

Conservation Assessment of *Diuris callitrophila* D.L.Jones (Orchidaceae)

Marc Freestone 23/10/2025

NSW Department of Planning and Environment

Diuris callitrophila D.L.Jones (Orchidaceae)

Distribution: Endemic to NSW

Current EPBC Act Status: Not listed

Current NSW BC Act Status: Endangered

Proposed listing on NSW BC Act: Endangered

No change to listing.

Summary of Conservation Assessment

Diuris callitrophila was found to be eligible for listing as Endangered under IUCN Criterion B1ab(iii,v)+2ab(iii,v). The main reasons for this species being eligible are: (1) it has a restricted geographical range (EOO 280 km² and AOO 20 km²); (2) it occurs in a very restricted number of threat-defined locations; and (3) it is projected to undergo continuing declines in area, extent and/or quality of habitat and number of mature individuals due to the threats posed by climate change, weeds, herbivory and overabundant *Callitris glaucophylla* regeneration.



Photo: *Diuris callitrophila* from Urana West. Credit: Marc Freestone © (used with permission).

Description and Taxonomy

Diuris callitrophila (Oaklands Diuris) is a conventionally accepted species (CHAH 2018, PlantNET 2024) within *Diuris*, subgenus *Diuris*, section *Purpureo-albae* (Indsto *et al.* 2009). *Diuris callitrophila* was described by Jones (2003) as “a tuberous terrestrial herb growing singly in loose scattered groups. Tubers more or less obovoid, bilobed to palmate, 15–35 mm long, 10–25 mm wide, fleshy, brown. Leaves basal, lax, 2–3, linear to linear-lanceolate, 15–35 cm long, 5–9 mm wide, convolute, green; base sheathing; apex acute to acuminate. Scape 30–50 cm tall, stout, 3–9-flowered. Sterile bracts two, narrowly ovate-lanceolate, 4–12 cm long, 5–9 mm wide, acute to acuminate, closely sheathing; lowest bract sometimes extended and leaf-like. Fertile bracts narrowly ovate-lanceolate, 3–7 cm long, 2–5 mm wide, acute to acuminate, closely sheathing. Pedicels 10–45 mm long, very slender. Ovaries obovoid, 4–8 mm long, 2–4 mm wide. Flowers porrect, c. 25–35 mm diam., slightly fragrant, whitish, mauve or purple, often marbled and striped with darker markings, the labellum usually darker than the rest and often with prominent interrupted striae. Dorsal sepal porrect in the proximal half then obliquely erect, ovate to ovate-elliptic, 10–20 mm long, 8–12 mm wide; apex broadly obtuse to apiculate. Lateral sepals obliquely deflexed, narrowly linear, 4–12 cm long, 2–4 mm wide, more or less parallel; margins involute; apex asymmetrically acute to acuminate. Petals erect, slightly divergent; lamina narrowly to broadly ovate to elliptic, 6–16 mm long, 6–10 mm wide, tapered basally into the claw; apex obtuse; claw 4–10 mm long, curved, green to brownish, widest near the apex, tapered to the base. Labellum 10–15 mm long, obliquely decurved, deeply 3-lobed; lateral lobes erect, oblong-cuneate, 3–6 mm long, 1–3 mm wide, shallowly curved; outer margins entire to slightly irregular; mid-lobe transversely ovate-reniform to flabelliform, 10–15 mm long, 8–15 mm wide, with a central longitudinal fold; margins slightly irregular; apex obtusely apiculate. Labellum callus glabrous, whitish marked with mauve or purple, well-developed on the labellum base and on the basal part of the mid-lobe, consisting of two raised divergent ridges which incurve slightly at the apex, with an ill-defined central tapered ridge extending well onto the mid-lobe. Column porrect from the end of the ovary, 5.5–6 mm long, 4–4.5 mm wide. Column wings more or less lanceolate, c. 6 mm long, c. 1.5 mm wide, irregularly toothed. Anther narrowly ovate, c. 5.5 mm long, c. 2.8 mm wide, brownish purple. Pollinarium c. 4.5 mm long, c. 2.4 mm wide; viscidium elliptic, c. 1 mm long; pollinia clavate, c. 4 mm long, white, mealy. Stigma broadly cordate, c. 2.5 mm long, c. 4 mm wide. Capsules ovoid to obovoid, 8–11 mm long, 4–6 mm wide, erect.”

Diuris callitrophila was previously known as *Diuris* sp. (Oaklands, Jones 5380) (NSW Scientific Committee 2001).

Recent whole genome single nucleotide polymorphism (SNP) data suggest *Diuris callitrophila* could be conspecific with *Diuris dendrobioides*, however further taxonomic research is ongoing (T. Hopley pers. comm. April 2024).

Distribution and Abundance

Diuris callitrophila occurs in the Riverina district of southern New South Wales (NSW) within the Riverina bioregion (DAWE 2021).

Diuris callitrophila is currently known to occur in four extant subpopulations (as per the IUCN (2024) definition): Oaklands, Urana West, Urana East and Cockatgedong (DAWE 2024a; Table 1). Subpopulations are separated by large distances (the

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smallest distance between subpopulations is 7.5 km) and are unlikely to exchange genetic material. No historical subpopulations are known. No subpopulations occur within conservation reserves, however Oaklands occurs on crown land and Urana East is in a Travelling Stock Reserve (TSR). Urana West, Urana East and Oaklands subpopulations are currently managed as part of the Saving Our Species (SoS) Program (DCCEEW 2024b). It is possible that additional undiscovered subpopulations of the species exist in unsurveyed, possibly suitable habitat, although most of this is on private land.

