Conservation Assessment of *Polystichum moorei* Christ (Dryopteridaceae)

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Polystichum moorei Christ (Dryopteridaceae)

Distribution: Endemic to Lord Howe Island, NSW
Current EPBC Act Status: Endangered
Current NSW BC Act Status: Endangered

Proposed listing on NSW BC Act: Critically Endangered

Reason for change: *Polystichum moorei* was originally listed as Endangered on the *Threatened Species Conservation Act 1995*, the highest category under that the legislation at that time. In 2005, the *Threatened Species Conservation Act 1995* was amended to provide for the listing of Critically Endangered species, but the eligibility of *Polystichum moorei* for listing as a Critically Endangered species has not been assessed until now. This new assessment has found that the species meets the IUCN Red List criteria for Critically Endangered status.

Summary of Conservation Assessment

Polystichum moorei was found to be Critically Endangered under IUCN Criterion B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v), C2a(i), D.

The reasons for the species being eligible for listing in the Critically Endangered category are: 1) it has a very highly restricted geographic distribution with an area of occupancy and extent of occurrence of 4 km^2; 2) it occurs in one threat-defined location; 3) it has a very low total number of mature individuals (estimated at 24); and 4) continuing decline is observed in the number of mature individuals, the area of occupancy, and the extent of occurrence, and inferred in area, extent and quality of habitat and number of subpopulations, due to the effects of drought.

Polystichum moorei. Photo: Dianne Brown/DCCEEW.

Description and Taxonomy

Polystichum moorei Christ, also known as the rock shield fern, is a conventionally accepted species in the family Dryopteridaceae (CHAH 2024; PlantNet 2024). *Polystichum moorei* is described as "terrestrial or lithophytic ferns. Rhizome short; scales dense, lanceolate, to 2 cm long, 2–5 mm broad, long-acute, brown. Fronds 3-pinnate or 2-pinnatisect; stipe 2–12 cm long; scales on stipe numerous, similar to those on rhizome, to 1.5 cm long, especially dense towards base; rachis with scattered, linear-lanceolate, brown scales to 1 cm long, especially towards base, and minute glandular hairs; lamina lanceolate in outline, 10–25 cm long, 7–14 cm broad; pinnules obliquely ovate, 0.5–2 cm long, with apices obtuse, bluntly serrate; veins not visible above. Sori ±dome-shaped, 1.5–2 mm diam., glandular; indusia orbicular" (PlantNet 2024).

Australian *Polystichum* are all polyploids - inferred by phylogeny of South American and Australian *Polystichum* (Morero *et al.* 2019) and origin of Hawaiian species (Driscoll and Barrington 2007).

Synonyms include *Aspidium aculeatum* var. *moorei* Christ ex Maiden, *Polystichum kingii* Watts, *P. kingii* Watts f. *kingii*, *P. kingii* f. *umbrosa* Watts, *P. moorei* (Christ ex Maiden) W.R.B.Oliv., and *P. moorei* var. *tenerum* Watts (CHAH 2024).

Distribution and Abundance

Polystichum moorei is endemic to the Pacific Subtropical Islands bioregion of New South Wales (NSW) (Commonwealth DCCEEW 2024) where it is confined to a few localities in southern mountains of Lord Howe Island (LHI) (DECC 2007; OEH 2018a).

Polystichum moorei occurs in two known subpopulations, as per the IUCN (2024) definition. Genetic analysis has shown that there is restricted gene flow between individuals at Erskine Creek and Mount Lidgbird, resulting in genetic divergence sufficient to consider each locality a distinct subpopulation, despite being separated by less than 1.5 km (McMaster *et al.* 2023).

The Mount Lidgbird subpopulation is the larger of the two extant subpopulations, with an estimated 13 mature individuals. This subpopulation occurs at ~450 m above sea level (a.s.l.) at the base of a south facing cliff on Mount Lidgbird (C. Stehn *in litt.* November 2024).

The Erskine Creek subpopulation is located ~1.3 km west-southwest of the Mount Lidgbird subpopulation and supports an estimated 11 mature individuals (Table 1). This subpopulation occurs on the lower western face of Mount Gower at ~15 m a.s.l. (C. Stehn *in litt.* November 2024).

