

Notice 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 remove *Boronia hapalophylla* Duretto, F.J.Edwards & P.G.Edwards from the Schedules of the Act by omitting reference to this species from Part 2 of Schedule 1 (Endangered species). The omission of species from the Schedules is provided for by Part 4 of the Act.

Summary of Conservation Assessment

The NSW Threatened Species Scientific Committee has found that:

1. *Boronia hapalophylla* Duretto, F.J.Edwards & P.G.Edwards is described by Duretto *et al.* (2004) as an “erect, much branched shrub to 3 m tall, very open and spindly, often supported by other species when tall. Multiangular stellate hairs sessile, with up to 15 rays; rays to 0.5 mm long, unicellular, free, firm, straight, glossy, smooth, white to yellow. Branches terete to slightly quadrangular in cross section, decurrent leaf bases lacking, not obviously glandular, with no massive cork development, with a moderately dense stellate indumentum, becoming glabrous with age, regrowing from a rootstock after disturbance. Leaves simple, opposite, rarely sub-opposite or in whorls of three, not conspicuously glandular, sessile to subsessile, leaf base so strongly attenuate as to appear petiolate, apparent petiole to 1.5 mm long; lamina narrow-elliptic to elliptic to lanceolate, (13–)18–50(–70) mm long, (1–)3.5–12 mm wide, strongly discolourous, paler beneath, dorsiventral, with palisade mesophyll above and spongy mesophyll below; tip acute; base strongly attenuate; margins entire, slightly recurved to revolute; midrib prominently raised abaxially, with tightly packed parenchyma with secondary thickening between midvein and abaxial epidermis, impressed adaxially; adaxial surface with a sparse to moderately dense, stellate indumentum; abaxial surface with a dense, heterogenous indumentum of two hair types: a moderately dense layer of multiangular stellate hairs over a dense layer of peltate stellate hairs. Inflorescence axillary, 1–5-flowered, with a dense stellate indumentum; peduncle absent, or sometimes 2–5 mm long in inflorescences with 3–5 flowers; prophylls minutely unifoliate, often leaf-like, 1.5–7(–20) mm long, with a dense stellate indumentum, or indumentum as leaves; anthopodia [pedicels] 2–6.5 mm long. Sepals broadly ovate-deltate, shorter and narrower than petals, acuminate, valvate in bud, 5–7 mm long, 3–4.5 mm wide, enlarging to 10 mm long and 7 mm wide with mature fruit, persistent; adaxial surface densely and minutely pubescent, becoming glabrous towards base; abaxial surface with a dense stellate indumentum. Petals pink, valvate in bud, (6–)8–10 mm long, enlarging to 15 mm long with mature fruit, with midvein raised abaxially, persistent; adaxial surface sparsely pilose, becoming glabrous towards base; abaxial surface with a dense stellate indumentum. Stamens all fertile, filaments bearing stiff, simple hairs abaxially and on margins below glandular tip; sepaline filaments clavate, tapering to anther connective, 2–2.5 mm long, the distal 0.5–1 mm prominently glandular; petaline filaments, c. 1.5 mm long, the distal end glandular; anthers monomorphic, glabrous; anther

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appendage erect or reflexed. Disc entire, glabrous, rarely with slight swelling opposite sepaline stamens. Ovary glabrous or rarely with few stellate hairs at apex; style glabrous or rarely with scattered stellate hairs at base; stigma slightly wider than style. Cocci c. 7 mm long, c. 3.5 mm wide, glabrous or hirsute. Seeds black, shiny, 5–6 mm long, 2.5–3 mm wide; surface at magnification tuberculate; tubercles free.”

2. *Boronia hapalophylla* is endemic to outcropping areas of the Kangaroo Creek Sandstone geological formation along the southern edge of the Clarence-Moreton Basin in northern NSW (NSW Scientific Committee 2004; NSW NPWS 2009). Initially considered to be restricted to a small area around Shannon Creek near Coutts Crossing (NSW Scientific Committee 2004), *B. hapalophylla* is now known from a number of sites across the southern Clarence Valley following extensive targeted surveys in the region (Sheringham 2021). There are now 13 known sites spread across three geographically distinct subpopulations, with five sites included in gazetted conservation reserves, four others in private or local government land set aside for conservation purposes, two in vacant Crown land and two in state forests.
3. Currently, the population of *Boronia hapalophylla* is regarded as a minimum of 17,780 plants based on census data (P. Sheringham *in litt.* April 2022). However, the true population number is likely much higher considering this count does not include two confirmed but unsurveyed sites as well as considerable areas of unsurveyed potential habitat within other key subpopulations.
4. The geographic distribution of *Boronia hapalophylla* is highly restricted. The Extent of Occurrence (EOO) is based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2022) and was measured at 572 km². Area of Occupancy (AOO) was calculated using 2 x 2 km grid cells, the scale recommended by IUCN (2022) and was calculated to be 208 km².
5. *Boronia hapalophylla* appears to be a facultative seeding species as it has been observed to both vigorously reshoot from rootstock after fire as well as producing numerous seedlings in the post-fire environment after wildfire (Duretto *et al.* 2004; Sheringham 2021; G. Phillips pers. obs. November 2021; J. Edwards *in litt.* April 2022). Mature plants in the northern Shannon Creek subpopulation, which are recorded as being larger plants on average, resprout vigorously from the base following fire (J. Edwards *in litt.* April 2022), whereas fewer resprouting plants have been recorded in the southern subpopulations which tend to have smaller mature plants on average and post-fire seedling growth appears to be favoured (Sheringham 2021). This however may be an artefact of the fire history of the sites, with most southern subpopulations being burnt far more regularly (NSW NPWS 2022; J. Edwards *in litt.* April 2022), and so the resulting smaller average mature individuals may be less likely to resprout and more likely to rely on seedling recruitment to replenish populations post fire.

