

# NSW Threatened Species Scientific Committee

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## Conservation Assessment of *Danhatchia copelandii* D.L.Jones & M.A.Clem. (Orchidaceae)

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NSW Threatened Species Scientific Committee

### ***Danhatchia copelandii* D.L.Jones & M.A.Clem. (Orchidaceae)**

Distribution: Endemic to NSW  
Current EPBC Act Status: Not listed  
Current NSW BC Act Status: Not listed

Proposed listing on NSW BC Act: Critically Endangered

### **Summary of Conservation Assessment**

*Danhatchia copelandii* was found to be eligible for listing as Critically Endangered under IUCN Red List Criteria B1ab(iii,v)+2ab(iii,v); C2a(i,ii) and D.

The main reasons for this species being eligible are i) it has a very highly restricted geographic distribution (AOO and EOO 4km<sup>2</sup>); ii) it has an extremely low population size (< 50 mature individuals); iii) it is severely fragmented and there is only one location; iv) there is continuing decline in area, extent and/or quality of habitat and the number of mature individuals, due to threats from herbivory, weeds and increasing severe weather; and v) all plants are found in one population.

### **Description and Taxonomy**

*Danhatchia copelandii* is a recently described slender hairy leafless orchid (Jones and Clements 2019). It is described in PlantNET (2023) as a "Rhizomatous, underground, mycoheterotroph. Leaves totally lacking. Inflorescence to 20 cm tall, reddish-brown, bearing numerous short glandular hairs, with 4–5 paler sterile bracts bearing conspicuous red-brown veins. Flowers 2 to 6, each with a closely sheathing elliptical fertile bract, flowers 5–5.5 mm long, segments spreading to 6.5–7.5 mm across, 'opening freely'; dorsal sepal oblong-obovate, 4.5–5 mm long by 1.5 mm wide, brown externally with whitish distal margins, dark median stripe and marginal stripes visible, apex upturned, obtuse; lateral sepals spreading, oblong-elliptical, 5–5.5 mm long by 2 mm wide, asymmetrical, margins incurved, whitish, apex obtuse; petals linear-obovate around 5 mm long and 1 mm wide, cream with pale brown medial band, apex obtuse, imbricate with dorsal sepal and labellum; labellum sessile, margins incurved, enclosed by dorsal sepal, almost broad-oblong, lemon-yellow with cream then hyaline margin, domed orange-yellow callus in distal two-thirds, base pouched and with four groups of fleshy hairs on either side, often in pairs or threes, median line thickened; fleshy and stiff toward tip, and tuberculate externally. Ovary glandular hairy. Capsules erect, broadly obovate."

### **Distribution and Abundance**

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*Danhatchia copelandii* is endemic to New South Wales and is currently only known from a single population on private land near Coffs Harbour on the NSW north coast (Jones and Clements 2019). It occurs in lowland subtropical rainforest that has a dense canopy to a height of c. 20-25m and a sparse ground layer that is covered with a deep layer of leaf litter (Jones and Clements 2019). Dominant trees in the rainforest are *Sloanea australis* (Maiden's Blush), *Niemeyera whitei* (Rusty Plum) and *Archontophoenix cunninghamiana* (Bangalow Palm). The soil is a moderately fertile clay loam derived from metasediments (L. Copeland *in litt.* May 2020). *Danhatchia copelandii* may occur in other topographies, vegetation communities and edaphic conditions.

The habitat in which *Danhatchia copelandii* is currently known to occur in (lowland subtropical rainforest with a dense, closed canopy) is very uncommon in the local Coffs Harbour area (L. Copeland *in litt.* May 2020). It occurs in 'Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions' (NSW SC 2011) an Endangered ecological community under the NSW *BC Act*, and 'Lowlands Rainforest of Subtropical Australia' (DSEWPC 2011), a Critically Endangered Ecological Community under the *EPBC Act*. The habitat most likely corresponds with Northern Lowland subtropical Rainforest Plant Community Type (PCT 3021) (L. Copeland *in litt.* November 2020) but may not be restricted to this PCT. Whilst this PCT is quite extensive on the north coast it is likely to vary considerably in structure and floristics throughout its range. There is relatively little of this vegetation type left around Coffs Harbour and much of what is left is highly degraded with the weed *Lantana camara* (Lantana) commonly present (L. Copeland *in litt.* November 2020).

