa* subsp. *torringtonensis* has been observed (NPWS 2003). "Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus* (L.)" and "Competition and habitat degradation by Feral Goats, *Capra hircus* Linnaeus 1758" are listed as Key Threatening Processes in the Act.

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Frequent fires can lead to population declines in species where juvenile plants have not had time to produce seeds in the interval between fires, and in species where individuals are small at maturation and have low seed output until they increase in size (e.g. *Boronia serrulata*; Auld 2001). Frequent fires are a concern for *B. inflexa* subsp. *torringtonensis* due to proximity to the village of Torrington (L. Copeland, pers. comm. April 2019). A national prioritisation of the impact of the 2019-2020 bushfire season on plant species ranked *Boronia inflexa* subsp. *torringtonensis* as at high risk from high fire frequency and severity and from the cumulative risks of potential future fires (Gallagher 2020). ‘High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition’ is listed in the Act as a Key Threatening Process.

Mining activities also present a threat to *Boronia inflexa* subsp. *torringtonensis*. According to the Torrington State Conservation Area Plan of Management, the area’s rich mineral and semi-precious gemstone deposits have been identified as an important mineral exploration and mining area, and the vast majority of land in and around the current EOO of *B. inflexa* subsp. *torringtonensis* has been explored for mining operations (NPWS 2003). All but two of the currently known sites where the species has been reported are threatened by mining activities.

Human disturbance in the form of trampling and bushrock removal may also degrade the habitat of *Boronia inflexa* subsp. *torringtonensis* and lead to population decline, as most known records occur next to established roads or tracks. There have also been proposals to construct a walking track to Bismuth Falls, another site where the species has been found (NPWS 2003).

Adapt NSW (2019) suggests that for the New England and North west areas (which contains the distribution of this taxon) “Hot days are projected to increase across the region by an average of 24 days per year by 2070, while autumn rainfall may marginally increase and winter rainfall decrease over the same time”. Populations of shrubs that grow in shallow sandy soil in the area are particularly susceptible to drought, and it is likely that *Boronia inflexa* subsp. *torringtonensis* will be affected by changes in drought frequency (L Copeland, pers. comm. April. 2019).

9. *Boronia inflexa* subsp. *torringtonensis* Duretto 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*:

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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 under Clause 4.3 (a) (d) (e 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.

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Clause 4.4 - Low numbers of mature individuals of species and other conditions
 (Equivalent to IUCN criterion Clause C)
 Assessment Outcome: Data Deficient.

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

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Clause 4.7 - Very highly restricted geographic distribution of species
(Equivalent to IUCN criterion D2)
Assessment Outcome: Vulnerable.

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
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NSW Threatened Species Scientific Committee

Supporting document:

Dimitrova N (2019) Conservation Assessment of *Boronia inflexa* subsp. *torringtonensis* Duretto (Rutaceae). (NSW Threatened Species Scientific Committee: Hurstville, NSW)

References:

Adapt NSW (2019) New England North West Climate change snapshot

<https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/New-England-North-West-Climate-Change-Downloads>

Armstrong JA (1979) Biotic pollination mechanisms in the Australian flora—a review. *New Zealand Journal of Botany* **17**, 467–508.

Auld TD (2001) The ecology of the Rutaceae in the Sydney region of south-eastern Australia: poorly known ecology of a neglected family. *Cunninghamia* **7**, 213–240.

Bayne P, Harden R, Davies I (2004) Feral goats (*Capra hircus* L.) in the Macleay River gorge system, north-eastern New South Wales, Australia. I. Impacts on soil erosion. *Wildlife Research* **31**, 519–525.

Berg RY (1975) Myrmecochorous plants in Australia and their dispersal by ants. *Australian Journal of Botany* **23**, 475–508.

Clarke PJ, Knox KJ, Campbell ML, Copeland LM (2009) Post-fire recovery of woody plants in the New England Tableland Bioregion. *Cunninghamia* **11**, 221–239.

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008) Threat abatement plan for competition and land degradation by unmanaged goats. DEWHA, Canberra.

Drake, W. E. (1981). Ant-seed interaction in dry sclerophyll forest on North Stradbroke Island, Queensland. *Australian Journal of Botany*, 29(3), 293-309.

Duretto MF (2003) Notes on *Boronia* (Rutaceae) in eastern and northern Australia. *Muelleria* **17**, 19–135.

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- Gallagher RV (2020) *Interim national prioritisation of Australian plants affected by the 2019-2020 bushfire season*. Report to the Wildlife and Threatened Species Bushfire Recovery Expert Panel
- Harrington G (1976) The effects of feral goats and sheep on the shrub populations in a semi-arid woodland. *The Rangeland Journal* **1**, 334–345.
- IUCN (International Union for Conservation of Nature Standards and Petitions Subcommittee) (2017) *Guidelines for Using the IUCN Red List Categories and Criteria*. Version 11. Prepared by the Standards and Petitions Subcommittee.
- Mackenzie BD, Auld TD, Keith DA, Ooi MK (2016) How fire and seasonal temperatures influence the germination of many plant species: insights from *Boronia* (Rutaceae). *Australasian Plant Conservation* **25**, 5–7.
- NPWS (NSW National Parks and Wildlife Service) (2002) Recovery Plan for *Boronia granitica* (Granite Boronia). NPWS, Hurstville, NSW.
- NPWS (NSW National Parks and Wildlife) (2003) Torrington State Conservation Area: Plan of management. NPWS, Glenn Innes, NSW.