

NSW Threatened Species Scientific Committee

Conservation Assessment of *Grevillea iaspicula* McGill (Proteaceae)

Rachael Collett and Caren Taylor 4/4/2023

NSW Department of Planning, Industry and Environment

Grevillea iaspicula McGill (Proteaceae)

Distribution: Endemic to the Wee Jasper-Burrinjuck area in New South Wales (NSW)

Current EPBC Act Status: Endangered

Current NSW BC Act Status: Critically Endangered

Summary of Conservation Assessment

The Wee Jasper Grevillea, *Grevillea iaspicula*, was found to be eligible for listing as Critically Endangered under Criterion B1ab(iii).

The main reasons for this species being eligible are i) it has a very highly restricted geographic range; ii) it occurs at one location; iii) there are continuing declines in quality of habitat, caused by goat browsing outside of the fenced areas and an increase in the frequency and intensity of hot, dry conditions with climate change.

Description and Taxonomy

Grevillea iaspicula was first described in 1986 by D. McGillivray. There have been no subsequent revisions (Bray 2008).

Grevillea iaspicula is described in PlantNET as a “shrub, mostly 1.2–2.5 m high. Leaves light green, narrow-elliptic to -oblong, 1–3.5 cm long, 3–10 mm wide, margins entire and recurved, glabrous. Inflorescences often deflexed and pendant, in ovoid clusters, much branched, 2–3 cm long. Perianth green to cream, pinkish near curve, glabrous outside, bearded usually above the middle inside. Gynoecium 16–18 mm long; stipe inconspicuous, ventrally swollen, usually pilose; ovary glabrous or with isolated hairs; ovary densely hairy and ± sessile; style pink to red, glabrous. Follicle usually hairy, without dark stripes or blotches”..

Based on morphological characters, *Grevillea iaspicula* has been classified in the 'G. floribunda, G. sericea and related species' group, defined by McGillivray (1993). In this group is another subgroup that consists of *G. iaspicula*, *G. lanigera*, *G. baueri*, *G. jephcottii* and *G. rosmarinifolia*. Hybridisation between *G. rosmarinifolia* and *G. iaspicula* has been documented in a wild population of *G. iaspicula*, 100-200 m from cultivated *G. rosmarinifolia* (NSW TSSC 2009). There are no known wild populations of *G. rosmarinifolia* close to the wild populations of *G. iaspicula* (Bray 2008).

Distribution

Grevillea iaspicula is only found on limestone rock outcrops in a restricted area between Wee Jasper and Lake Burrinjuck on the NSW Southern Tablelands (NSW SOS 2021). The species is known from the edge of Lake Burrinjuck, around Wee Jasper, and along the steep cliffs of the Goodradigbee River (Hoebee *et al.* 2008). The population is geographically situated in two clusters. The northern most cluster contains two sites on the southern edge of Lake Burrinjuck: Burrinjuck Nature Reserve and the Bluff. The southernmost cluster sits to the east of Wee Jasper Nature Reserve and consist of three sites: Wee Jasper northwest, Wee Jasper south and Punchbowl. There is approximately 16 km between the most northern site at Burrinjuck and the southernmost site at Wee Jasper. The two Lake Burrinjuck sites are separated by 2 km from east to west. The three sites surrounding Wee Jasper are each separated by

NSW Threatened Species Scientific Committee

2 km from north to south. Three of these sites are on private land, one occurs on Burrinjuck Nature Reserve, and one is located on crown land reserve in an area dedicated for recreation (NSW SOS 2021). All the currently occupied sites are fenced to exclude goats.

Grevillea iaspicula was first collected in 1966 at Macphersons Swamp Creek, 20km northwest of Wee Jasper. The species has not been re-located at this site. Briggs and Leigh (1990) conducted two searches along several kilometres of the northern end of Macphersons Swamp Creek but failed to locate *G. iaspicula*. The collection site may have once been part of a larger Lake Burrinjuck population. The area has since been over-run by goats (Bray 2008). Although there is no evidence that *G. iaspicula* was widespread in the recent past, it is possible that some of its original population was submerged following the damming of Lake Burrinjuck (NSW Government 2021). The species geographic range is also likely to have been reduced by land clearing and heavy grazing from domestic stock and wild goats (Bray 2008).