A third subpopulation (inferred) previously occurred at Soldier Creek, approximately 2.5 km north of the two extant subpopulations. Plants in this subpopulation were confined to the calcarenite rocks approximately 30 m from the sea and around 4 m a.s.l. (Hutton 2001). *Polystichum moorei* was first recorded at this locality in 1898 by Joseph Maiden (RBGDT 2024). In 2001, two larger individuals and 10 juveniles (plus four dried/dead individuals) were recorded at this locality (Hutton 2001). By 2008, this number had declined to 10 individuals, nine of which were dried/dead (LHIB 2017). From 2017–2021, only a single individual persisted at this locality (Table 1). Since 2021, *Polystichum moorei* has not been recorded at Soldier Creek, and following

multiple follow up surveys, the species is now considered to be locally extinct (Table 1; C. Stehn pers. comm. November 2024).

Table 1. Population breakdown of mature plants within monitoring plots over time showing indicative population trends. Note that plants outside monitoring plots are not included. Source: C. Stehn *in litt.* November 2024.

Site	2017	2019	2021	2022	2023
Mount Lidgbird	6	4	4	4	4*
Eskine Creek	11	11	12	15	11
Soldier Creek	1	1	1	0	0
TOTAL	**18**	**16**	**17**	**19**	**15**

*most mature plants occur outside of plots at this location.

The current distribution estimate is based on the locations of SoS monitoring sites (LHIB 2017). Records from NSW BioNet Atlas, Atlas of Living Australia, and herbaria (ALA 2024; ANHSIR 2024; BioNet 2024; RBGDT 2024) were excluded due to the incorrect georeferences or very low spatial accuracy of most records.

Extent of occurrence and area of occupancy

The area of occupancy (AOO) is estimated to be 4 km^2 and was calculated using 2 x 2 km grid cells, the scale recommended by IUCN (2024). The extent of occurrence (EOO) was calculated at 0.1 km^2 and is based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2024). The IUCN (2024) states that "if EOO is less than AOO, EOO should be changed to make it equal to AOO to ensure consistency with the definition of AOO as an area within EOO". Therefore, EOO is estimated at 4 km^2. Both EOO and AOO were calculated using ArcGIS (Esri 2015), enclosing all confirmed survey records, and cleaned spatial datasets.

Population size and trends

The current minimum population size of *Polystichum moorei* is estimated at 24 mature individuals (C. Stehn *in litt.* November 2024). Fifteen of these individuals occur in monitoring plots (Table 1) with the remainder occurring outside of plots in the Mt Lidgbird subpopulation (C. Stehn *in litt.* December 2024).

Previous population estimates have been variable, at least partially attributable to different methods and the varying inclusion/exclusion of juvenile and senesced individuals in counts (C. Stehn pers. comm. November 2024). Hutton (2001) recorded 29 mature individuals and 23 juvenile plants. The Lord Howe Island Board (LHIB 2008, cited in DE 2015) recorded a total of 81 individuals (of all age classes and including dried/dead plants) in the same area. In 2016–2017, a total of 37 plants were measured with at least an additional 20 observed (LHIB 2017).

Since 2017, there has been a net decline of three mature individuals in monitored plots (Table 1), at least partially due to drought conditions from 2017–2018 (C. Stehn *in litt.* November 2024). Using the estimates provided by Hutton (2001), there has been a net decline of at least five mature individuals over the past ~20 years. Maturity of the nine individuals lost from Soldier Creek between 2008 and 2017 is not known (LHIB 2017).

Previous estimates have put the total population of *Polystichum moorei* at >120 individuals (in all age classes; LHIB 2017). However, targeted searches of probable habitat have failed to find any additional plants (C. Stehn pers. comm. November 2024). This includes drone and binocular surveys of probable sites higher up on the cliff above the Mount Lidgbird site (C. Stehn *in litt.* November 2024). In some cases, plants which were thought to be *P. moorei* from a distance were found to be a different fern species (C. Stehn pers. comm. November 2024). It is thought that the current population estimate is likely to underestimate the true population size, but not by a significant number (C. Stehn pers. comm. November 2024).

Ecology

Habitat

Polystichum moorei is largely restricted to protected niches on rock faces, crevices, and caves (LHIB 2017; OEH 2018b) at elevations ranging from close to sea level to ~450 m a.s.l. (C. Stehn *in litt.* November 2024). Historically it has been found on calcareous and basalt geologies (LHIB 2017; OEH 2018b), but the loss of the Soldier Creek subpopulation means it now occurs only on basalt. The Erskine Creek subpopulation is low enough that it can experience spray from the ocean (C. Stehn pers. comm. November 2024).

