

# NSW Threatened Species Scientific Committee

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## Conservation Assessment of *Caladenia amnicola* D.L.Jones (Orchidaceae)

Stephen Bell and Aisling Kelly 22/06/2023  
NSW Threatened Species Scientific Committee

Distribution: Endemic to NSW  
Current EPBC Act Status: Not listed  
Current NSW BC Act Status: Not listed  
Proposed listing on NSW BC Act: Endangered

### Summary of Conservation Assessment

*Caladenia amnicola* was found to be eligible for listing as Endangered under IUCN Criterion D

The main reason for this species being eligible is that it has a very low population size (>50 but <250 individuals).

### Description and Taxonomy

*Caladenia amnicola* is a geophytic, terrestrial orchid described by Jones (2021) as: 'Leaf linear lanceolate, 100-150 x 5-6mm, hairy. Flower stem 200-350mm tall, slender, wiry, densely hairy, 1-flowered. Flowers 40-50mm across, green to yellowish green with red central stripes; sepals and petals with yellowish-brown clubs 5-15mm long. Dorsal sepal erect, 40-50 x 2-2.5mm, incurved. Lateral sepals stiffly spreading then obliquely decurved, 40-50 x 2.5-3mm, divergent. Petals similarly arranged, 25-40 x 1.5-2mm. Labellum delicately hinged, 14-18 x 13-17mm, dark green with a maroon apex; basal margins with 4-7 pairs of thin erect comb-teeth to 4mm long; midlobe margins with 6-10 pairs of blunt teeth to the apex; tip recurved. Basal calli c. 3mm long. Lamina calli to 2mm long, maroon, in 4 or 6 densely crowded rows nearly to the apex of the midlobe. Column incurved, 12-15 x 6-7mm, transparent with red flecks; basal glands ovoid, c. 2mm long, yellow with a short red stalk, shiny.'

### Distribution and Abundance

*Caladenia amnicola* is restricted to a single location (Teatree Creek) west of Armidale on the New England Tableland, northern NSW (Map 1). The Australian Virtual Herbarium includes four spatially dispersed records, three (CANB 651298.1; CANB 651298.2; CANB 650590.1) refer to Teatree Creek in location notes, while the other (AD 97708578) is the initial 1934 collection with a general location only. Only one population is presently known, with all individuals occurring across a combination of private freehold tenure, travelling stock reserve and other tenure Crown land. In 2021, 17 of 18 plants occurred on freehold land within 25 m of the travelling stock reserve adjacent to Bundarra Road, and one individual was present within the crown land parcel (Copeland 2021). Targeted searches by recognised orchid botanists in and around the known population have failed to locate further plants (Copeland 2021).

The earliest known collection of *Caladenia amnicola* was made in December 1934 (N. McKie, near Armidale; AD97708578), but there are no associated details on precise location or population size. The species was not collected again until nearly 60 years later at Teatree Creek near Armidale, on 5 January 1993 (R.G. Tunstall; CANB650590.1). On 26 November 1996, D.L. Jones and colleagues collected several specimens from Teatree Creek (NSW521898; CANB602024.1; CANB602024.2; CANB602024.3; CANB602024.4; CANB602024.5), noting it to be 'rare'. The holotype

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and isotypes were among these collections. R.G. Tunstall again collected specimens at Teatree Creek on 28 December 1996 (CANB651298.1; CANB651298.2), followed by L.M. Copeland there on 27 November 1999 (with a comment noting it to be 'locally occasional') (NE 70754). *Caladenia amnicola* has subsequently been observed flowering between late November and early January, and all collections (apart from that made by McKie in 1934 from 'near Armidale') have been made at Teatree Creek.

In his compendium on *Caladenia*, Backhouse (2018) estimated a total population size of 'about 100 plants' for *Caladenia amnicola*, although he conceded that the species may possibly also occur elsewhere in the region. The most recent targeted survey undertaken by Copeland (2021) located just 18 individuals on a single day in early December 2021, although in previous informal visits at this site Copeland observed closer to 50 plants (Copeland 2021). Repeat surveys across the known flowering period (November to January: Jones 1997, 2021) would likely reveal more individuals and provide a better estimate of population size by addressing detection issues associated with asynchronous flowering and grazing impacts. These surveys do not provide sufficient information to assess the trajectory of population size.