Extent of Occurrence and Area of Occupancy

Grevillea iaspicula has a 34 km² Extent of Occurrence (EOO), calculated as a minimum convex polygon containing all known occurrences, the method of assessment recommended by IUCN (2022). The Area of Occupancy (AOO) is estimated to be 20 km² based on 2 x 2 km grid cells, the scale recommended for assessing AOO by IUCN (2022).

Abundance

Grevillea iaspicula grows to 2.5 m high. The species is mature by three years of age, which generally corresponds to a height of more than 1 m (Hoebee *et al.* 2008). Therefore, plants >1 m are classed as mature individuals for this assessment. The presented total number of mature individuals is the lowest estimate, as some mature plants may fall into a smaller size class due to browsing or dieback.

The *Grevillea iaspicula* population contains 734 mature individuals, based on a 2022 count of all plants at the five sites and assignment to size classes. The total population size is 1853, spread across five size classes (<25 cm, 26-50 cm, 51-100 cm, 100-200 cm and >200 cm) (R. Armstrong pers. comm. June 2022). Efforts to manage the threats to *G. iaspicula* have occurred since the species' discovery, and there have been substantial population increases across all sites in the last two decades, from a mature population of ~154 plants in 2003 (Bray 2008) to 734 in 2022. Severe drought in 2017–2020 resulted in a net population decline including a loss of 66% of individuals at the Burrinjuck Nature Reserve site (J. Briggs pers. comm March 2022). However, the total population has increased since the breaking of the drought and favourable seasonal conditions from mid-2020 (NSW SOS 2021).

There have been three enhancement plantings since 2003 within three of the naturally occurring sites. Enhancement plantings consisted of 160 seedlings being planted. Of these initial plantings 114 survived to maturity and have since been viably producing flowers and seed (J. Briggs pers. comm August 2022).

Ecology

Cultural Significance

NSW Threatened Species Scientific Committee

The Yass region, including the Wee Jasper valley, has traditionally been inhabited by the Aboriginal Ngunnawal and Wiradjuri peoples (NSW Gov 2010). The name Burrinjuck is thought to derive from the local Aboriginal words Booren Yiack (unknown language group specifically), which mean 'precipitous mountain', and refers to the peak that rises in the west. Evidence of Aboriginal use of the land can be seen in protected archaeological deposit sites throughout the Burrinjuck reserve and Wee Jasper Valley (NSW NPWS 2023).

This assessment is not intended to be comprehensive of the Traditional Ecological Knowledge that exists for *Grevillea iaspicula* or to speak for the Wiradjuri or Ngunnawal people. Aboriginal people have a long history of biocultural knowledge, which comes from observing and being on Country, and evolves as it is tested, validated, and passed through generations (Woodward *et al.* (Eds.) 2020). Aboriginal Peoples have cared for Country for tens of thousands of years (Bowler *et al.* 2003; Clarkson *et al.* 2017). Although no specific information could be collected on *Grevillea iaspicula* specifically it is acknowledged that there is traditional ecological knowledge for all plants, animals and fungi connected within the kinship system (Woodward *et al.* (Eds.) 2020). Many diverse Aboriginal groups across Australia have been known to use *Grevillea* sp. flowers to make sweet drinks and nectar can be sucked directly as a sweet treat (Cumpton 2020).

Habitat

Grevillea iaspicula grows on rocky limestone outcrops, and around sink holes and cave entrances (NSW Government 2021). There is a suggestion that the species' current distribution may be the result of periods of heavy grazing, as these rocky outcrops would have offered some protection from domestic stock (McGillivray 1993). *Grevillea iaspicula* is found in remnant open woodland dominated by *Eucalyptus albens* (White Box) and *Eucalyptus bridgesiana* (Apple Box), generally with an open understorey of shrubs and grasses (Briggs and Leigh 1990). Vegetation at four of the five sites has been highly disturbed by the conversion of land for stock grazing (Hoebee 2002).