A total of 1,075 plants have been tagged in monitoring plots across all four subpopulations (A. Murphy pers. comm. May 2024). However, plants also occur outside of monitoring plots. Therefore, an estimate of the total number of plants at each site was made with the calculation: *total number plants = number of plants in monitoring plot x (localised extent of occurrence OR area of monitoring plot)*. The localised extent of occurrence for each site was calculated with QGIS (QGIS 2024) using a polygon incorporating all BioNet records at the site (DCCEEW 2024a). Where the area of BioNet records was smaller than the area of the monitoring plot, it was assumed the monitoring plot contains the entirety of the BioNet records, and no calculation was made. It is assumed that the mean density of plants inside and outside the monitoring plot is the same, and that no unrecorded plants occur at the subpopulations.

The total population size of *Diuris callitrophila* is estimated at 1,659 mature individuals (Table 1). It is unknown if this is an under- or overestimate, as distribution within the population is unlikely to be homogenous, and additional unrecorded plants are likely to occur particularly at Oaklands and Urana East subpopulations (M. Freestone pers. obs. July 2023). Flowering of *D. callitrophila* is heavily influenced by rainfall conditions and grazing pressure, and as a result, the number of flowering plants fluctuates from year to year (Table 2; A. Murphy pers. comm. May 2024).

Two large conservation translocations were undertaken in 2022 using ex-situ grown plants at Urana East and Coorabin. However, insufficient time has elapsed since the translocations, and there are currently no data on recruitment. Therefore, translocated plants are not yet included as part of the wild population, as per IUCN (2024).

Table 1. *Diuris callitrophila* subpopulation estimates*

Location	No. plants in monitoring plot ¹	Area of monitoring plot	Area of records ²	Estimated no. plants	
Cocketgedong (West) ³	132	400 m ²	120 m ²	132	357
Cocketgedong (East) ³	225	400 m ²	150 m ²	225	
Oaklands (North) ³	269	100 m ²	180 m ²	484	808
Oaklands (South) ³	162	200 m ²	400 m ²	324	
Urana West	235	400 m ²	500 m ²	294	
Urana East	200 ⁴	NA ⁴	NA ⁵	200	

* B. Davies pers. comm. May 2024. ¹Total number of tagged plants in monitoring plots. ²BioNet records (DCCEEW 2024a). ³The Cocketgedong and Oaklands subpopulations each have two monitoring plots. ⁴The count of Urana East is a total estimate of the number of plants in the subpopulation and includes plants inside and outside of the monitoring plot. ⁵Only one BioNet record exists for this subpopulation so no calculation of the area of records is possible.

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Table 2. *Diuris callitrophila* subpopulation monitoring data

Subpopulation	Number of plants (year)	Source
Cocketgedong	>15 (2023) 75 (2021) 130 (2020) 0 (2019) 0 (2018) 34 (2017) 208 (2016)	A. Murphy pers. comm. May 2024
Oaklands	69 (2023) 161 (2021) 195 (2020) 18 (2019) 0 (2018) 114 (2017) 225 (2016)	A. Murphy pers. comm. May 2024
Urana West	131 (2023) 144 (2021) 141 (2020) 0 (2019) 0 (2018) 3 (2017) 112 (2016)	A. Murphy pers. comm. May 2024
Urana East	>200 (2023) 32 (2021) 34 (2020) 0 (2019) 0 (2018) 1 (2017)	A. Murphy pers. comm. May 2024

Extent of Occurrence and Area of Occupancy

The Extent of Occurrence (EOO) of *Diuris callitrophila* is based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2024). The Extent of Occurrence (EOO) is estimated at 280 km². The Area of Occupancy (AOO) of the species was calculated using 2 x 2 km grid cells, the scale recommended by IUCN (2024) and was estimated to be 20 km². Both EOO and AOO were calculated using QGIS (QGIS 2024), enclosing all likely extant survey records and cleaned spatial datasets. Cleaning removed one record with incorrect location details (NSW621898 from Oaklands), leaving 551 clean records used in this assessment. Based on these estimates, *D. callitrophila* has a highly restricted EOO and AOO.

Number of Locations

Diuris callitrophila is found at one threat-defined location when considering the most serious plausible threat of increased frequency and intensity of drought, and reduced winter–spring rainfall due to climate change. Climate change projections for the southern Riverina region are for a 10–20% reduction in annual rainfall, which is particularly severe in spring, when a 25–30% reduction is predicted (AdaptNSW 2024) along with increased time spent in drought (CSIRO and BOM 2022). Flowering

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of *D. callitrophila* is very reduced or non-existent in dry years (A. Murphy pers. comm. May 2024), when the species likely persists as non-flowering or dormant plants, as illustrated by the effective failure of flowering across the entire population in 2018 and 2019 (Table 1). With reduced winter-spring rainfall and increased frequency and intensity of drought predicted due to climate change, episodes of reduced or failed flowering would be expected to increase, resulting in decreased recruitment of the species. Seed of most Australian terrestrial orchids is unlikely to be long-lived in the soil (Batty *et al.* 2000), and requires sustained adequate soil moisture conditions throughout the growing season to support germination by symbiotic orchid mycorrhizal fungi (Janissen *et al.* 2021). Orchid mycorrhizal fungi are sensitive to soil moisture (Freestone *et al.* 2021) and it is likely that a reduction in the length of the growing season caused by climate change-driven changes to rainfall patterns, causing the failure of germination, is a major factor in the lack of recruitment and associated decline of threatened orchids in southeast Australia (Janissen *et al.* 2021). In addition to reduced recruitment, it is likely that an increased frequency of drought conditions will contribute to increasing adult mortality. Although *D. callitrophila* possesses a tuber and can persist in a dormant state during unfavourable conditions, long periods of dormancy are associated with increased mortality of adult plants in other terrestrial orchids (Coates *et al.* 2006; Pfeifer *et al.* 2006). The highly restricted EOO of *D. callitrophila* means that local drought conditions are likely to affect all subpopulations of this species at the same time, suggesting that *D. callitrophila* has a single threat-defined location. While the effect of drought conditions is likely currently mediated by the occurrence of average or above-average rainfall years in between periods below-average rainfall conditions, it is plausible that increasing frequency or intensity of drought conditions and reductions in winter–spring rainfall projected under climate change could cause substantial population declines and possibly result in the elimination of the species within a short timeframe.