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6. Observations from the Yuraygir subpopulation indicate a primary juvenile period of less than two years for *Boronia hapalophylla*, with seedlings germinating after wildfire in January 2020 becoming reproductively mature and bearing viable seed by November 2021 (G. Phillips pers. obs. November 2021; Sheringham 2021). Plants in the Shannon Creek catchment that have been observed resprouting after fire are also recorded as being reproductively mature within two years, indicating a secondary juvenile period of approximately that length (J. Edwards *in litt.* April 2022). *B. hapalophylla* also appears to have a high proportion of seedlings that reach reproductive maturity, with the majority of recruits at the Yuraygir site in November 2021 bearing fruit and viable seeds (G. Phillips pers. obs. November 2021).
7. Species related to *Boronia hapalophylla* in *Boronia* section *Valvatae* have been found to germinate faster and more abundantly only at spring and summer temperatures after treatment with heat shock and smoke, with little to no germination at low temperatures, indicating faster seedling emergence following spring and summer fires and a considerable delay in germination following autumn and winter fires (Mackenzie *et al.* 2016). It is highly likely that *B. hapalophylla* responds similarly, with observations of large germination events in wild populations following the 2019/20 fires supporting this (G. Phillips pers. obs. November 2021). Seed viability in *Boronia* is also typically high (Mackenzie *et al.* 2016, Ma *et al.* 2018) and the moving of seeds underground by ants may also affect dormancy breaking, germination and seedling emergence depending on the depth of burial, providing further buffering against stochastic effects of disturbances such as fire and the exhaustion of soil seedbanks in a single disturbance event (Hughes and Westoby 1992; Auld 2001; NSW NPWS 2002).
8. *Boronia hapalophylla* is regarded as having three threat-defined locations when the most serious plausible threat of changed fire regimes is considered. These three locations are: 1) All records from Chambigne Nature Reserve southwest to Flaggy Creek Nature Reserve; 2) Sherwood Nature Reserve and areas immediately northeast; and 3) the Yuraygir subpopulation. This is based on the fire history of the region including previous fire extent and known biogeographical barriers to fire (NSW NPWS 2009).
9. The Shannon Creek subpopulation of *B. hapalophylla* was considered at risk from clearing for infrastructure projects related with the Shannon Creek Dam when initially described and listed as a threatened species in 2004 (Duretto *et al.* 2004; NSW Scientific Committee 2004). The provision of an access road and infrastructure for the dam resulted in the clearing of 1.2 ha of habitat and 100–200 plants of *B. hapalophylla* when the dam was constructed (Greenloaning 2004). Given the subsequent discovery of substantially more plants away from Shannon Creek, this clearing now represents less than 2% of the current known population.

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10. Continuing decline is not currently evident in the known subpopulations of *Boronia hapalophylla* despite plausible threats being present. The previous removal of a portion of the Shannon Creek subpopulation for the construction of an access road and infrastructure to support the construction of Shannon Creek Dam resulted in some localised population loss, however decline is no longer continuing, and this subpopulation is currently regarded as stable (J. Edwards *in litt.* April 2022) and the remaining plants are now protected in a conservation reserve (McPherson 2008).
11. *Boronia hapalophylla* appears to be adapted to persist in fire prone environments and recent surveys have found numerous seedling plants already producing seed less than two years post-fire (Sheringham 2021; G. Phillips pers. obs. November 2021). A number of subpopulations are subject to high fire frequencies shorter than the recommended fire-free threshold for the species of 10 years (NSW NPWS 2019; NSW BioNet 2022) and demographic shifts toward smaller plants and obligate seeding life strategies (Sheringham 2021) may be resulting from this. However, these subpopulations are reported to be in good health and stable, with no decline apparent post-fire and an appropriate mosaic of burnt and unburnt habitat being maintained (Sheringham 2021).
12. Clearing for rural development, agriculture, quarries, roads, tracks and forestry operations and the fragmentation these activities may cause are also plausible localised threats. However, the large proportion of currently recorded *Boronia hapalophylla* in conservation reserves and protected areas and the fact that core habitat is largely not conducive to clearing means that clearing is not regarded as contributing to continuing decline except in highly localised instances on individual plants (Sheringham 2021; P. Sheringham *in litt.* June 2022). Given this, no observed, estimated, inferred or suspected decline in Extent of Occurrence, Area of Occupancy, extent and/or quality of habitat, number of locations or subpopulations or number of mature individuals is yet evident and future declines resulting from identified threats are only regarded as plausible, not satisfying the definition for continuing decline (IUCN 2022).
13. The identified plausible future threats to *Boronia hapalophylla* of changes in fire regimes and the clearing of habitat and habitat fragmentation are also likely to be localised in nature if and when they do become apparent. Thus, these threats are not considered likely to rapidly drive the species to extinction in a very short time (1-2 generations) across its full distribution.
14. In view of the above, the NSW Threatened Species Scientific Committee is of the opinion that *Boronia hapalophylla* Duretto, F.J.Edwards & P.G.Edwards is not eligible to be listed as a threatened species in any category under the Act.