Life history

Flowering has been recorded between May and December, and there is a peak in winter and spring (McGillivray 1993; NSW OEH 2022). *Grevillea iaspicula* is primarily bird pollinated (as with other red or pink-flowered grevilleas) (Briggs and Leigh 1990). Honeyeaters have been recorded visiting the flowers (Hoebee and Young 2001), as have European honeybees (NSW TSSC 2009). Given the species is known to be bird pollinated, there is likely to be some gene flow between sites (J. Briggs pers. comm March 2022). However, Hoebee and Young's (2001) genetic diversity study showed that genetic distances were large between the sites, indicating genetic isolation and limited gene flow (Hoebee and Young 2001).

The species readily sets seed, and fruits ripen in late December (Bray 2008). Recruitment is episodic and dependent on favourable seasonal conditions (NSW Government 2021). Seedling establishment can be reasonably plentiful with good rainfall in winter or spring, and where stock grazing is excluded (J. Briggs pers. comm. March 2022).

The lifespan of *Grevillea iaspicula* is approximately 11 years (Hoebee *et al.* 2008). Plants start to flower at 3-5 years, and flower reliably after 5 years (J. Briggs pers.

NSW Threatened Species Scientific Committee

comm March 2022). Based on this information, generation time is estimated to be approximately 10 years (*sensu* IUCN 2022).

Threats

Weeds

Grevillea iaspicula is threatened by weed invasion (NSW TSSC 2009). *Rubus fruticosus* (Blackberry) poses the greatest threat, and some sites are also heavily infested with *Rosa rubiginosa* (Sweet Briar), *Hypericum perforatum* (St John's Wort) and other woody weeds including *Cotoneaster* and *Photinia*. Woody weeds have the capacity to smother *G. iaspicula* (NSW Government 2021). Weed invasion is particularly prevalent at the three sites near Wee Jasper. There is ongoing management of weeds at all *G. iaspicula* sites, which has effectively reduced this threat. If management is not continued weeds are likely to cause population decline (J. Briggs pers. comm March 2022).

Browsing by feral and domestic goats

Browsing by goats (*Capra hircus*) has resulted in past population declines of *Grevillea iaspicula* and continued degradation of the species' habitat, including the loss of all adult plants (~240) from the Burrinjuck sites between 1986 and 1996 (J. Briggs pers. comm August 2022). All five known sites have now been fenced (30 ha) to protect the species from herbivory and habitat degradation, and this has assisted with substantial recovery of the population within the fenced areas (NSW SOS 2021). Recruitment is not viable outside of the fenced sites as seedlings are eaten by goats (J. Briggs pers. comm August 2022). Goats pose a threat at all sites and the fences require ongoing management, including quarterly fence checks. Cessation of management would lead to goat incursion and likely *G. iaspicula* population decline within the fenced areas (J. Briggs pers. comm March 2022). 'Competition and habitat degradation by Feral Goats, *Capra hircus* Linnaeus 1758' is listed as a Key Threatening Process under the *Biodiversity Conservation Act 2016*.

High frequency fire

High frequency fire regimes may pose a threat at all *Grevillea iaspicula* sites. The Bluff site was burnt in a wildfire in January 2003. This fire killed all but 10 plants at the site, which consisted of 40-50 mature plants at the time. In the late 2000s, relatively small parts of the Wee Jasper South and Wee Jasper North-west sites were burnt. Both fires started in neighbouring properties and escaped into the *G. iaspicula* sites. Most plants within the burnt areas were killed (J. Briggs pers. comm August 2022). As with other *Grevillea* species in fire-prone habitats (Morris 2000; Auld & Denham 2006), standing plants are killed by fire and the population depends on regeneration of seedlings from a persistent soil seed bank. The time taken for seedlings to reach maturity and produce seed is 3-5 years (NSW SOS 2021). There is a small risk that frequent fires may therefore interrupt the species life cycle and result in population declines (Keith 1996). However, this threat is considered unlikely to occur, as an entire site would have to burn twice within ~5 years to be extirpated. 'High frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is listed as a Key Threatening Process under the *BC Act 2016*.