Ecology

Habitat

Diuris callitrophila occurs at approximately 120–150 m a.s.l. in an area from Oaklands in the south to Urana in the northeast and Cocketgedong in the northwest. It occurs in *Callitris glaucophylla* (White Cypress Pine) Woodland or associated grassland on sandy loam soils, either among dense grasses in flat areas with associated eucalypts (e.g., *Eucalyptus melliodora*), or amongst sparse grasses and forbs on low sandhills (DCCEEW 2024b). Associated understorey species can include *Anthosachne scabra*, *Aristida behriana*, *A. jerichoensis*, *Arthropodium strictum*, *Austrostipa scabra*, *Bothriochloa macra*, *Cheilanthes sieberi*, *Chrysocephalum apiculatum*, *Convolvulus* spp., *Digitaria ammophila*, *Enneapogon nigricans*, *Eragrostis elongata*, *Glycine clandestina*, *Maireana humillima*, *Oxalis perennans*, *Panicum effusum*, *Rytidosperma auriculatum*, *Tricoryne elatior*, *Vittadinia* spp., *Wahlenbergia gracilentia* (DCCEEW 2024a).

Diuris callitrophila occurs in the State-listed ecological community Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions (NSW Scientific Committee 2008).

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Life History

Diuris callitrophila is dormant during the summer months, from approximately December–March/April, depending on the timing of autumn rains (M. Freestone pers. obs. Nov 2016). The species flowers in November, with most BioNet records from early-mid November (DCCEEW 2024a). Flowering is much reduced or completely absent in dry years, when individuals persist as non-flowering or dormant plants (A. Murphy pers. comm. May 2024). When plants are dormant or not flowering they are very difficult to see among understorey grasses (M. Freestone pers. obs. November 2016). While *Diuris callitrophila* possesses a tuber and can persist in a dormant state during unfavourable conditions, long periods of dormancy are associated with increased mortality of adult plants in other Australian terrestrial orchids (Coates *et al.* 2006).

The fire response of *Diuris callitrophila* is unknown. Orchids from other grassy ecosystems are usually fire-responsive species, with increased flowering following fire during the orchid's dormant season (Coates *et al.* 2006). However, fire during the non-dormant growing season can be detrimental to the persistence of Australian terrestrial orchids (Jasinge *et al.* 2018). Tubers at this time may have insufficient resources to sustain a second flush of leaf production, resulting in tuber mortality and consequently plant senescence (Jasinge *et al.* 2018). Seedlings generally do not develop tubers until spring, and they are likely to be located at a very shallow depth, suggesting fires during the non-dormant season are likely to cause high seedling mortality (M. Freestone pers. obs. September 2018).

Reproductive Ecology

Diuris callitrophila is pollinated by *Amegilla* bees, which are apparently deceived into pollinating *D. callitrophila* while visiting neighbouring *Arthropodium strictum* (M. Freestone pers. obs. Nov 2016). The orchid probably uses food deceptive guild mimicry to deceive pollinators like other *Diuris* (Beardsell *et al.* 1986; Indsto *et al.* 2006; Scaccabarozzi *et al.* 2020), although the related *Diuris alba* does produce small amounts of nectar (Indsto *et al.* 2007).

Diuris species take around three years to reach maturity in cultivation (M. Freestone pers. obs. November 2016–August 2023). The maximum lifespan of *Diuris* is unknown, although *Diuris* species in cultivation generally have maximum lifespans of one to two decades (M. Freestone pers. obs. November 2016–August 2023). Generation time is estimated based on the primary juvenile period and lifespan using the formula: $\text{primary juvenile period} + [z * (\text{reproductive lifespan} - \text{primary juvenile period})]$ where z is generally assumed to be 0.5 (IUCN 2024). Based on this, the minimum generation length of *D. callitrophila* is estimated as: $3 + [0.5 * (10 - 3)] = 6.5$ years. The maximum generation length is estimated as: $3 + [0.5 * (20 - 3)] = 11.5$ years. Using the average of the maximum and minimum estimates gives an estimated generation length of 9 years, and an estimated three generation period of 27 years. However, these values are likely to be underestimates, and are founded on data from specimens in cultivation.

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Seed Ecology

Diuris species reproduce via seed, and each plant has a single underground tuber, replaced annually, that allows it to persist underground for long periods. Orchid seeds are generally miniscule in size and wind-dispersed and are not known to form a persistent soil seedbank (Batty *et al.* 2000). *Diuris* species, like all orchids, require a fungal symbiont for germination and nutrient uptake. *Diuris callitrophila* associates with a species of *Tulasnella* fungus (M. Freestone pers. obs. June 2023). Orchid mycorrhizal fungi are sensitive to soil moisture (Freestone *et al.* 2021) and successful germination requires sustained adequate soil moisture conditions throughout the growing season, during which time the germinating orchid seedling must produce a tuber before the onset of dry soil conditions (Janissen *et al.* 2021; M. Freestone pers. obs. Sep 2018). Therefore, the length of the growing season is likely an important factor in the success or failure of recruitment (Janissen *et al.* 2021). Orchid mycorrhizal fungi from terrestrial orchids in temperate Australia can survive dry soil conditions (e.g., during summer months), although the mechanisms by which they do this are not well understood (M. Freestone pers. comm. June 2024).

Cultural significance

Diuris callitrophila occurs on the traditional lands of the Wiradjuri First Nations people (NPWS 2014). This assessment is not intended to be comprehensive of the traditional ecological knowledge that exists for *Diuris callitrophila*, or to speak for Aboriginal people. Aboriginal people have a long history of biocultural knowledge, which comes from observing and being on Country, and evolves as it is tested, validated, and passed through generations (Woodward *et al.* (Eds.) 2020). Aboriginal peoples have cared for Country for tens of thousands of years (Bowler *et al.* 2003; Clarkson *et al.* 2017). There is traditional ecological knowledge for all plants, animals and fungi connected within the kinship system (Woodward *et al.* 2020). Traditional ecological knowledge referenced in this assessment belongs to the relevant knowledge custodian and has been referenced in line with the principals of the NSW Indigenous Cultural and Intellectual Property protocol (ICIP) (Janke and Company 2023).