Life history

The life history of *Polystichum moorei* is not well known (LHIB 2017). During dry periods, the species tends to die back, with the rhizome persisting within cracks of rock faces (DE 2015). This strategy has been recorded in other fern species and is thought to result in vulnerability segmentation, whereby fronds desiccate and hydraulically disconnect before the perennial stem experiences significant levels of drought-induced embolism (Suissa *et al.* 2022). Individuals of *P. moorei* which have died back during drought often regenerate within a couple of years of consistent rainfall (C. Stehn *in litt.* November 2024).

In cultivation, the species has been found to develop slowly. Spores added to plain agar germinate readily but grow slowly (G. Errington *in litt.* November 2024). Currently, spores germinated in April 2022 are still prothalli (gametophytes) and do not appear to have developed any reproductive structures (G. Errington *in litt.* November 2024). Attempts to germinate spores on rock from Lord Howe Island failed (G. Errington *in litt.* November 2024).

Other species of *Polystichum* have been found to absorb atmospheric water through their leaves (Limm and Dawson 2010; Schwerbrock and Leuschner 2016). However, *Polystichum* is one of the most diverse genera of ferns globally, comprising ~350–400 species (Morero *et al.* 2015). Consequently, inferring life history strategies from geographically distant congeners with different ecological niches may be of limited value.

Lifespan and generation length

Little is known about the longevity of *Polystichum moorei* and there are insufficient data to estimate its generation length.

Threats

Polystichum moorei is threatened by drought and likely to be threatened by extreme rainfall events. Weed invasion is a plausible future threat. Browsing by feral goats (*Capra hircus*) may have been a historical threat (Hutton 2001).

Drought

Drought is the most serious threat to the survival of *Polystichum moorei*. Mature plants are typically resilient to drought, dying off during dry periods and regenerating from rhizomes during wet periods, although several mature plants failed to recover following the drought in 2017–2018 (C. Stehn *in litt.* November 2024). Immature plants (prothalli) are particularly susceptible to drought, with substantially higher rates of mortality observed during drought (C. Stehn *in litt.* November 2024). Thus, drought (or below average rainfall) leads to population declines in *P. moorei* predominantly by reducing survival of juveniles, although mature plants may also perish during drought.

Uncertainty remains in the projected range and severity of climate change impacts on Lord Howe Island. However, data from the last 50 years show ongoing declines in rainfall and cloud cover and increases in temperature (Auld and Leishman 2015). The observed decrease in rainfall in recent years, particularly in autumn and winter, has adversely affected the species, as it is dependent on seepage areas remaining moist (OEH 2018).

If rainfall and cloud cover continue to decrease and temperatures continue to increase, as has been observed on Lord Howe Island over the past 50 years temperature (Auld and Leishman 2015), it is plausible these changes will lead to more extreme and prolonged droughts, which may in turn adversely affect the *Polystichum moorei* population in the future.

'Anthropogenic climate change' is listed as a Key Threatening Process under the *Biodiversity Conservation Act 2016*. 'Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases' is listed as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999*.

Extreme rainfall events

Polystichum moorei is likely to be threatened by extreme rainfall events, which can result in landslips, scouring and storm surges. Steep topographic slopes are associated with storm-triggered landslips (Densmore and Hovious 2000). As the Mount Lidgbird subpopulation is located at the base of a cliff on a steep slope, it is likely to be vulnerable to landslips during extreme rainfall events. The Erskine Creek subpopulation, being located along an exposed seaside cliff at ~15 m a.s.l., may be more vulnerable to storm surges. Lord Howe Island is subjected to mid-latitude cyclones and ex-tropical cyclones, both of which can result in significant increases in swell and wave generation (Haskoning Australia 2014). While rare, storm surges of up to ~15 m are not without precedent in Australia (Callaghan and Helman 2008). Coupled with projections of ongoing sea level rise (CSIRO 2024), extreme rainfall events and associated storm surges have the potential to directly affect the Erskine Creek subpopulation. It is plausible these changes will lead to more frequent landslips

and storm surges, which could in turn adversely affect the *P. moorei* population in the future.

'Anthropogenic climate change' is listed as a Key Threatening Process under the *Biodiversity Conservation Act 2016*. 'Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases' is listed as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999*.

