

NSW Threatened Species Scientific Committee

Conservation Assessment of *Lobelia claviflora* Albr. & R.W.Jobson (Campanulaceae)

J Scott 15/07/2021

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***Lobelia claviflora* Albr. & R.W.Jobson (Campanulaceae)**

Distribution: Endemic to NSW

Current EPBC Act Status: Not listed

Current NSW BC Act Status: Not listed

Proposed listing on NSW BC Act and EPBC Act: Critically Endangered

Conservation Advice: *Lobelia claviflora*

Summary of Conservation Assessment

Lobelia claviflora was found to be eligible for listing as Critically Endangered under Criterion B1ab(iii)+B2ab(iii).

The main reasons for this species being eligible are: i) it has a very highly restricted geographical range; ii) it is only found at a single location; and (iii) there is inferred continuing decline due to habitat disturbance from feral pigs, stock grazing and further loss of potential habitat.

Description and Taxonomy

Lobelia claviflora was discovered in 2012 and recently described by Albrecht *et al.* (2018). PlantNET (2020) describe it as an “annual (or possibly rarely a short-lived perennial) herb to c. 25 cm high, single-stemmed or occasionally with several stems arising from base. Stems erect or ascending, glabrous, sometimes producing adventitious roots from lower nodes. Leaves linear-subulate or lowermost linear-lanceolate, 5–21 mm long, 0.4–3 mm wide, glabrous, entire or lower leaves with irregularly placed small marginal swellings, apex narrowly acute to subacute, often with a tiny translucent apiculum, base attenuate. Flowers bisexual, each initially developing in the axil of one leaf of a sub-opposite pair of distal leaves, the axis between the sub-opposite leaves subsequently elongating so that the leaves are displaced and appear alternate, this pattern repeating with subsequent terminal growth so that a flower appears to be borne at every second node, lateral flower-bearing shoots sometimes produced from the ‘non-flowering’ nodes if conditions favourable for flowering persist; pedicels 16–55 mm long, glabrous. Calyx lobes 1.5–2.5 mm long. Corolla weakly 2-lipped, 10–14 mm long; upper lip two-lobed, violet-blue; lower lip three-lobed, the lobes basally fused for c. 2–3.5 mm above the sinus between the two lips, the fused part with a prominent central yellow zone and 3 deep purple, ±basally fused broad bands, deep purple bands extending into the tube on the ventral side and covered with dense club-shaped hairs; central lobe violet-blue distally, white proximally; lateral lobes mostly violet-blue but white proximally on the half adjacent to the central lobe; tube 5–7 mm long, split to within 3.5–4.8 mm of base on dorsal side, glabrous externally, internally with dense club-shaped hairs on the ventral side covering the deep purple vertical bands and yellow zone adjacent and immediately below, longer hairs to c. 0.3 mm present further below in the proximal region of the

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tube. Anther tube dark greyish-blue, 1.5–1.9 mm long, two lower anthers each with an apical seta c. 0.3–0.5 mm long. Fruit obconical to obovoid, slightly compressed laterally, 3.3–5 mm long. Seeds subcylindrical to ellipsoid or ovoid, subterete to slightly compressed, 0.38–0.5 mm long, mid to dark brown, with a network of almost straight to heterogeneously undulating close fine surface ridges.”

Lobelia claviflora has also been known as *Isotoma* sp. 'Cuttabri' (R.W. Jobson RWJ 1540) (PlantNET 2020).

“Of the species of Lobelioideae occurring in NSW, only *Lobelia stenophylla* Benth [this species is incorrectly referred to *Isotoma armstrongii* E.Wimm. in the Flora of New South Wales (Wiecek 1992)] shares with *L. claviflora* the non-mat-forming habit, violet-blue corolla <18 mm long with a weakly cleft tube, linear-lanceolate leaves with entire to weakly toothed margins, and preference for swamps, creeks and other seasonally moist areas. However, *Lobelia stenophylla* is readily distinguished from *L. claviflora* in having the upper two corolla lobes less than half the width of the lower three lobes, the corolla lacking hairy deep purple bands in the throat, the apex of the lower 2 anther cells each with a minute seta c. 0.1–0.4 mm long but lacking an associated tuft of microhairs, and the seeds having a reticulate testa with more or less isodiametric alveolae.” (Albrecht *et al.* 2018).