Using all records included in Copeland (2021), i.e., validated records in the vicinity of Teatree Creek, an Area of Occupancy (AOO) of 4 km<sup>2</sup> was calculated. This was based on 2 x 2 km grid cells, the scale recommended for assessing AOO by IUCN (2022). Extent of Occurrence (EOO) was calculated as 0.021 km<sup>2</sup>; however, following IUCN (2022) guidelines this was set at 4 km<sup>2</sup> for assessment purposes to align with the definition for AOO as being an area within EOO. Calculations of AOO and EOO were undertaken in GeoCAT (Bachman et al. 2011). It is acknowledged that only 18 individuals from the 2021 census were used for AOO and EOO analyses; however, all other collections and observations are from this same location, and it is unlikely that these and any additional non-emergent individuals (as noted in Copeland 2021) would alter the 4 km<sup>2</sup> outcome for both.

## Ecology

### Habitat

Jones (1997) summarised habitat for *Caladenia amnicola* as dense scrubby forest beside and above streams, with flowering scapes often threading through the branches of low shrubs. After more detailed survey, Copeland (2021) described habitat as dense shrubby woodland on metasediment geology, in flat areas with relatively shallow soil supporting a sparse canopy of *Eucalyptus blakelyi* and *Eucalyptus youmanii*. All *Caladenia amnicola* individuals occurred beneath a 2-3 m tall shrub layer of *Leptospermum brevipes*, with the low shrub *Brachyloma daphnoides*. Ground layer associates included *Chrysocephalum apiculatum*, *Cheilanthes sieberi*, *Wahlenbergia stricta* and *Aristida personata*. Lichens and moss are also reported as common around *Caladenia amnicola* individuals. This habitat is likely secondary regrowth after historical tree clearing and/or a response to fire exclusion over a long period of time. Viewing of historical aerial photographs (NSW Spatial Services 2022) shows some infill vegetation thickening is evident in current-day imagery.

### Reproductive Ecology

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No information is available on the reproductive ecology of this species; however, insights can be gained from related *Caladenia* species (Backhouse 2018) and for the genus as described by Dixon and Tremblay (2009).

All *Caladenia* taxa are herbaceous perennials which have an extensive period of dormancy where they die back to a subterranean tuber. During the pre-flowering period (late autumn to early winter), a single leaf is produced (usually triggered by winter rainfall) and is followed by a flowering stem if conditions remain suitable. Replacement tubers are produced annually, which fill with nutrients, starch and water to sustain individuals over the dormant period. Many *Caladenia* show increased flowering after fire events, although this is most pronounced in those with food-deception pollination syndromes that rely on attracting pollinators in the post-fire environment (Dixon and Tremblay 2009).

Pollination in *Caladenia* is variable, with different species employing self-pollination, food-rewarding, food-deception, or sexual deception pollination systems (Dixon and Tremblay 2009). *Caladenia amnicola* lies within the *Calonema* subgenus, and, as such, pollination occurs through floral sexual deception with male thynnid wasps. Pollinator rarity within some landscapes has been identified as a limitation to persistence and recruitment in some sexually deceptive *Caladenia* (e.g. Phillips et al. 2015; Reiter et al. 2019). When fertilisation does occur, up to 30,000 seeds are produced per capsule and released close to parent plants (or occasionally these may be dispersed further afield on the wind). Vegetative propagation may also occur, with daughter tubers produced distally or proximally, this process is thought to compensate for low pollination rates in some species.

The dust-like seed of *Caladenia* will germinate only in the presence of moisture and the appropriate mycorrhizal fungus, and if no inoculation occurs after 3–4 months the seed may lose viability (Dixon and Tremblay 2009). Annual flowering and seed production is therefore critical to maintain seed availability, as the seed bank is highly transient (<6-8 months), although seed release from just one capsule may contribute very large numbers of seeds. Compared with other Australian terrestrial orchids, the specificity of mycorrhiza in *Caladenia* is well researched; some interactions are highly specific, but others can engage with a wider diversity of fungi (Dixon and Hopper 2009).

## Fire ecology

Flowering in many *Caladenia* species is known to be stimulated by fire events (Coates and Duncan 2009; Dixon and Tremblay 2009), although some studies have found little correlation between time since fire and pollinator visitation (e.g. Brown and York 2017). Those species with food deception pollination syndromes tend to have the greatest flowering responses to fire events and given *Caladenia amnicola* likely uses sexual deception to attract pollinators, increased flowering following a fire is not likely to be substantial. There appear to be no records of fire in the Teatree Creek area based on the combined NSW National Parks and Wildlife Service, State Forests, Fire and Rescue NSW, and NSW Rural Fire Service layer file (NSW Rural Fire Service 2021), although as this species occurs largely on private and crown land, unreported fires may still have occurred.