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Assessment against *Biodiversity Conservation Regulation 2017* criteria

The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome:

Boronia hapalophylla was found to be Least Concern and thus ineligible for listing as a threatened species as none of the Clauses were met.

Clause 4.2 – Reduction in population size of species

(Equivalent to IUCN criterion A)

Assessment Outcome: Clause not met

(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: Clause 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,

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	(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: Clause 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.

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Clause 4.5 - Low total numbers of mature individuals of species (Equivalent to IUCN criterion D)

Assessment Outcome: Clause 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.

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

(Equivalent to IUCN criterion D2)

Assessment Outcome: Clause 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.
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Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Phillips G.P. (2022) Conservation Assessment of *Boronia hapalophylla* Duretto, F.J.Edwards & P.G.Edwards (Rutaceae). NSW Threatened Species Scientific Committee.

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References:

- 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(2)**: 213–239.
- Duretto MF, Edwards J, Edwards P (2004). *Boronia hapalophylla* (Rutaceae), a new and restricted species from north-eastern New South Wales. *Telopea* **10(3)**: 705–710.
- Environmental Systems Research Institute (Esri) (2015). ArcGIS 10.4 for desktop. Redlands, California, USA. Esri Inc. 1999–2005.
- Greenloaning (2004). Clarence Valley and Coffs Harbour Regional Water Supply – Shannon Creek Storage – Ecological assessment of the amended preferred access road route, Parts A and B. A report for North Coast Water, Greenloaning Biostudies.
- Hughes L, Westoby M (1992). Fate of seeds adapted for dispersal by ants in Australian sclerophyll vegetation. *Ecology* **73(4)**: 1285–1299.
- IUCN Standards and Petitions Subcommittee (2022). Guidelines for Using the IUCN Red List Categories and Criteria. Version 15. URL: https://nc.iucnredlist.org/redlist/content/attachment_files/RedListGuidelines.pdf (Accessed 10 June 2022).
- Ma H, Wu H, Ooi MKJ (2018). Within population variation in germination response to smoke cues: convergent recruitment strategies and different dormancy types. *Plant Soil* **427**: 281–290.
- Mckenzie BDE, Auld TD, Keith DA, Hui FKC, Ooi MKJ (2016). The effect of seasonal ambient temperatures on fire-stimulated germination of species with physiological dormancy: A case study using *Boronia* (Rutaceae). *PLoS ONE* **11(5)**: e0156142.
- McPherson S (2008). Conservation Agreement between the Minister for the Environment of the State of New South Wales and Clarence Valley Council for Shannon Creek Conservation Area. Clarence Valley Council, Grafton, Australia.
- NSW BioNet (2022). Ecological data (Species: *Boronia hapalophylla*) [dataset]. NSW Department of Planning and Environment. URL: https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pld=10101&pType=SpeciesCode (Accessed 10 June 2022).
- NSW National Parks and Wildlife Service (NPWS) (2002). Recovery Plan for *Boronia granitica* (Granite Boronia). NSW National Parks and Wildlife Service, Hurstville, NSW.

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NSW National Parks and Wildlife Service (NPWS) (2009). Sherwood Nature Reserve Plan of Management. URL:

<https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Parks-reserves-and-protected-areas/Parks-plans-of-management/sherwood-nature-reserve-plan-of-management-090332.pdf>

(Accessed 28 April 2022).

NSW National Parks and Wildlife Service (NPWS) (2019). Firetools Cloud Results – NPWS North Coast Branch [dataset]. NSW Department of Planning and Environment. URL:

<https://datasets.seed.nsw.gov.au/dataset/firetools-cloud-results-for-npws-north-coast-branch> (Accessed 10 June 2022).

NSW Scientific Committee (2004). *Boronia hapalophylla* (a shrub) – endangered species listing. URL:

<https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2004-2007/boronia-hapalophylla-a-shrub-endangered-species-listing> (Accessed 28 April 2022).

Sheringham P (2021). Survey of Shannon Creek *Boronia hapalophylla*. Unpublished report to the NSW Department of Planning and Environment.