Weed invasion

Competition from weeds is patchy within most of the distribution of *Polystichum moorei* but has the potential to result in significant impacts if species such as *Asparagus aethiopicus* (ground asparagus) were to establish in areas where *P. moorei* occurs (OEH 2018b). *Asparagus aethiopicus* has been recorded on rock outcrops and rock faces at elevation on Mount Lidgbird (LHIB 2017). Other weeds of concern on Lord Howe Island include *Ageratina adenophora* (Crofton weed), *Cenchrus clandestinum* (Kikuyu grass), *Psidium cattleianum* (cherry guava), *Ochna serrulata*, and *Lilium formosum* (tiger lily; DECC 2007; LHIB 2017). Weed control proximate to subpopulations is ongoing (NSW DCCEEW 2024).

'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants', 'Invasion and establishment of exotic vines and scramblers', and 'Invasion of native plant communities by exotic perennial grasses' are listed as Key Threatening Processes under the *Biodiversity Conservation Act 2016*. 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants' and 'Novel biota and their impact on biodiversity' are listed as Key Threatening Processes under the *Environment Protection and Biodiversity Conservation Act 1999*.

Number of locations

Polystichum moorei occurs at one threat-defined location as per the IUCN (2024) definition, due to the most serious plausible threat which results in the lowest number of locations, being drought. With the two extant subpopulations separated by only ~1.3 km, it is highly plausible a single drought would be capable of affecting all individuals of the species simultaneously.

Assessment against IUCN Red List criteria

For this assessment it is considered that the survey of *Polystichum moorei* has been adequate and there is sufficient scientific evidence to support the listing outcome.

Criterion A *Population size reduction*

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) *[(a) cannot be used for A3]*.

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation *[except A3]*

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality

(d) actual or potential levels of exploitation

(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

Outcome

Polystichum moorei is considered Data Deficient under Criterion A.

Population reductions

Since 2017, there has been a net decline of three mature individuals in monitored plots (Table 1), mainly due to drought conditions from 2017–2018 (C. Stehn *in litt.* November 2024). Hutton (2001) counted 29 mature individuals. Based on this, with a current count of 24 mature individuals, there has been a net decline of at least five mature individuals over the past ~20 years. Another nine individuals, recorded as dried/dead, were lost from Soldier Creek sometime between 2008 and 2017 (LHIB 2017). However, it is not known whether these individuals were mature or juveniles. The count of 81 individuals by LHIB (2001, cited in DE 2015) included individuals of all age classes, so cannot be used to assess population trends.

Conclusion

There is insufficient data to estimate the generation length of *Polystichum* moorei. Furthermore, historical population estimates have variably included mature, juvenile, and dried/dead plants, making it impossible to accurately estimate population declines over the past 10 years (the minimum amount of time to assess under Criterion A). Consequently, there are insufficient data to estimate, infer, or project the magnitude of past or future reductions in the population size of *P. moorei*.

Criterion B *Geographic range*

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)			
	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(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			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Outcome

Polystichum moorei is Critically Endangered under Criterion B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v).

EOO and AOO

Polystichum moorei is endemic to Lord Howe Island. The extent of occurrence (EOO) and area of occupancy (AOO) have both been calculated at 4 km^2.

Number of threat-defined locations

Polystichum moorei is found at one threat-defined location when considering the most serious plausible threat of drought.

Severely fragmented

Polystichum moorei is not considered to be severely fragmented, as the species occurs in two subpopulations separated by ~1.3 km and has a high dispersal potential (via spores). Despite high levels of inbreeding, genetic analyses indicate there is relatively high genetic diversity within the population (McMaster *et al* 2023), suggesting each subpopulation is likely to be viable.

Continuing decline

Continuing decline of *Polystichum moorei* is observed in the number of mature individuals, the area of occupancy, and the extent of occurrence, and inferred in area, extent and quality of habitat and number of subpopulations, largely due to the effects of drought. The loss of all individuals from the Soldier Creek site (inferred to be a subpopulation) resulted not only in continuing decline in the number of mature individuals, but also continuing decline in the area of occupancy, the extent of occurrence, and the number of subpopulations. At least five mature individuals have been lost in the last ~20 years, three of which have been lost since 2017.

Extreme fluctuations

There is no evidence to suggest *Polystichum moorei* undergoes extreme fluctuations.