NSW Threatened Species Scientific Committee

Hybridisation

Hybridisation and genetic introgression from cultivated *Grevillea* taxa, particularly *Grevillea rosmarinifolia*, is a potential threat. Cultivated *G. rosmarinifolia* readily spreads into nearby areas, where it can hybridise with local grevillea species, polluting their genetic integrity and threatening the survival of rare species (Identic 2016). There are no known wild populations of *G. rosmarinifolia* close to the *G. iaspicula* sites, however there are domestic plantings of *G. rosmarinifolia* at Wee Jasper and hybridisation between *G. rosmarinifolia* and *G. iaspicula* has been documented in wild *G. iaspicula*, growing 100-200 m from cultivated *G. rosmarinifolia* (NSW TSSC 2009).

Decreasing rainfall and increasing temperature as a result of climate change

Grevillea iaspicula is sensitive to dry conditions and high mortality occurs during extended dry conditions (J. Briggs pers. comm March 2022). Severe drought from 2017–early 2020 led to significant death of plants, causing an overall population to decline of 15% from 2018 to 2020, including plants from all size classes (NSW SOS 2021). The two Burrinjuck site were particularly impacted and 66% of individuals were lost (J. Briggs pers. comm March 2022). Droughts are predicted to become more frequent and intense under climate change in NSW (Hennessy et al. 2004; IPCC 2021). Climate model projections using 10 km grid cells around the *G. iaspicula* sites indicate an increasing risk of below average annual (-2.8%) and spring (-11.4%) rainfall in the near future (2020-39), and higher annual temperatures (+2.01°C) and number of days >35°C (+12) in the far future (2060-79) (NSW Government 2022). There is a substantial projected increase in frequency of extremely hot and extremely dry years in southeast Australia (CSIRO 2021). Increased frequency and intensity of hot, dry conditions will cause high mortality of both adult and immature plants, and reduced spring rainfall is likely to impact seedling establishment, which is reliant on good rainfall in winter and spring (J. Briggs pers. comm March 2022).

Uncertainty of land management on private property

Three of the *Grevillea iaspicula* sites (Bluff, Wee Jasper North-west, and Wee Jasper South) occur on private property and as such there is a risk that land management practices will not be conducive to the conservation of the species. The current landowners are supportive of protecting *G. iaspicula* and of the Saving our Species conservation project, however this may change in the future if land ownership or management changes (NSW SOS 2021).

Land clearing

Most of the hills immediately west of the southern arm of Lake Burrinjuck have been cleared of native vegetation. Clearing for agriculture and grazing pressure are likely to have led to a historical decline in the *Grevillea iaspicula* population and degradation of the species' habitat (Bray 2008). The few remaining sites exist in a fragmented landscape that has been cleared for agriculture and grazing (Hoebee and Young 2001), and some level of land clearing is likely to be ongoing.

Assessment against IUCN Red List criteria

Criterion A

Population size reduction

NSW Threatened Species Scientific Committee

plants in the past (NSW SOS 2021), and decreased rainfall and higher temperatures are therefore likely to lead to poorer site conditions over time.

c) Extreme fluctuations.

Assessment Outcome: Not met.

Justification: Changes in the mature population observed to date do not meet the subcriterion for extreme fluctuations, which are typically required to be 10-fold (IUCN 2022).

Criterion C *Small population size and decline*

Assessment Outcome: Not met.

Justification: The *Grevillea iaspicula* population is currently observed to contain 734 mature individuals, based on a 2022 population census using height of >1 m as a proxy for maturity. Therefore, the species falls under the Endangered threshold for number of mature individuals (<2,500). However, the additional conditions are not met, as the population is currently in an upward trajectory, due to weed management and the fencing of all sites to exclude goats. Any cessation of goat or weed management would lead to a decline in number of mature individuals (J. Briggs pers. comm March 2022).

Criterion D *Very small or restricted population*

Assessment Outcome: Vulnerable under D1.

Justification: The *Grevillea iaspicula* population is observed to contain 734 mature individuals, based on a 2022 population census using height of >1 m as a proxy for maturity. Therefore, the species falls within the Vulnerable threshold for number of mature individuals under D1 (<1000). The species has a 20 km² AOO and one location, however there is no clear future threat to *G. iaspicula* that would contribute to the extinction of the species in a very short time. As a result, *G. iaspicula* does not meet the threshold for listing under Criterion D2.