Threats

The NSW Scientific Committee (2001) stated that threats to *Diuris callitrophila* include “road maintenance activities, and... the impact of chance events on low population numbers and the low number of individuals in each population”. Although subpopulation numbers are larger than originally reported by NSW Scientific Committee (2001), additional threats are now known, inferred or suspected to be adversely affecting the species (DCCEEW 2024b, 2024c).

Reduced winter–spring rainfall and increased frequency of drought due to climate change

Climate change projections based on NARClIM2.0 for NSW (AdaptNSW 2024) under a high emissions scenario predict a 10–20% reduction in annual rainfall for the areas containing subpopulations of *D. callitrophila*, with reduced rainfall predicted in every season but particularly in spring (September–November), where a 25–30% reduction is predicted. Increased time spent in drought is also predicted for the region (CSIRO and BOM 2022). In addition to changes in rainfall, average mean temperature is

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predicted to increase by 3.5–4.0°C with 5–10 more hot days over 35°C predicted in spring, indicating likely increased rates of evaporation during the species' growing period, compounding the effect of reduced rainfall on soil moisture (Horwitz *et al.* 2008).

Flowering of *Diuris callitrophila* is very reduced or non-existent in dry years (A. Murphy pers. comm. May 2024), when the species likely persists as non-flowering or dormant plants. Dry conditions in the months preceding the species' November flowering period appear to substantially reduce flowering rates, as illustrated by no flowering plants in 2018 and very few in only one of the four subpopulations in 2019 (Table 1), both of which were years of below average late winter–spring rainfall (BOM 2024). Although *D. callitrophila* possesses a tuber and can persist in a dormant state during unfavourable conditions, long periods of dormancy are associated with increased mortality of adult plants in other Australian terrestrial orchids (Coates *et al.* 2006). Therefore, decreases in winter–spring rainfall and increased time spent in drought are likely to have an adverse effect on this species, which is likely dependent on adequate soil moisture during the winter–spring growing season for reproduction (Janissen *et al.* 2021). Drought may cause increased adult mortality (Pfeifer *et al.* 2006) and alter site hydrology leading to the habitat becoming unsuitable for the species.

Therefore, it is plausible that climate change represents a real threat to the long-term survival of the species, particularly through increased adult mortality and decreased recruitment resulting from a shortening of the growing season length or dry soil conditions during the growing season. As the seed of *D. callitrophila* are inferred to be short-lived in the soil, sustained failures of flowering or recruitment are likely to result in population declines. 'Anthropogenic Climate Change' is listed as a Key Threatening Process under the NSW Biodiversity Conservation Act 2016 (NSW Scientific Committee 2000), while 'Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases' is listed as a Key Threatening Process under the EPBC Act 1999 (TSSC 2001a).

Grazing by introduced animals or overabundant kangaroos

Diuris callitrophila is highly susceptible to grazing pressure (A. Murphy pers. comm. May 2024). This includes grazing from livestock, *Macropus* spp. (kangaroos), *Oryctolagus cuniculus* (European rabbit) and slugs. At Cocketgedong, the majority of plants detected in 2023 were found in a small fenced enclosure, and very few were found at plots outside the enclosure, presumably due to grazing by stock, kangaroos and/or European rabbit, all of which are present at the site (A. Murphy pers. comm. May 2024). At Urana East, plant density was greater in portions of the site excluded from grazing by fencing or natural barriers (A. Murphy pers. comm. May 2024). An infestation of non-native slugs was observed eating the species at a reintroduction site in 2023, but were absent following the application of snail bait (A. Murphy pers. comm. May 2024; M. Freestone pers. obs. June 2023). 'Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus* (L.) is listed as a Key Threatening Process under the NSW Biodiversity Conservation Act 2016 (NSW Scientific Committee 2002), while 'Competition and land degradation by rabbits' is listed as a Key Threatening Process under the EPBC Act 1999 (DoEE 2016).

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Competition with overabundant *Callitris glaucophylla*

Part of the Cocketgedong subpopulation was fenced to exclude stock over a decade ago, and dense recruitment of *Callitris glaucophylla* occurred within the enclosure as a result (M. Freestone pers. obs. November 2016). Recent records of the species at Cocketgedong are located outside the enclosure in open, grassy areas (A. Murphy pers. comm. May 2024). It is not known if the species still occurs within the area now occupied by dense *C. glaucophylla* recruits. Overabundant *C. glaucophylla* recruitment is also a threat at Oaklands, where fewer plants were detected in areas with a high abundance of young *C. glaucophylla* (A. Murphy pers. comm. May 2024).

Fragmentation due to agricultural activities and/or roadworks

Diuris callitrophila is not protected within formal conservation reserves and as such, clearing is a potential threat to every subpopulation. *Diuris callitrophila* is likely to have suffered historical broad-scale loss of habitat to agriculture (NSW Scientific Committee 2008) and clearing of potential habitat on private land may be ongoing. One subpopulation occurs in a golf course and is susceptible to changes in management that could cause clearing of its native grassland habitat. The species has potential habitat along roadsides which could be at risk from road maintenance activities, such as clearing or herbicide application (NSW Scientific Committee (2001). 'Clearing of native vegetation' is listed as a Key Threatening Process under the NSW Biodiversity Conservation Act 2016 (NSW Scientific Committee 2001), while 'Land clearance' is listed as a Key Threatening Process under the EPBC Act 1999 (TSSC 2001b).