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## Threats

As *Caladenia amnicola* occupies only a single small population, all threats have the potential to operate across its full geographical extent. Copeland (2021) identified three key threats for the ongoing persistence of this species: drought, weed invasion, and potential land use change. Road widening, grazing, out-of-season fires, and illegal collection may also threaten the species. No other threats are noted by Jones (1997, 2021) or Copeland and Backhouse (2022).

### Recurrent drought

*Caladenia amnicola* only occurs in areas above and beside streams (Jones 1997). Thus, stream flow seems likely to be important for the persistence of the Teatree Creek population. The projections in AdaptNSW (accessed 29/3/2023) suggest that temperatures in the near future (2020-2039) will be 0.68 degrees C higher (potentially increasing evaporation), while rainfall is predicted to be 11.8% higher in autumn, but lower in summer (-0.4%), winter (-4.7%) and spring (-5.7%). Extended droughts are projected to become more frequent and more severe as climate change unfolds (CSIRO & Bureau of Meteorology 2015). As *Caladenia* seeds will germinate only in the presence of moisture and the appropriate mycorrhizal fungus, and may lose viability if no inoculation occurs after 3-4 months (Dixon and Tremblay 2009), periods of drought may also cause regeneration failure and thus population declines. Rocky habitat supporting shallow soils is prone to prolonged dry periods, and some dieback of *Leptospermum brevipes* and eucalypt species was observed within *Caladenia amnicola* habitat following the 2018-19 drought (Copeland 2021). Most terrestrial orchid species can avoid the direct impacts of individual drought events through non-emergence in a season, but recurrent drought over successive years will reduce starch reserves and possibly lead to death of individuals (Weston et al. 2005; Pfeifer et al. 2006). High incidence of recurrent drought may pose a risk to the long-term stability of this species' population.

### Invasive weeds

Invasive perennial grasses and herbs are also present within the population, particularly along road verges. *Hyparrhenia hirta*, *Eragrostis curvula* and *Coreopsis lanceolata* are noted in Copeland (2021), but there are likely to be additional species given the proximity of Bundarra Road to the population (c. 20 m) and use of part of the species' habitat as a travelling stock reserve. Left unchecked, these species will progressively degrade orchid habitat and potentially reduce available inter-tussock spaces for new recruitment to occur.

### Land use change

The known extent of *Caladenia amnicola* encompasses land owned and managed as freehold land, Crown land, and travelling stock reserve. In 2021, nearly all plants (17 of 18 recorded: Copeland 2021) occurred on freehold land within 25 m of the travelling stock reserve that approximates Bundarra Road, and one individual was present within the crown land parcel. While this area currently supports remnant bushland, its long-term future is uncertain, and change in land management incorporating (for example) increased stock grazing may be detrimental to the population.

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## Road widening

Almost all of the known *Caladenia amnicola* population currently occurs within 35 m of the bituminised Bundarra Road. This road provides a significant regional east-west transport link between Armidale and Yarrowyck, and beyond. Future upgrading of this road may reduce current habitat or increase the reach of invasive weed species. Weed impacts associated with road management are also a potential threat.

## Grazing

Grazing by herbivores (native or feral) has not previously been identified as a threat to *Caladenia amnicola*, although it remains a possibility for this and many other terrestrial orchid species (Wraith and Pickering 2020). Potential herbivores impacting on *Caladenia amnicola* may include invertebrates, macropods, wombats, rabbits, and hares (Duncan et al. 2005; Light and MacConaill 2011). Birds (e.g. White-Winged Choughs, *Corcorax melanorhamphos*) also occasionally feed on orchids and their tubers (Duncan et al. 2005; Faast and Facelli 2009). Cattle and horses may be a further threat on freehold land if stock are permitted to graze during flowering periods. Grazing by native herbivores is only a threat if population numbers have been artificially elevated through, for example, the provision of additional water points (Duncan et al. 2005).

## Out-of-season fires

Out-of-season fires may threaten terrestrial orchids by burning at times (autumn-winter) when plants may have depleted starch reserves in their tubers and limited capacity to resprout.

## Illegal collection

The proximity of the population to a road means that illegal collection could be a potential future threat.

## **Assessment against IUCN Red List criteria**

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

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

#### Assessment Outcome: Data Deficient

Justification: There are insufficient data to determine if this taxon is eligible for listing under this criterion as no reliable and comprehensive estimates of population size had been made prior to Copeland (2021). Backhouse (2018) estimated approximately 100 individuals, but it is unknown if this estimate was based on any systematic survey, hence comparisons between the two datasets are not possible.