Distribution and Abundance

Lobelia claviflora is a short-lived, ephemeral semi-arid species that occurs near Cuttabri, south west of Wee Waa in north western NSW (Appendix 2). It is currently known from three sites that are no more than 5.5 km apart and located on private land in sedge-dominated wetlands occupying shallow basins on the Namoi River floodplain (Albrecht *et al.* 2018). The vegetation community where *Lobelia claviflora* currently occurs is dominated by *Eleocharis blakeana*, *E. pusilla*, *Damasonium minus*, *Goodenia gracilis*, *Utricularia fenhamii*, *Nymphoides geminata*, *Juncus radula*, *Eriocaulon australasicum* and *Eragrostis microcarpa* (Albrecht *et al.* 2018). *Eucalyptus pilligaensis* and *Casuarina cristata* occur scattered within and on the margins of the sedgeland (Albrecht *et al.* 2018). The general area in which the swamps are located is heavily thinned woodland that is used for grazing livestock (R. Jobson *in litt.* February 2019).

The three known sites were surveyed in 2016 and a total of 380-500 individuals were observed, with approximately 400 (± 50 plants), 40 (± 10 plants) and one mature individual of *Lobelia claviflora* recorded at each site, respectively (R. Jobson *in litt.* February 2019). The number of plants was estimated by circumnavigating the swamps and counting all individuals that were seen in a 1.5-hour time period. The species can only be detected above ground following significant rainfall events, as *L. claviflora* is present only in the soil seed bank in dry times (R. Jobson pers. comm. December 2020). The searches detecting the known occurrences for *Lobelia claviflora* were not systematic or comprehensive and potential habitat occurs in the region for several kilometres in all directions from the known sites (Albrecht *et al.* 2018). The potential habitat might be quite restricted, as the vegetation community in which *Lobelia claviflora* currently occurs comprises a distinct suite of species and it may warrant recognition as a distinct ecological community (R. Jobson *in litt.* February 2019). On the other hand, the habitat may be more widespread and include wetlands of the 'Pilliga Outwash Ephemeral Wetlands in the Brigalow Belt South Bioregion' (and referred to in the remainder of this report as the 'Pilliga Outwash TEC'). The Pilliga

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Outwash TEC is an Endangered Ecological Community (NSW TSSC 2015) listed under the NSW BC Act and extends in a band of c. 40 km to the north and northwest of Pilliga National Park towards the Namoi River (Bell *et al.* 2012). The wetlands where *Lobelia claviflora* occurs are potentially part of the Pilliga Outwash TEC (J.T. Hunter *in litt.* April 2020). *Lobelia claviflora* was not recorded in surveys of the Pilliga Outwash TEC during an appropriate wet period by Bell *et al.* (2012) (Albrecht *et al.* 2018) but not all wetlands of this TEC may have been surveyed.

The Pilliga State Conservation Area and Pilliga National Park are the closest conservation reserves to known sites (situated within 10 - 20 km) and they may also have suitable habitat. The northern edge of the Pilliga is floristically diverse with a number of species restricted to that area or known in few other localities in NSW (K. Wilson *in litt.* August 2019). *Myriophyllum implicatum* and *Eriocaulon australasicum* are listed on the NSW BC Act and co-occur in the largest of the wetlands containing *Lobelia claviflora*, while also occurring in other states (*M. implicatum* in Queensland, *E. australasicum* in Victoria (PlantNET 2020)). Further searches for *L. claviflora* in the surrounding landscape could include potential habitat of these co-occurring species. It should be noted that areas in Pilliga National Park where *M. implicatum* occurs consist of slightly different habitat to the known sites for *L. claviflora* (T. Mazzer pers. comm June 2020), but may still be worth considering when surveying for *L. claviflora*. A map of the distribution of potential habitat near current records of *M. implicatum* is shown in Appendix 3.

Lobelia claviflora has a very highly restricted geographic distribution. Records were accessed from the Atlas of Living Australia database (accessed on 25th August 2020) and from Jobson (*in litt.* February 2019). The area of occupancy (AOO) and the extent of occurrence (EOO) were estimated using the GeoCAT tool (Bachman *et al.* 2011) with the adjustment of the grid reference point to give the minimum AOO estimate as per NSW TSSC Guidelines (2020). The AOO was estimated to be 8 km², based on the species occupying two 2 km x 2 km grid cells, the spatial scale of assessment recommended by IUCN (2019). The EOO was also 8 km². The EOO is reported as equal to AOO, despite the range of the species, measured by a minimum convex polygon containing all the known sites of occurrence (2.9 km²), being less than the AOO. This is to ensure consistency with the definition of AOO as an area within EOO, following IUCN Guidelines (2019). The Critically Endangered threshold is met for EOO (<100 km²) and AOO (<10 km²). As noted above, further searches of nearby potential habitat may lead to the discovery of further populations of *L. claviflora*. If new populations are found the EOO may exceed the Critically Endangered threshold of 100 km² but is less likely to exceed the Endangered threshold of 5,000 km² or the Vulnerable threshold of 20,000 km². The EOO for the Pilliga Outwash TEC is 2,342 km² (NSW TSSC 2015) (Endangered) and may be indicative of the upper bound of possible habitat extent for *L. claviflora*, but only if assuming the habitat is similar. Further survey work in the area nearby to the known sites of *L. claviflora* is required to determine if the habitat is distinctive as suggested by R. Jobson (*in litt.* February 2019). If it is a distinctive vegetation community, correlating it with the more widespread Pilliga Outwash TEC may not be appropriate.