Competition with invasive weeds

Herbaceous weeds can outcompete terrestrial orchids (Scade *et al.* 2006). The species occurs with introduced plants at all subpopulations, with *Eragrostis curvula* (African lovegrass), *Avena* spp. (wild oats) and *Gazania* sp. a threat to the species at Oaklands (DCCEEW 2024b, 2024c) where they have been observed to outcompete *Diuris callitrophila* (A. Murphy pers. comm. May 2024). Weed control works were undertaken at Oaklands in 2023 (A. Murphy pers. comm. May 2024). *Lycium ferocissimum* (African boxthorn) is present at Cocketgedong and could threaten the species if the infestation increases in size, although it has also been the subject of weed control works in the past (M. Freestone pers. obs. June 2023). However, the threat from invasive weeds may increase if weed management works cease for extended periods of time. 'Invasion of native plant communities by exotic perennial grasses' and 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants' are listed as Key Threatening Processes under the NSW Biodiversity Conservation Act 2016 (NSW Scientific Committee 2003, 2011), while 'Novel biota and their impact on biodiversity' is listed as a Key Threatening Process under the EPBC Act 1999 (TSSC 2013).

Assessment against IUCN Red List criteria

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

Criterion A Population Size reduction

Assessment Outcome: Data Deficient

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Justification: The number of mature individuals of *Diuris callitrophila* is estimated at 1,659 plants. However, flowering of *D. callitrophila* is heavily influenced by rainfall conditions and grazing pressure, and as a result, the number of flowering plants fluctuates from year to year (Table 1). These fluctuations do not represent changes in the number of mature individuals, as most plants likely survive dry season as dormant or non-flowering plants. Approximately 75% of 1,075 tagged plants re-emerged at least once from 2016–2021 (A. Murphy pers. comm. May 2024). However, this is unlikely to be reflective of a 25% mortality rate, because the species may be dormant or non-flowering and because around a third of all tagged plants were likely tagged late in this five-year period. These fluctuations limit the ability to draw inferences on population trends from current monitoring data. Although the species is likely to have suffered broad-scale habitat loss due to historic land clearing for agriculture, and some clearing of potential habitat is probably still ongoing, there are no data on how this may affect the population size of *Diuris callitrophila*. Therefore, there are insufficient data to assess *D. callitrophila* under this criterion.

Criterion B Geographic range

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

Justification: *Diuris callitrophila* is endemic to a small area of the Riverina and has a restricted geographic distribution. The Extent of Occurrence (EOO) is estimated at 280 km², meeting the threshold for listing as Endangered. The Area of Occupancy (AOO) has been calculated as 20 km², also meeting the threshold for listing as Endangered.

In addition to these thresholds, at least two of three other conditions described below must be met. *Diuris callitrophila* meets two of these conditions (a, b) based on justifications provided below:

- 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: Met for Critically Endangered, due to the species having one threat-defined location.

Justification: *Diuris callitrophila* is found at one threat-defined location when considering the most serious plausible threat of reduced winter–spring rainfall and increased frequency and intensity of drought due to climate change.

Climate change projections for the southern Riverina region are for a 10–20% reduction in annual rainfall, which is particularly severe in spring, when a 25–30% reduction is predicted (AdaptNSW 2024) along with increased time spent in drought (CSIRO and BOM 2022). Flowering of *D. callitrophila* is very reduced or non-existent in dry years (A. Murphy pers. comm. May 2024), as illustrated by the effective failure of flowering across the entire population in 2018 and 2019 (Table 1). An increasing number of years in which few plants flower is likely to result in decreased recruitment and increased mortality (Coates *et al.* 2006; Pfeifer *et al.* 2006). Seed of most Australian terrestrial orchids are unlikely to be long-lived in the soil (Batty *et al.* 2000) and seedlings are sensitive to short periods of dry soil moisture conditions (Janissen *et al.* 2021). A reduction in the length of the growing

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season caused by climate change driven changes to rainfall patterns, causing reproductive failure, is a major factor in the lack of recruitment and associated decline of threatened orchids in southeast Australia (Janissen *et al.* 2021).

The highly restricted EOO of *D. callitrophila* means that local drought conditions are likely to affect all subpopulations of this species at the same time, suggesting that *D. callitrophila* has a single threat-defined location. Although the effect of drought conditions is likely currently mediated by the occurrence of average or above-average rainfall years in between periods below-average rainfall conditions, it is plausible that increasing frequency or intensity of drought conditions and reductions in winter–spring rainfall projected under climate change (AdaptNSW 2024; CSIRO and BOM 2022) could cause substantial population declines and possibly result in the elimination of the species within a short timeframe.

The species occurs in subpopulations that vary in size from 200 to over 800 mature individuals. It is not known whether the subpopulations that account for at least half of the total known number of individuals may go extinct. Therefore, there are insufficient data to determine if the species is severely fragmented according to IUCN (2024).

- 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 continuing decline observed, inferred and/or projected for (iii) area, extent and/or quality of habitat; and (v) number of mature individuals.

Justification: Decline in the area, extent and/or quality of habitat has been observed, inferred and is projected to continue due to the threats of weed invasion, herbivory, below-average rainfall and increased time spent in drought during the species' growing season, competition with overabundant *Callitris glaucophylla*, and habitat loss. Reduced winter–spring rainfall and increased frequency of drought due to climate change are likely to cause future population declines. Climate change projections for the southern Riverina region are for a 10–20% reduction in annual rainfall, which is particularly severe in spring, when a 25–30% reduction is predicted (AdaptNSW 2024) along with increased time spent in drought (CSIRO and BOM 2022). Drought conditions in late winter–spring in 2018 and 2019 resulted in the effective failure of flowering across all subpopulations in those years. Precipitation changes driven by climate change are implicated in declines of other threatened orchids in southeast Australia (Janissen *et al.* 2021). Overabundant *C. glaucophylla* has previously caused declines in the number of individuals in affected areas of Cocketgedong and Oaklands subpopulations, grazing by introduced animals and stock has caused declines in the quality of habitat at Cocketgedong, while weed invasion has degraded the species' habitat at Cocketgedong and Oaklands in the past and could continue to threaten these subpopulations if management actions cease for extended periods of time. Habitat loss has likely been a major

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historical threat to the species, and it has the potential to affect the extant subpopulations, none of which are protected in formal conservation reserves.

c) Extreme fluctuations.