Conclusion

Polystichum moorei is eligible to be listed as Critically Endangered as it has a very highly restricted geographic distribution (an AOO and EOO of 4 km^2), occurs in one threat-defined location, and is undergoing continuing decline in the extent of occurrence, area of occupancy, area, extent and/or quality of habitat, number of subpopulations, and number of mature individuals.

Criterion C Small population size and decline

C. Small population size and decline				
		Critically Endangered	Endangered	Vulnerable
Number of mature individuals		< 250	< 2,500	< 10,000
AND at least one of C1 or C2				
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):		25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:				
(a)	(i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
	(ii) % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals				

Outcome

Polystichum moorei is Data Deficient under Criterion C1 and Critically Endangered under Criterion C2a(i).

Number of mature individuals

The current population size of *Polystichum moorei* is estimated at 24 mature individuals (C. Stehn *in litt.* November 2024).

Continuing decline

There has been observed decline in the number of mature individuals over the past ~20 years. Hutton (2001) estimated there to be 29 mature individuals, while the current estimate is 24 mature individuals. However, there are insufficient data to estimate the generation length of *Polystichum moorei*, meaning it is not possible to assess under Criterion C1.

Mature individuals in each subpopulation

Polystichum moorei occurs in two subpopulations totalling 24 mature individuals, below the threshold of ≤50 mature individuals in each subpopulation for Critically Endangered.

% of mature individuals in a single subpopulation

Polystichum moorei occurs in two subpopulations, each supporting less than 90–100% of the total population.

Extreme fluctuations

There is no evidence to suggest *Polystichum moorei* undergoes extreme fluctuations.

Conclusion

Polystichum moorei is eligible to be listed as Critically Endangered under Criterion C2(i) as it has a very small population size estimated at 24 mature individuals, resulting in <50 mature individuals in each subpopulation.

Criterion D Very small or restricted population

D. Very small or restricted population			
	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	D1. < 1,000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	D2. typically: AOO < 20 km² or number of locations ≤ 5

Outcome

Polystichum moorei is Critically Endangered under Criterion D and ineligible to be listed under Criterion D2.

Number of mature individuals

The current population size of *Polystichum moorei* is estimated at 24 mature individuals (C. Stehn *in litt.* November 2024), below the threshold of <50 for Critically Endangered.

Risk of future extinction in a very short amount of time (D2)

D2 is inapplicable as the species is CE under D.

Criterion E Quantitative Analysis

E. Quantitative Analysis			
	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Outcome

Polystichum moorei is considered data deficient under Criterion E.

Probability of extinction

No quantitative analysis has been undertaken to assess the extinction probability of this species and there are currently insufficient data to undertake one.

Conservation and Management Actions

Polystichum moorei is currently listed on the NSW *Biodiversity Conservation Act 2016* and a conservation project has been developed by the NSW Department of Climate Change, Energy, the Environment and Water 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. *Polystichum moorei* sits within the 'site-managed species' management stream of the SoS program and the conservation project can be viewed here: https://savingourspecies.environment.nsw.gov.au/project/98.

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Expert Communications

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APPENDIX 1

Assessment against *Biodiversity Conservation Regulation 2017* criteria
The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome:

Polystichum moorei was found to be Critically Endangered under Clause 4.3(a)(d)(e i,ii,iii,iv), Clause 4.4(a)(e i,ii A(I)), and Clause 4.5(a).

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 i,ii,iii,iv).

The geographic distribution of the species is:				
	(a)	for critically endangered species		very highly restricted, or
	(b)	for endangered species		highly restricted, or
	(c)	for vulnerable species		moderately restricted,
and at least 2 of the following 3 conditions apply:				
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,		
	(e)	there is a projected or continuing decline in any of the following:		
		(i)	an index of abundance appropriate to the taxon,	
		(ii)	the geographic distribution of the species,	
		(iii)	habitat area, extent or quality,	
		(iv)	the number of locations in which the species occurs or of populations of the species,	
	(f)	extreme fluctuations occur in any of the following:		
		(i)	an index of abundance appropriate to the taxon,	
		(ii)	the geographic distribution of the species,	
		(iii)	the number of locations in which the species occur or of populations of the species.	

Clause 4.4 - Low numbers of mature individuals of species and other conditions
(Equivalent to IUCN criterion C)
Assessment Outcome: Critically Endangered under Clause 4.4(a)(e i,ii A(l)).

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.

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.

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