*Danhatchia copelandii* has not been recorded elsewhere in rainforest surveys of the NSW north coast. Extensive searches in the vicinity of the known population over at least five flowering seasons have been undertaken but no further populations have been found (L. Copeland *in litt.* November 2020, 2021 and 2022). Given the species' leafless habit, searches were undertaken during the flowering period (see Ecology section below), as it may be difficult to detect at other times. Searches in the nearby State Forest and similar rainforest behind Coffs Harbour and in Bongil Bongil National Park were also undertaken but no *D. copelandii* plants were found (L. Copeland *in litt.* November 2021). The orchid is only known from an area of less than one hectare on flat terraces with deep leaf litter. These flat areas are very uncommon as most other areas of this rainforest habitat are sloping and much of the leaf litter can be washed downslope by runoff following rainfall (L. Copeland *in litt.* November 2020). Whether the orchid is very specific in its requirements and is hence restricted by limited habitat availability is unknown (L. Copeland *in litt.* November 2020).

The geographic distribution of *Danhatchia copelandii* is very highly restricted. The area of occupancy (AOO) is estimated to be 4 km<sup>2</sup>, based on the species occupying one 2 km x 2 km grid cell, the spatial scale of assessment recommended by IUCN (2022). The extent of occurrence (EOO) is also estimated to be 4 km<sup>2</sup>. The EOO was measured by a minimum convex polygon containing all the known sites of occurrence. When EOO is less than AOO, IUCN (2022) recommend EOO estimates be adjusted to be equal to AOO to ensure consistency with the definition of AOO as an area within EOO.

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There is an extremely low number of mature individuals of *Danhatchia copelandii*. The total number of *D. copelandii* plants recorded over five flowering seasons (2018 to 2022) varies from 16 to around 40. In 2022, some 36 plants were seen, although 3 of these were later lost to herbivory, most likely from native mammals. Plants seen flowering in one season that did not re-emerge in the following season are not necessarily dead. Rather, they may remain dormant underground, a common ecological strategy observed with orchids with a similar life history.

## Ecology

*Danhatchia copelandii* is a mycoheterotroph, meaning that it has no or limited photosynthetic capacity but instead obtains nutrients from a complex relationship with soil fungi. For most of the year the orchid lives below ground as a rhizome (not a tuber like many other ground orchids) (L. Copeland *in litt.* May 2020). In spring, the orchid sends up small stems that flower very quickly, within two weeks of emerging from the soil. The flowers open widely for several days and last for a maximum of 1-2 weeks, then all of the above ground parts of the plants wither soon afterwards. Hence, detecting the species is limited to a period of about 1 month each year (L. Copeland *in litt.* May 2020). The flowers exude nectar likely to mean the species is insect pollinated, reflected in the low-moderate pollination success, i.e. about a third to half of the flowers develop swollen ovaries/capsules. Self-pollinating species usually have higher pollination rates (L. Copeland *in litt.* February 2023). Tiny dust-like seeds develop inside a capsule that dehisces and the seed is dispersed by wind. As the plants are low to the ground and occupy a relatively sheltered environment, the seeds may not disperse far (L. Copeland *in litt.* May 2020). Germination details for the species are unknown. It is also unclear how long it takes for the species to mature from germination to a flowering adult, but it is likely to be several years based on all other similar ground orchids (L. Copeland *in litt.* May 2020). Individual plants are thought to live for a minimum of several years (L. Copeland *in litt.* May 2020).

## Threats

The main threats to *Danhatchia copelandii* are from habitat clearing, weed incursion, herbivory, and increased disturbance due to the effects of a changing climate.

**Clearing of habitat:** Extensive historical clearing of rainforest habitat has occurred in the Coffs Harbour area. Many of the sheltered gullies in the broader area that once would have harboured lowland subtropical rainforest have been cleared. Clearing of rainforest is still occurring in the Coffs Harbour area and the impacts of edge effects and fragmentation on remaining rainforest habitat may be ongoing. It is possible *Danhatchia copelandii* may have once occurred elsewhere in rainforest that has now been cleared (L. Copeland *in litt.* May 2020). The only known population of *Danhatchia copelandii* occurs on private land. Whilst this habitat is currently being managed for conservation of the species by the current landowner, it is not secure in the long-term. 'Land clearance' is listed as a Key Threatening Process (KTP) under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). 'Clearing of native vegetation' is listed as a KTP under the NSW BC Act.