Assessment Outcome: Not met.

Justification: The number of individuals of *Diuris callitrophila* that produce flowers in a given year can fluctuate depending on recent rainfall and management conditions. However, this seems unlikely to represent a fluctuation in the number of mature individuals, as many individuals likely persist as dormant or non-flowering plants during such years. Therefore there is no evidence or likely mechanism of extreme fluctuations in the number of mature individuals.

Criterion C Small population size and decline

Assessment Outcome: Vulnerable under Criterion C2a(i), due to the species having a projected continuing decline in number of mature individuals and there are a limited number of mature individuals in the largest subpopulation.

Justification: The estimated number of mature individuals of *Diuris callitrophila* is 1,659 plants, meeting the threshold for Endangered.

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

Assessment Outcome: Data deficient

Justification: There are no data on population trends in *Diuris callitrophila* (see Criterion A).

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

Assessment Outcome: Met for Vulnerable.

Justification: There is a projected continued decline in the number of mature individuals due to reductions in winter–spring rainfall and increasing time spent in drought due to climate change, weeds, herbivory, competition from *Callitris glaucophylla*, and clearing; and the largest subpopulation has a limited number of individuals.

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: The largest subpopulation at Oaklands is estimated to contain 808 individuals (Table 1). Therefore, the species

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meets the subcriterion threshold for Vulnerable, but not that for Endangered.

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

Assessment Outcome: Not met.

Justification: The largest subpopulation at Oaklands is estimated to contain 49% of the species' population (Table 1), which is below the minimum threshold for this subcriterion.

- b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Not met.

Justification: The number of flowering individuals of *Diuris callitrophila* can fluctuate depending on recent rainfall and management conditions. However, this does not suggest a fluctuation in the number of mature individuals, as many individuals likely persist as dormant or non-flowering plants during such years.

Criterion D Very small or restricted population

Assessment Outcome: Not met

Justification: The species' number of mature individuals is estimated at 1,659 plants and its AOO is estimated at 20 km², which do not meet the thresholds required under Criterion D.

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: Not met.

Justification: The species' number of mature individuals is estimated at a minimum of 1,659 plants.

- 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: Not met

Justification: The species' AOO is estimated at 20 km² and it is found at one threat-defined location. While the species faces several current threats, there are no plausible future threats that are not already acting on the species, which are likely to drive the species to CR or EX in a very short period of time. Therefore, it is considered that *D. callitrophila* does not meet the threshold for D2.

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Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient

Justification: A quantitative analysis of extinction probability is not currently available for this species.

Conservation and Management Actions

Diuris callitrophila is currently listed on the NSW *Biodiversity Conservation Act 2016* as *Diuris* sp. (Oaklands, D.L. Jones 5380) and a conservation strategy 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. *Diuris callitrophila* sits within the site-managed management stream of the SoS program and the conservation strategy can be viewed [here](#). There is no National Recovery Plan for this species.

References

- Batty AL, Dixon KW, Sivasithamparam K (2000). Soil seed bank dynamics of terrestrial orchids. *Lindleyana* **15**, 227–236.
- Beardsell DV, Clements MA, Hutchinson JF, Williams EG (1986). Pollination of *Diuris maculata* R Br (Orchidaceae) by floral mimicry of the native legumes *Daviesia* spp. and *Pultenaea scabra* R Br. *Australian Journal of Botany* **34**, 165–173.
- BOM (Bureau of Meteorology) 2024. Daily rainfall statistics for Urana (Nowranie), Australian Government Bureau of Meteorology. Available at: http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=2018&p_c=-1097893747&p_stn_num=074087 (accessed 15 September 2024).
- Bowler JM, Johnston, H Olley JM, Prescott JR, Roberts RG, Shawcross W and Spooner N A (2003) 'New ages for human occupation and climatic change at Lake Mungo, Australia'. *Nature* **421**, 837–840.
- CHAH (Council of Heads of Australasia Herbaria) (2018) Australian Plant Census, Council of Heads of Australasian Herbaria. Available at: <https://biodiversity.org.au/nsi/services/rest/reference/apni/51316736> (accessed 18 May 2024).
- Clarkson C, Jacobs Z, Marwick B, Fullagar R, Wallis L, Smith M, Roberts RG, Hayes E, Lowe K, Carah X and Florin SA (2017) 'Human occupation of northern Australia by 65,000 years ago'. *Nature* **547**, 306–310.
- Coates F, Lunt ID, Tremblay RL (2006). Effects of disturbance on population dynamics of the threatened orchid *Prasophyllum correctum* DL Jones and implications for grassland management in south-eastern Australia. *Biological Conservation* **129**, 59–69.
- Commander LE, Coates D, Broadhurst L, Offord CA, Makinson RO, Matthes M (2018) Guidelines for the translocation of threatened plants in Australia. Third Edition. Australian Network for Plant Conservation, Canberra. Available at:

NSW Threatened Species Scientific Committee

https://www.anpc.asn.au/wp-content/uploads/2019/03/Translocation-Guidelines_FINAL-WEB2.pdf (accessed 18 May 2024).

CSIRO and BOM (Commonwealth Scientific and Industrial Research Organisation and Bureau of Meteorology) (2022) Murray Basin subcluster: Climate Change in Australia website. Commonwealth Scientific Research Organisation, and Bureau of Meteorology, Canberra. Available at: <https://www.climatechangeinaustralia.gov.au/en/projections-tools/regional-climate-change-explorer/sub-clusters/?current=MBC&tooltip=true&popup=true> (accessed 21 May 2024).