To be listed as Vulnerable under D, a species must meet at least one of the two following conditions:

D1. Population size estimated to number fewer than 1,000 mature individuals

Assessment Outcome: Vulnerable under D1.

Justification: The *Grevillea iaspicula* population is observed to contain 734 mature individuals, based on a 2022 population census using height of >1 m as a proxy for maturity. Therefore, the species falls within the Vulnerable threshold for number of mature individuals under D1 (<1000).

D2. Restricted area of occupancy (typically <20 km²) or number of locations (typically <5) with a plausible future threat that could drive the taxon to CR or EX in a very short time.

NSW Threatened Species Scientific Committee

Assessment Outcome: Not met.

Justification: The species has a 20 km² AOO and one location, however there is no clear future threat to *Grevillea iaspicula* that would contribute to the extinction of the species in a very short time.

Criterion E Quantitative Analysis

Assessment Outcome: Data deficient.

Justification: Sufficient data are not available to conduct a quantitative analysis.

Conservation and Management Actions

This species is currently listed on the NSW *Biodiversity Conservation Act 2016* and a conservation project has been developed by the NSW Department of Planning and Environment under the Saving our Species program. The conservation project identifies priority locations, critical threats and required management actions to ensure the species is extant in the wild in 100 years. *Grevillea iaspicula* sits within the site-managed species management stream of the SoS program and the conservation project can be viewed here:

(<https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10366>).

References

Auld TD, Denham AJ (2006) How much seed remains in the soil after fire? *Plant Ecology* **187**, 15-24.

Bray C (2008) 'Conservation status of *Grevillea iaspicula* McGillivray (Proteaceae) in New South Wales'. Report to the NSW Scientific Committee, Sydney.

Bowler JM, Johnston H, Olley JM, Prescott JR, Roberts RG, Shawcross W, Spooner NA (2003). New ages for human occupation and climatic change at Lake Mungo, Australia. *Nature*, 421(6925), 837-840.

Briggs JD, Leigh JH (1990) 'Delineation of important habitats of threatened plant species in south-eastern New South Wales'. Australian Heritage Commission, Canberra.

CSIRO (2021) Drought in south-east Australia. Available at: <https://www.csiro.au/en/research/natural-disasters/drought/Forecasting-and-monitoring/South-east-Australia> (accessed 07/07/2022).

Clarkson C, Jacobs Z, Marwick B, Fullagar R, Wallis L, Smith M, Roberts RG, Hayes E, Lowe K, Carah X, Florin SA (2017) Human occupation of northern Australia by 65,000 years ago. *Nature*, 547(7663), pp.306-310.

Cumpston Z (2020) Indigenous Plant Uses. A booklet on the medicinal, nutritional and technological use of Indigenous plants. Clean air and Urban landscapes Hub.

NSW Threatened Species Scientific Committee

Available at; <https://nespurban.edu.au/wp-content/uploads/2020/08/Indigenous-plant-use.pdf> (accessed 3rd April 2023)

Enright NJ, Fontaine JB, Bowman DMJS, Bradstock RA, Williams RJ (2015) Interval squeeze: Altered fire regimes and demographic responses interact to threaten woody species persistence as climate changes. *Frontiers in Ecology and the Environment* **13(5)**, 265–272.

Hennessy K, McInnes K, Abbs D, Jones R, Bathols J, Suppiah R, Ricketts J, Rafter T, Collins D, Jones D (2004) Climate change in New South Wales, Part 2: Projected changes in climate extremes. Technical Report. CSIRO Atmospheric Research, Technical Report (Aspendale, Victoria, Australia) http://www.cmar.csiro.au/e-print/open/hennessy_2004c.pdf.

Hoebee SE (2002) 'Conservation genetics of the endangered shrub *Grevillea iaspicula*.' PhD thesis, Australian national University, Australia.

Hoebee SE, Young AG (2001) Low neighbourhood size and high interpopulation differentiation in the endangered shrub *Grevillea iaspicula* McGill (Proteaceae). *Heredity* **86**, 489-496.

Hoebee SE, Thrall PH, Young AG (2008) Integrating population demography, genetics and self-incompatibility in a viability assessment of the Wee Jasper *Grevillea* (*Grevillea iaspicula* McGill., Proteaceae). *Conservation Genetics* **9**, 515-529.