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**Herbivory:** *Danhatchia copelandii* has a very small population size and any localised losses may lead to declines and extinction. Swamp Wallaby (*Wallabia bicolor*), Northern Brown Bandicoot (*Isodon macrourus*) and Bush Rats (*Rattus fuscipes*) are all present in, or in close proximity to, the rainforest habitat and all occur in reasonable numbers in the adjacent state forest. In 2022, three plants were lost to native mammal herbivores, most likely the Northern Brown Bandicoot, with the entire plant including the rhizome, dug up and consumed (L. Copeland *in litt.* February 2023). Whilst herbivory by native species is a natural occurrence, herbivory, including loss of plants, may be increased in areas of small remnant bushland if herbivores are sustained by surrounding cleared grassy areas. Should rates of plant loss to herbivory increase, there is a risk to the species' persistence.

**Weeds:** There are a number of introduced weed species that occur in the vicinity of the *Danhatchia copelandii* population and more widely in the surrounding area and nearby State Forest. The main weeds that threaten the species are *Lantana camara* (Lantana), *Ageratum houstonianum* (Billy Goat Weed), *Solanum capsicoides* (Devil's Apple) and *Paspalum mandiocanum* (Broad-leaf Paspalum). The landowner regularly kills/controls several weed species in very close proximity (within 20 m) to the *D. copelandii* population in order to reduce their incursion into the site. Such ongoing weed control is necessary to maintain habitat suitability for *D. copelandii*, as problem weed species can readily be dispersed back into the habitat from surrounding areas (the main weeds of concern are bird or wind dispersed). Lantana and Broad-leaf Paspalum grow closest to the site and are most likely to impact the orchids through competition and smothering of plants and seedlings. The rainforest canopy where *D. copelandii* currently occurs is intact, permitting relatively low levels of light to reach the forest floor – which is unfavourable to the rapid growth of the environmental weeds. Should there be a change to the rainforest canopy cover, such as damage from a storm leading to a canopy gap or disease impacting the canopy species, then the threat of competition from weeds would be expected to increase. 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants' is listed as a KTP under the NSW BC Act.

**Climate change:** There is a projected increase in the frequency of severe weather events under a changing climate in this region. Severe fire weather is projected to increase during summer and spring in the north coast region of NSW by 2070 (ADAPT NSW 2022). CSIRO (2022) also note a harsher fire-weather climate in the future (high confidence) for the east coast subcluster region. As a holomycotrophic species, a reliance on organic materials including wood debris, which may be eliminated during intense or repeated fires, may contribute to the decline in the species. An increased risk of fires in the habitat is likely to impact the survival of rainforest trees and lead to increased weed establishment, changing the habitat characteristics that currently support the species. There is also a projection for increased intensity of extreme rainfall events (with high confidence) in the region (CSIRO 2022). Storms may damage the rainforest canopy, altering the habitat and allowing in additional light which would in turn favour weed invasion of the site (L. Copeland *in litt.* May 2020). Whilst storm damage can naturally lead to gaps in the rainforest canopy and hence provide light for regeneration of many rainforest species, the small area where *D. copelandii* occurs may be adversely affected and more frequent storm events may decrease the recovery time between disturbances. Intense rainfall and subsequent runoff may erode

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leaf litter exposing soil and semi-exposed rhizomes (L. Copeland *in litt.* February 2023). The small extent of the population, and the close vicinity of weed species make the population very vulnerable to any changes. 'Anthropogenic Climate Change' is listed as a KTP under the NSW BC Act.

**Pathogens:** Dieback of trees in the habitat of *D. copelandii* is a potential future threat through loss of sensitive tree and shrub species. These species provide habitat structure, shade and important nutrient resources for *D. copelandii* and the ecosystem. Time spent in drought is projected, with medium confidence, to increase over the course of the century in the region where *D. copelandii* occurs (CSIRO 2022) and drought can accelerate tree mortality and the creation of canopy gaps. Additionally, canopy trees in the habitat may be susceptible to dieback from the soil-borne water moulds in the *Phytophthora* genus. Metcalfe and Bradford (2008) found extensive dieback in trees from the Elaeocarpaceae (the family of *Sloanea*, a dominant for the habitat of *D. copelandii*) and potential loss of seedlings of *S. australis* ssp. *parviflora* to *Phytophthora* spp. The pathogen is also known to infect *Archontophoenix* species (Cahill *et al.* 2008) and *Archontophoenix cunninghamiana* is also present in the habitat. Pathogenic *Phytophthora* species are known from the Coffs Harbour area (McDougall and Liew 2020) and could spread into habitat of *D. copelandii*. 'Infection of native plants by *Phytophthora cinnamomi*' and 'is listed as a KTP under the NSW BC Act 2016 and 'Dieback caused by the root-rot fungus *Phytophthora cinnamomi*' is listed as a KTP under the EPBC Act.