DAWE (Department of Agriculture, Water and Environment) (2021) Australia's bioregions (IBRA). Commonwealth Department of Climate Change, Energy, the Environment and Water, Canberra. Available at: <https://www.dcceew.gov.au/environment/land/nrs/science/ibra> (accessed 19 May 2024).

DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2024a) BioNet records for *Diuris callitrophila*. NSW Department of Climate Change, Energy, Environment and Water.

DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2024b) Oaklands Diuris (Diuris sp. (Oaklands, D.L. Jones 5380)): Saving our Species strategy. NSW Department of Climate Change, Energy, Environment and Water. Available at: <https://www.environment.nsw.gov.au/savingourspeciesapp/project/282> (accessed 21 May 2024).

DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2024c) Oaklands Diuris - profile Available at: <https://threatenedspecies.bionet.nsw.gov.au/profile?id=10242> (accessed 21 May 2024).

DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2024d) State Vegetation Type Map on the SEED portal. NSW Department of Climate Change, Energy, Environment and Water. Available at: <https://datasets.seed.nsw.gov.au/dataset/nsw-state-vegetation-type-map> (accessed 21 May 2024).

DoEE (Department of Energy and Environment) (2016) Threat abatement plan for competition and land degradation by rabbits. Available at: <https://www.dcceew.gov.au/environment/biodiversity/threatened/publications/tap/competition-and-land-degradation-rabbits-2016> (accessed 19 May 2019).

Freestone MW, Swarts ND, Reiter N, Tomlinson S, Sussmilch FC, Wright MM, Holmes GD, Phillips RD, Linde CC (2021) Continental-scale distribution and diversity of *Ceratobasidium* orchid mycorrhizal fungi in Australia. *Annals of Botany* **128**, 329–343.

Grose MR, Bhend J, Argueso D, Dowdy AJ, Hoffmann P, Evans JP, Timbal B (2015). Comparison of various climate change projections of eastern Australian rainfall. *Australian Meteorological and Oceanographic Journal* **65**, 72–89.

NSW Threatened Species Scientific Committee

- Horwitz P, Bradshaw D, Hopper S, Davies P, Froend R, Bradshaw F (2008). Hydrological change escalates risk of ecosystem stress in Australia's threatened biodiversity hotspot. *Journal of the Royal Society of Western Australia* **91**, 1–11.
- Indsto JO, Weston PH, Clements MA, Dyer AG, Batley M, Whelan RJ (2006). Pollination of *Diuris maculata* (Orchidaceae) by male *Trichocolletes venustus* bees. *Australian Journal of Botany* **54**, 669–679.
- Indsto JO, Weston PH, Clements MA, Dyer AG, Batley M, Whelan RJ (2007). Generalised pollination of *Diuris alba* (Orchidaceae) by small bees and wasps. *Australian Journal of Botany* **55**, 628–634.
- Indsto JO, Weston, PH, Clements MA (2009). A molecular phylogenetic analysis of *Diuris* (Orchidaceae) based on AFLP and ITS reveals three major clades and a basal species. *Australian Systematic Botany* **22**, 1–15.
- IUCN (International Union for the Conservation of Nature) (2024). Guidelines for Using the IUCN Red List Categories and Criteria. Version 16 (March 2024). Standards and Petitions Committee of the IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
- Janissen B, French G, Selby-Pham J, Lawrie AC, Huynh T (2021) Differences in emergence and flowering in wild, re-introduced and translocated populations of an endangered terrestrial orchid and the influences of climate and orchid mycorrhizal abundance. *Australian Journal of Botany* **69**, 9–20.
- Janke (Terri Janke and Company – Lawyers and Consultants) (2023) '*Indigenous Cultural and Intellectual Property protocol*'. Department of Planning and Environment NSW, Parramatta.
- Jasinge NU, Huynh T, Lawrie AC (2018) Consequences of season of prescribed burning on two spring-flowering terrestrial orchids and their endophytic fungi. *Australian Journal of Botany* **66**, 298–312.
- Jones DL (2003). Two new species of threatened *Diuris* (Orchidaceae) from New South Wales. *The Orchadian* **14**, 133–135.
- Martyn Yenson AJ, Offord CA, Meagher PF, Auld T, Bush D, Coates DJ, Commander LE, Guja LK, Norton SL, Makinson RO, Stanley R, Walsh N, Wrigley D, Broadhurst L (2021) Plant Germplasm Conservation in Australia: strategies and guidelines for developing, managing and utilising ex situ collections. Third edition. Australian Network for Plant Conservation, Canberra. Available at: https://anpc.asn.au/wp-content/uploads/2021/09/GermplasmGuidelinesThirdEdition_FINAL_210902.pdf (accessed 18 May 2024).
- NPWS (National Parks and Wildlife Service) (2014) Oolambeyan National Park and Kumbatine State Conservation Area Plan of Management. NSW National Parks and Wildlife Service. Available at: <https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Parks-reserves-and-protected-areas/Parks-plans-of-management/oolambeyan-national-park-plan-of-management-160097.pdf> (accessed 18 May 2024).

NSW Threatened Species Scientific Committee

NSW Scientific Committee (2000). Anthropogenic Climate Change - key threatening process listing. Available at: <https://www.environment.nsw.gov.au/Topics/Animals-and-plants/Threatened-species/NSW-Threatened-Species-Scientific-Committee/Determinations/Final-determinations/2000-2003/Anthropogenic-Climate-Change-key-threatening-process-listing> (accessed 18 May 2024).

NSW Scientific Committee (2001) *Diuris* sp. Oaklands (D.L. Jones) (an orchid) – endangered species listing. Available at: <https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2000-2003/diuris-sp-oaklands-an-orchid-endangered-species-listing> (accessed 19 May 2024).

NSW Scientific Committee (2001). Clearing of native vegetation - key threatening process listing. Available at: <https://threatenedspecies.bionet.nsw.gov.au/profile?id=20023> (accessed 18 May 2024).