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Ecology

Lobelia claviflora is an ephemeral herb that appears shortly after significant rain that floods the local creeks and leads to the inundation of wetland habitat (R. Jobson *in litt.* February 2019). Emergent flowering plants of *L. claviflora* are found in water up to c. 20 cm in depth and also in moist areas on the margins of swamps from which water has receded (Albrecht *et al.* 2018). *Lobelia claviflora* appeared following habitat inundation in October 2012 to January 2013 and again between October 2016 and December 2016 (R. Jobson *in litt.* February 2019). There were no above ground plants observed in the intervening dry period (R. Jobson *in litt.* February 2019).

Flowering was observed in October 2016 indicating it may have commenced in September (Albrecht *et al.* 2018). In cultivation, with unlimited water supply, *Lobelia claviflora* was observed to flower through to April the following year (Albrecht *et al.* 2018). It is likely that in the wild, plant longevity and the length of the flowering season are determined by rainfall events and temperature patterns (Albrecht *et al.* 2018).

Whilst there was good rainfall in parts of north-western NSW during 2020, a field inspection in late 2020 suggested that there had been no spring flooding to promote germination and growth of *Lobelia claviflora* (R. Jobson *in litt.* Nov 2020).

Threats

Much of the Pilliga Outwash area and particularly the ephemeral wetlands are subject to continuing physical degradation from domestic and feral animals and other agricultural activities (K. Wilson *in litt.* August 2019) including alteration of the water regime by dam construction (Brock *in litt.* October 2019).

Livestock grazing

All three sites where *Lobelia claviflora* are found are open to domestic livestock grazing in both wet and dry periods. The wetland habitat can be a focal point for domestic stock and feral animals (D. Albrecht *in litt.* July 2019). Livestock may trample the soil disrupting the seed bank and graze on plants (during wet periods). They add nutrients to the habitat that can exacerbate weed growth and may increase water turbidity.

Feral animal damage

Feral pigs (*Sus scrofa* Linnaeus 1758) occur throughout the area and damage has been observed at the two smaller sites where *Lobelia claviflora* occurs. Pigs trample and dig up the soil leading to disturbance to the ground surface, vegetation foliage, roots and soil seed bank, and fauna habitats. Disruption of the soil seed bank may affect future plant recruitment. 'Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* Linnaeus 1758' is a Key Threatening Process under the BC Act.

Disturbance to the Habitat

There is a history of conversion of wetlands to stock watering points throughout the surrounding landscape (D. Albrecht *in litt.* July 2019). Similar swamp habitat nearby (within c. 300 m) to the wetlands where *Lobelia claviflora* currently occurs have been converted to dams (R. Jobson *in litt.* February 2019). The conversion of wetlands to dams may involve clearing of habitat, removal or relocation of soil and the building of levee banks leading to the disruption to the natural hydrology of the area. This may

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damage and disturb the soil seed bank of *L. claviflora* and lead to the local extinction of the species at these sites. *Lobelia claviflora* was not found in the nearby dam sites (R. Jobson *in litt.* February 2019). Whether it was previously located there is unknown, but the wetlands may have been habitat that is now lost. Other nearby wetlands may be suitable habitat for *L. claviflora* (even if not currently occupied). The loss of sites that may play a role in recolonization may eventually impact the species (IUCN 2019).

Other human activities may also lead to the disruption of the natural hydrology of the very flat terrain. Road maintenance activities including the mounding of soil beside roads can disrupt the hydrology of the area. Wetland species are sensitive to hydrological change as it is the pattern of access to periodic inundation that often drives their life cycles. 'Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands' is a Key Threatening Process under the BC Act.

Assessment against IUCN Red List criteria

For this assessment the current data are considered adequate and there is sufficient scientific evidence to support the listing outcome. Further survey of *Lobelia claviflora* following sufficient rainfall is recommended.

Criterion A Population Size reduction

Assessment Outcome: Data Deficient

Justification: There are no available data to determine if there has been a reduction in the population size of *Lobelia claviflora*.