Identic (2016) 'Weeds of Australia - *Grevillea rosmarinifolia*.' Available at: https://keyserver.lucidcentral.org/weeds/data/media/Html/grevillea_rosmarinifolia_subsp._rosmarinifolia.htm (accessed 13.07.2022).

IPCC (2021) Climate Change 2021: The Physical Science Basis. Cambridge University Press, Cambridge, United Kingdom.

IUCN Standards and Petitions Subcommittee (2022) Guidelines for Using the IUCN Red List Categories and Criteria. <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>.

McGillivray D (1993) *Grevillea*, Proteaceae: a taxonomic revision. Melbourne University Press, Carlton.

Morris EC (2000) Germination response of seven east Australian *Grevillea* species (Proteaceae) to smoke, heat exposure and scarification. *Australian Journal of Botany* **48**, 179–189.

Keith, DA (1996) Fire-driven mechanisms of extinction in vascular plants: a review of empirical and theoretical evidence in Australian vegetation. *Proceedings of the Linnean Society of New South Wales* **116**, 37-78.

NSW Government (2021) 'Wee Jasper *Grevillea* - profile.' Available at: <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10366> (accessed 14.06.2022).

NSW Threatened Species Scientific Committee

NSW Government (2022) 'Adapt NSW – Interactive climate change projections map.'
Available at: <https://www.climatechange.environment.nsw.gov.au/projections-map>
(accessed 14.07.2022).

NSW Government (2010) Wee Jasper Nature Reserve Plan of Management. NSW National Parks and Wildlife Service Part of the Department of Environment, Climate Change and Water May 2010. Available at: [Wee Jasper Nature Reserve - Plan of Management \(nsw.gov.au\)](#) (accessed 3rd April 2023)

NSW NPWS (2023) Burrinjuck Nature Reserve. Available at: Burrinjuck Nature Reserve | NSW National Parks. (Accessed 3rd April 2023)

NSW Office of Environment and Heritage (2022) BioNet Atlas. Data accessed 13/07/2022.

NSW Saving our Species (2021) Saving our Species project report 2016 - 2021. Unpublished report.

NSW Scientific Committee (2009) Final determination to list to list the shrub *Grevillea iaspicula* McGill as Critically Endangered [WWW Document]. Available at: <https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2008-2010/grevillea-iaspicula-critically-endangered-species-listing> (accessed 01.07.2022).

Olde P, Marriott N (1995) The Grevillea Book. Kangaroo Press, Kenthurst.

PlantNET (The NSW Plant Information Network System) Royal Botanic Gardens and Domain Trust, Sydney. <http://plantnet.rbgsyd.nsw.gov.au> (accessed 30 June 2022). Available at:
<https://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Grevillea~iaspicula#:~:text=Grevillea%20iaspicula%20McGill.&text=Description%3A%20Shrub%2C%20mostly%201.2%E2%80%93,%2C%202%E2%80%933%20cm%20long.>

Woodward, E., Hill, R., Harkness, P. and R. Archer (Eds.) (2020) Our Knowledge Our Way in caring for Country: Indigenous-led approaches to strengthening and sharing our knowledge for land and sea management. Best Practice Guidelines from Australian Experiences. NAILSMA and CSIRO, Cairns, Australia. Available at:
<https://www.csiro.au/en/research/indigenous-science/indigenous-knowledge/our-knowledge-our-way> [Verified 01 September 2022].

Expert Communications

John Briggs – NSW Government, Department of Planning and Environment
Rob Armstrong - NSW Government, Department of Planning and Environment

NSW Threatened Species Scientific Committee

APPENDIX 1

Assessment against *Biodiversity Conservation Regulation 2017* criteria

The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome:

Grevillea iaspicula was found to be Critically Endangered under Clause 4.3 (a)(d)(e, iii).

Clause 4.2 – Reduction in population size of species

(Equivalent to IUCN criterion A)

Assessment Outcome: 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: 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,

NSW Threatened Species Scientific Committee

	(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: 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: Vulnerable under Clause 4.5(c).

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

NSW Threatened Species Scientific Committee

(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.
-------------------------	--