## Assessment against IUCN Red List criteria

For this assessment it is considered that the survey of *Danhatchia copelandii* has been adequate.

### *Criterion A*                      *Population Size reduction*

Assessment Outcome: Data Deficient.

Justification: There are limited data on short-term fluctuations in above ground abundance over the last five years, but no clear trends in total population size with time. The generation length of *D. copelandii* is unknown and the degree of loss and fragmentation of potential habitat for the species over three generations are also unknown.

### *Criterion B*                      *Geographic range*

Assessment Outcome: Critically Endangered under Criterion B1ab(iii,v)+2ab(iii,v).

Justification: The area of occupancy (AOO) is estimated to be 4 km<sup>2</sup>, based on the species occupying one 2 km x 2 km grid cell, the spatial scale of assessment recommended by IUCN (2022). The extent of occurrence (EOO) is also estimated to be 4 km<sup>2</sup>. 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, being less than AOO. This is to ensure consistency with the definition of AOO as an area within EOO, following IUCN Guidelines (2022). *Danhatchia copelandii* meets the threshold for Critically Endangered under both EOO (<100 km<sup>2</sup>), and AOO (<10 km<sup>2</sup>),

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respectively. 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),  $\leq 5$  (EN) or  $\leq 10$  (VU) locations.

Assessment Outcome: Met for Critically Endangered.

Justification: *Danhatchia copelandii* is severely fragmented as the only known population may go extinct and the single population is by definition isolated (*sensu* IUCN 2022).

There is one location as the population occurs in a very small area where weed encroachment may rapidly affect all the individuals of the taxon present and its habitat. Weed encroachment would be favoured by an opening in the rainforest canopy, which may result from severe storm damage with a changing climate or an increased risk of fire.

- 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) area, extent and/or quality of habitat; and (v) number of mature individuals.

Justification: Only a very small population of the species is known and three plants were lost to herbivory in 2022. Ongoing management is required to remove weed incursions into the habitat of the species. Further, there are future predictions of increases in severe fire weather, increased intensity of extreme rainfall events and increased time spent in drought (ADAPT NSW 2022, CSIRO 2022) and the risk of disease leading to dieback of canopy dominants in the area. Continuing decline is inferred and projected in (iii) area, extent and/or quality of habitat; and (v) number of mature individuals.

- c) Extreme fluctuations.

Assessment Outcome: Data Deficient.

Justification: Extreme fluctuations are not known for the species. There is variation in the number of plants that appear above ground annually (L. Copeland *in litt.* November 2022), but the species does persist below ground between fruiting seasons.

## Criterion C *Small population size and decline*

Assessment Outcome: Critically Endangered under Criterion C2a(i,ii).

Justification: There are considered to be < 50 mature individuals in the one population based on 5 recent surveys during flowering seasons (L. Copeland *in litt.* November 2022). *Danhatchia copelandii* meets the Critically Endangered threshold of <250 (CR).

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) (CR); 20% in 5 years or 2

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generations (whichever is longer) (EN); or 10% in 10 years or 3 generations (whichever is longer) (VU).

Assessment Outcome: Data Deficient.

Justification: There are some limited data on short-term fluctuations in above ground abundance over the last five years, but no clear trends in population size. The generation length of *D. copelandii* is unknown and the degree of loss and fragmentation of potential habitat for the species over one, two or three generations are also unknown.

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

Assessment Outcome: Met.

Justification: Only a very small population of the species is known and three plants were lost to herbivory in 2022. Ongoing management is required to remove weed incursions into the habitat of the species. Further, there are future predictions of increases in severe fire weather, increased intensity of extreme rainfall events and increased time spent in drought (ADAPT NSW 2022, CSIRO 2022). Continuing decline is inferred and projected in the number of mature individuals.

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

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

Assessment Outcome: met for Critically Endangered

Justification: There are considered to be  $< 50$  mature individuals in the one population based on 5 recent surveys during flowering seasons (L. Copeland *in litt.* November 2022).

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

Assessment Outcome: met for Critically Endangered

Justification: All mature individuals are in one population.

- b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: data deficient.

Justification: Extreme fluctuations are not known for the species. There is variation in the number of plants that appear above ground annually (L. Copeland *in litt.* November 2022), but the species does persist below ground between fruiting seasons.

*Criterion D Very small or restricted population*

Assessment Outcome: Critically Endangered under Criterion D. Vulnerable under D2.

Justification: There are considered to be  $< 50$  mature individuals in the one population based on 5 surveys carried out in flowering seasons (L. Copeland *in litt.* November 2022). *Danhatchia copelandii* meets the Critically Endangered threshold  $< 50$  (CR).