Criterion B Geographic range

Assessment Outcome: Critically Endangered under Criterion B1ab(iii)+B2ab(iii).

Justification: *Lobelia claviflora* has a very highly restricted geographic distribution. The area of occupancy (AOO) was estimated to be 8 km², based on the species occupying two 2 km x 2 km grid cells, the spatial scale of assessment recommended by IUCN (2019). The extent of occurrence (EOO) was also 8 km². The EOO is reported as equal to AOO, despite the range of the species, measured by a minimum convex polygon containing all the known sites of occurrence (as 2.9 km²), being less than AOO. This is to ensure consistency with the definition of AOO as an area within EOO, following IUCN Guidelines (2019). *L. claviflora* meets the Critically Endangered threshold for both EOO (<100 km²) and AOO (<10 km²).

In addition to these thresholds, at least two of three other conditions must be met. These conditions are:

- a) The population or habitat is observed or inferred to be severely fragmented or there is 1 (CR), ≤5 (EN) or ≤10 (VU) locations.

Assessment Outcome: There is only one location, which fits the threat category of critically endangered. The species is not currently considered to be severely fragmented.

Justification: The main threat for defining the number of locations is disturbance of the habitat/seed bank from domestic livestock and feral pigs. Feral pigs occur throughout the waterways and may affect all habitat, above

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and below ground plants and the seed bank of *L. claviflora* at all three sites during the same period of time. There has been evidence of damage from feral pigs at two of the three sites. Each of the wetland sites are open to livestock grazing during both wet and dry periods (R. Jobson *in litt.* February 2019).

The species is probably not severely fragmented even though the two smaller sites may not be viable as they had a very low number of *L. claviflora* individuals when they were surveyed in 2016. However, they are not separated by a large distance and seeds are likely to be dispersed via flooding, potentially allowing recolonisation.

- b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals

Assessment Outcome: met for (iii)

Justification: There is continuing decline in the quality of the habitat from the ongoing disturbance from feral pigs and livestock grazing. *Lobelia claviflora* is reliant on the seed bank in the soil for the establishment of the next generation of plants following the next wet period. The threat of clearing of potential habitat for construction of dams, as has occurred in similar habitats adjacent to the known occurrences of *L. claviflora*, is also likely to limit the future recolonization options which may eventually impact the species.

- c) Extreme fluctuations.

Assessment Outcome: Data deficient

Justification: It is unknown if *Lobelia claviflora* has extreme fluctuations and more information about the ecology of the species is required before this can be determined. Even though the plants are only above ground following a wet period and die back in the dry periods, there remains a seed bank in the soil. It is not known how much of the seed bank is exhausted after a flood event.

Criterion C Small population size and decline

Assessment Outcome: Data Deficient.

Justification: In 2016 Jobson (*in litt.* February 2019) estimated there were 350-500 mature individuals based on observations whilst circumnavigating the swamps where the species was known to occur. This currently meets the threshold for Endangered (>250 and <2,500 mature individuals). Further surveys of potential habitat nearby and in the Pilliga Outwash TEC may lead to the discovery of other populations of the species.

At least one of two additional conditions must be met. These are:

- C1. An observed, estimated or projected continuing decline of at least: 25% in 3 years or 1 generation (whichever is longer) (CE); 20% in 5 years or 2 generations (whichever is longer) (EN); or 10% in 10 years or 3 generations (whichever is longer) (VU).

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Assessment Outcome: Data Deficient.

Justification: There is insufficient data to quantitatively assess decline in the population of *Lobelia claviflora*.

C2. An observed, estimated, projected or inferred continuing decline in number of mature individuals.

Assessment Outcome: Data Deficient

Justification: Whilst there is inferred decline in the quality of the habitat of *Lobelia claviflora* there is currently no data available for continuing decline in the number of mature individuals. Further surveys after flooding events are required to determine population changes.

In addition, at least 1 of the following 3 conditions:

- a (i). Number of mature individuals in each subpopulation ≤ 50 (CR); ≤ 250 (EN) or ≤ 1000 (VU).

Assessment Outcome: met for Vulnerable

Justification: One subpopulation recorded 350-450 mature individuals which meets the threshold for Vulnerable of ≤ 1000 (VU).

- a (ii). % of mature individuals in one subpopulation is 90-100% (CR); 95-100% (EN) or 100% (VU)

Assessment Outcome: not met

Justification: Whilst one subpopulation contains over 90% of the plants (the estimates ranged from 87% to 94% depending on whether you take various combinations of upper and lower bounds) it does not meet the requirement for Endangered of 95 - 100% (EN) or Vulnerable of 100% (VU) of individuals in the one subpopulation.