NSW Scientific Committee (2002). Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus* (L.) - key threatening process listing. Available at: <https://www.environment.nsw.gov.au/Topics/Animals-and-plants/Threatened-species/NSW-Threatened-Species-Scientific-Committee/Determinations/Final-determinations/2000-2003/Competition-and-grazing-by-the-feral-European-rabbit-key-threatening-process-listing> (accessed 19 May 2024).

NSW Scientific Committee (2003). Invasion of native plant communities by exotic perennial grasses – key threatening process listing. Available at: <https://www.environment.nsw.gov.au/Topics/Animals-and-plants/Threatened-species/NSW-Threatened-Species-Scientific-Committee/Determinations/Final-determinations/2000-2003/Invasion-of-native-plant-communities-by-exotic-perennial-grasses-key-threatening-process-listing> (accessed 19 May 2024).

NSW Scientific Committee (2008). Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions - Endangered Ecological Community listing. Available at: <https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2008-2010/sandhill-pine-woodland-endangered-ecological-community-listing> (accessed 19 May 2024).

NSW Scientific Committee (2011). Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants - key threatening process listing. Available at: <https://www.environment.nsw.gov.au/Topics/Animals-and-plants/Threatened-species/NSW-Threatened-Species-Scientific-Committee/Determinations/Final-determinations/2011-2012/Loss-and-degradation-of-native-plant-and-animal-habitat-key-threatening-process-listing> (accessed 19 May 2024).

PlantNET 2024 (The NSW Plant Information Network System). Royal Botanic Gardens and Domain Trust, Sydney. <https://plantnet.rbgsyd.nsw.gov.au> (accessed 11 December 2024).

NSW Threatened Species Scientific Committee

- Pfeifer M, Wiegand K, Heinrich W, Jetschke G (2006) Long-term demographic fluctuations in an orchid species driven by weather: implications for conservation planning. *Journal of Applied Ecology* **43**, 313–324.
- QGIS (2024). QGIS Geographic Information System. Open Source Geospatial Foundation Project. <http://qgis.osgeo.org>
- Reiter N, Dimon R, Arifin A, Linde C (2023). Culture age of *Tulasnella* affects symbiotic germination of the critically endangered Wyong sun orchid *Thelymitra adorata* (Orchidaceae). *Mycorrhiza* **33**, 409–424.
- Scaccabarozzi D, Guzzetti L, Phillips RD, Milne L, Tommasi N, Cozzolino S, Dixon KW (2020). Ecological factors driving pollination success in an orchid that mimics a range of Fabaceae. *Botanical Journal of the Linnean Society* **194**, 253–269.
- Scade A, Brundrett MC, Batty AL, Dixon KW, Sivasithamparam K (2006). Survival of transplanted terrestrial orchid seedlings in urban bushland habitats with high or low weed cover. *Australian Journal of Botany* **54**, 383–389.
- TSSC (Threatened Species Scientific Committee) (2001a) Commonwealth listing advice on Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases. Australian Government, Canberra. Available at: <https://www.dcceew.gov.au/environment/biodiversity/threatened/key-threatening-processes/loss-of-habitat-caused-by-greenhouse-gases> (accessed 18 May 2024).
- TSSC (Threatened Species Scientific Committee) (2001b) Commonwealth listing advice on Land clearance. Australian Government, Canberra. Available at: <https://www.dcceew.gov.au/environment/biodiversity/threatened/key-threatening-processes/land-clearance> (accessed 18 May 2024).
- TSSC (Threatened Species Scientific Committee) (2013) Commonwealth listing advice on Novel biota and their impact on biodiversity. Australian Government, Canberra. Available at: <https://www.dcceew.gov.au/environment/biodiversity/threatened/key-threatening-processes/novel-biota-impact-on-biodiversity> (accessed 18 May 2024).
- Woodward E, Hill R, Harkness P and R Archer (eds.) (2020) 'Our Knowledge Our Way in caring for Country: Indigenous-led approaches to strengthening and sharing our knowledge for land and sea management, best practice guidelines from Australian experiences'. NAILSMA and CSIRO, Cairns, Australia.

Expert Communications

Davies, Bryce. Assistant Regional Operations Officer, NSW Department of Climate Change, Energy, the Environment and Water.

Freestone, Marc. Consultant.

Hopley, Tara. Research Scientist (Conservation Genetics), Royal Botanic Gardens Victoria.

Murphy, Anna. Senior Threatened Species Officer, NSW Department of Climate Change, Energy, the Environment and Water.

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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:

Diuris callitrophila was found to be Endangered under Clause 4.3 (b)(d)(e i,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: Endangered under Clause 4.3 (b)(d)(e i,iii)

The geographic distribution of the species is:		
	(a)	for critically endangered species
	(b)	for endangered species
	(c)	for vulnerable species
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:

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	(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: Vulnerable under Clause 4.4 (c)(e i,ii A(III))

The estimated total number of mature individuals of the species is:				
	(a)	for critically endangered species		very low, or
	(b)	for endangered species		low, or
	(c)	for vulnerable species		moderately low,
and either of the following 2 conditions apply:				
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):		
		(i)	for critically endangered species	very large, or
		(ii)	for endangered species	large, or
		(iii)	for vulnerable species	moderate,
	(e)	both of the following apply:		
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and	
		(ii)	at least one of the following applies:	
			(A)	the number of individuals in each population of the species is:
			(I)	for critically endangered species extremely low, or
			(II)	for endangered species very low, or
			(III)	for vulnerable species low,
			(B)	all or nearly all mature individuals of the species occur within one population,
			(C)	extreme fluctuations occur in an index of abundance appropriate to the species.

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

Assessment Outcome: Clause not met

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

Clause 4.6 - Quantitative analysis of extinction probability (Equivalent to IUCN criterion E)

Assessment Outcome: Data deficient

The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

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

(Equivalent to IUCN criterion D2)

Assessment Outcome: Clause not met

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.
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