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Even though Criterion D is met for Critically Endangered, Criterion D2 needs to be additionally and independently assessed, as it is relevant to Clause 4.7 of the NSW Biodiversity Conservation Regulation 2017. The highest threat category for Criterion D2 is Vulnerable.

D2. Population with a very restricted area of occupancy (typically less than 20 km<sup>2</sup>) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming CR or even EX in a very short time period.

Assessment Outcome: Met.

Justification: The species has a restricted AOO and only one location and given the small area of habitat occupied and extremely low population size, herbivory, weeds or other localised disturbances could drive the taxon to CR or EX in a very short time.

## *Criterion E Quantitative Analysis*

Assessment Outcome: Data Deficient

Justification: There have been no quantitative analyses for *Danhatchia copelandii*

## **Conservation and Management Actions**

There is currently no National Recovery Plan and no NSW Saving our Species program for this species. The following is derived from the threat information.

### Primary conservation objective

Ensure ongoing persistence of the known population including managing habitat to mitigate threats. Ensure germplasm of the species is conserved *ex situ* and site data is securely protected.

### Invasive species

- Control weed incursions into the known habitat and reduce weeds in general vicinity to reduce the rate of dispersal into the site.

### Herbivory

- Limit impacts of native and feral herbivores that may consume plants/rhizomes. This may require exclusion fencing, depending on potential adverse disturbance impacts of installation of fencing into the habitat.

### Disease

- Develop and implement phytosanitary guidelines (such as those outlined in the Arrive Clean, Leave Clean guidelines (DOE 2015)) for access to the wild site. Although *Danhatchia copelandii* may not be directly impacted by pathogens, other structural dominants in the habitat such as *Sloanea australis* and *Archontophoenix cunninghamiana* may be.



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## Habitat loss, disturbance and modification

- Minimise/prevent habitat disturbance that may promote invasion or establishment of weeds, attract herbivores or introduce disease to the site as listed above.

## Ex situ conservation

- Develop and implement a targeted seed or other germplasm collection program (e.g., *ex situ* seed banking, following best-practice guidelines (Martyn Yenson *et al.* 2021).
- If appropriate, investigate the feasibility of establishing translocated populations from *in vitro* material that will improve the conservation outlook of the species noting that holomycotrophic orchids can be challenging due to complex fungal interactions that are not easily replicated *ex situ* or *in vitro* (Swarts and Dixon 2009). Translocations should be conducted in accordance with best practice guidelines and procedures (refer to Commander *et al.* 2018), including monitoring translocated populations through to recruitment to ensure they are viable.

## Stakeholders

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

## **Survey and Monitoring priorities**

Maintain a monitoring program to:

- Monitor annual population flowering and fruiting success.
- Determine trends in population size.
- Monitor levels of seed production and recruitment.
- Document threats to plants, loss of plants (plant survivorship) and recruitment of any new plants in relation to habitat disturbance or other factors.
- Monitor for habitat degradation or other site disturbances.
- Monitor for any adverse pathogen impacts, especially on key habitat structural species.
- Monitor for any herbivory impacts when plants are above ground.

Conduct targeted surveys in flowering seasons to determine if other populations can be found in potentially suitable habitat.

## **Information and Research priorities**

- Conduct research into the life history and ecology of the species. This includes continued monitoring to determine above ground flowering, plant survival and longevity, pollinators, recruitment, and seed dispersal.

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- Research the *ex situ* germination and culture requirements of the species.

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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:

*Danhatchia copelandii* was found to be Critically Endangered under Clause 4.3(a)(d)(e i,iii); Clause 4.4(a)(e i,ii,A(I)B) and Clause 4.5(a).

#### Clause 4.2 – Reduction in population size of species (Equivalent to IUCN criterion A)

Assessment Outcome: Data Deficient

<b>(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:</b>			
	(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.
<b>(2) - The determination of that criteria is to be based on any of the following:</b>			

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	(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, iii).**

<b>The geographic distribution of the species is:</b>			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
<b>and at least 2 of the following 3 conditions apply:</b>			
	(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(I)B)**

<b>The estimated total number of mature individuals of the species is:</b>				
	(a)	for critically endangered species	very low, or	
	(b)	for endangered species	low, or	
	(c)	for vulnerable species	moderately low,	
<b>and either of the following 2 conditions apply:</b>				
	(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,

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	(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).**

<b>The total number of mature individuals of the species is:</b>			
	(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**

<b>The probability of extinction of the species is estimated to be:</b>			
	(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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