- b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Data Deficient.

Justification: It is unknown if *Lobelia claviflora* has extreme fluctuations and more information about the ecology of the species is required before this can be determined. Even though the plants are only above ground following a wet period and die back in the dry periods, there remains a seed bank in the soil. It is not known how much of the seed bank is exhausted after a flood event.

Criterion D Very small or restricted population

Assessment Outcome: met for Vulnerable under Criterion D1+2

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: met for Vulnerable.

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Justification: In 2016 Jobson (*in litt.* February 2019) estimated there were 350-500 mature individuals based on observations whilst circumnavigating the swamps where the species was known to occur. This currently meets the threshold for Vulnerable (<1,000 mature individuals). Further surveys of potential habitat nearby and in the Pilliga Outwash TEC may lead to the discovery of other populations of the species.

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.

Assessment Outcome: met for Vulnerable.

Justification: There is a restricted area of occupancy of <20 km² and the number of locations is <5 with a plausible future threat of habitat disturbance (such as converting the wetlands to dams), or disruption to the species life cycle and wetland habitat by disturbance from domestic stock and feral pigs, that could drive the taxon to CR or EX in a very short time.

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient.

Justification: There are insufficient data to quantify the extinction risk for this species.

Conservation and Management Actions

There is no National Recovery Plan and no NSW Saving our Species program for *Lobelia claviflora*. The following actions are derived from the threat information. The NSW Saving our Species program has threat information for the Pilliga Outwash TEC, *Myriophyllum implicatum* and *Eriocaulon australasicum* that may be relevant to the habitat of *L. claviflora*.

Habitat loss, disturbance and modification

- Liaise with land holders regarding conservation management of the wetland habitat, including management of any grazing by stock and other introduced animals during flooded periods, maintenance of local hydrology, and alternatives to dam construction.
- Feral animal control for pigs, including culling programs to reduce abundance.
- Ensure fencing is maintained where appropriate and consider the feasibility of fencing around habitat areas, ensuring no change to hydrology.

Invasive species management

- Feral animal control for pigs.
- Identify any invasive weed species that may co-occur in the wetlands. Removal /control of weeds needs careful consideration to prevent disturbance to *Lobelia claviflora* and its seed bank.

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Ex situ conservation

- Develop a targeted seed collection program for *ex situ* seed banking. See cultivation work already undertaken at the Australian National Botanic Gardens nursery in Canberra (Albrecht *et al.* 2018).

Engaging with stakeholders

- Inform land owners and managers of sites where there are known populations and consult with these groups regarding options for conservation management and protection of the species.

Survey and Monitoring priorities

- Monitor and survey populations and habitat for degree of damage from feral pigs and domestic stock, and any habitat degradation (e.g. incursions of invasive weeds). Use the results of surveys to guide the implementation of conservation actions detailed above.
- Conduct regular surveys when appropriate (after rainfall events) to determine the amount of rainfall required to facilitate a germination response.
- Determine population abundance and whether there is a decline in the population of *Lobelia claviflora*.
- Survey surrounding areas for further populations of *Lobelia claviflora* after appropriate rainfall events, particularly wetlands close by to the known sites (particularly to the east) and other areas identified as the Pilliga Outwash TEC or sites where *Myriophyllum implicatum* and *Eriocaulon australasicum* occur.

Information and Research priorities

- Conduct research focused on understanding the life cycle of *Lobelia claviflora*, such as determining critical life stages of the species. Research into seed dormancy and longevity, and the effect of temperature on seed dormancy and viability would be important particularly as the climate is warming, as will understanding seed longevity in the context of the projected changes in precipitation in western NSW. Determine the water requirements for the species, i.e. the amount and duration required for the life cycle of the plant, as precipitation patterns are projected to change over time under climate change (OEH 2014) and it is unclear how this may affect the species.

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Expert Communications

Margaret Brock – Wetland Ecologist

John T. Hunter – Ecological Consultant, Hewlett Hunter Pty Ltd, Invergowrie NSW.

Richard Jobson – Systematic Botanist, Science Education Conservation, National Herbarium of NSW, Royal Botanic Gardens, Sydney.

Terry Mazzer – Senior Project Officer (Threatened Species), North West Branch, Biodiversity and Conservation Division. NSW Department of Planning, Industry and Environment, Dubbo.

Karen Wilson - Honorary Research Associate, National Herbarium of NSW, Royal Botanic Gardens, Sydney.

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APPENDIX 1

Assessment against NSW Biodiversity Conservation Act criteria

The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: 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: 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,

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		(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 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: 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.

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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: Vulnerable under Clause 4.7.

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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