### *Criterion B*                      *Geographic range*

#### Assessment Outcome: Data Deficient

Justification: Based on the detailed location data contained in Copeland (2021), Extent of Occurrence (EOO) and Area of Occupancy (AOO) were both calculated as 4 km<sup>2</sup>.

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There are no other data for additional populations that may occur beyond the area covered by Copeland (2021). EOO was calculated using a minimum convex hull, while AOO used a 2 x 2 km grid cell method as outlined in the IUCN Guidelines (IUCN 2022). Both calculations were performed in GeoCAT (Bachman *et al.* 2011). As both estimates are <10 km<sup>2</sup>, the taxon meets the threshold for listing as Critically Endangered under sub-criterion B1 and sub-criterion B2.

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

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

Assessment Outcome: Single location

Justification: The taxon occupies a single location, based on the most plausible serious threats (recurrent/extended drought) as per IUCN Guidelines (IUCN 2022). Drought in 2018-19 affected the known habitat of *Caladenia amnicola*, with dieback in *Leptospermum brevipes* and some eucalypts observed in December 2021 (Copeland 2021). All *Caladenia amnicola* individuals occur beneath a *Leptospermum brevipes* shrub layer.

It is unknown whether or not the *Caladenia amnicola* population is severely fragmented. As at 2021 nearly all known plants occur within a highly restricted area of two hectares, along approximately 250 m of Bundarra Road within a larger area of contiguous native vegetation. One single plant was also present approximately 130 m distant from Bundarra Road (Copeland 2021), and it is likely that additional non-flowering specimens also occur within the intervening area. These distances are expected to be within the foraging range of the pollinating thynnine wasps.

A single subpopulation is severely fragmented if that subpopulation is too small to be viable (IUCN 2022). There are insufficient data on fecundity and recruitment for *Caladenia amnicola* to determine whether the Teatree Creek population is viable and thus not severely fragmented.

- 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: Data Deficient

Justification: Jones (1997) provided no indication of population size when scientifically describing the species, and it is unlikely that the estimate given by Backhouse (2018) of 'about 100' individuals was based on any systematic count. Consequently, Copeland (2021) represents the first systematic survey of the species, and the resulting 18 individuals located on 2 December 2021 was less than he has informally recorded in previous years (up to 50). While this may be indicative of decline, it should be remembered that these are single-day surveys within an eight-week flowering period, and it is likely that repeat surveys within the one season would locate more individuals. Additionally, orchid presence above ground is highly variable season to season, hence single-day surveys are unreliable for comparative purposes.

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There is no information available on EOO, AOO, or habitat extent and quality between initial collections of the species in 1996 and that observed in 2021, hence there is insufficient evidence to estimate, infer, or project decline.

c) Extreme fluctuations.

Assessment Outcome: Data Deficient

Justification: Extreme fluctuations do not generally occur in terrestrial orchid populations, as high annual variation in emergence from tubers can be tied to environmental conditions prior to and during designated flowering periods (e.g. Kindlmann and Balounova 2001; Pfeifer et al. 2006; Brundrett 2016). It is possible that the current population of *Caladenia amnicola* may have colonised the area along Bundarra Road following initial earthworks or may have been present prior to road construction. Viewing of historical aerial photographs as far back as 1956 show Bundarra Road to be well established at least since then, suggesting that this species may have been present in the area for at least 65 years.

*Criterion C Small population size and decline*

Assessment Outcome: Data Deficient

Justification: Based on Copeland (2021), and the absence of any other known populations, the estimated total number of mature individuals (up to 100) of *Caladenia amnicola* is very low, and the very restricted geographical distribution meets the threshold for Critically Endangered (<250 individuals).

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 available to quantify an observed, estimated or projected continuing proportional decline in the population of *Caladenia amnicola*. No assessment of population size has exceeded 100 individuals, and the only systematic survey, undertaken on a single day in early December 2021, recorded 18 individuals (Copeland 2021). Assessing population size confidently in terrestrial orchids requires multi-day repeat surveys over consecutive and variable seasons, and such datasets are rarely available. It is not possible, therefore, to infer continuing decline in this species as a proportion of the total known population.

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

Assessment Outcome: Data Deficient

Justification: The total number of mature individuals of *Caladenia amnicola* recorded in a single-day survey in December 2021 was 18 (Copeland 2021), which is very low. However, there are insufficient data available to suggest

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that this number has or will decline into the future. Terrestrial orchid emergence is highly variable season to season, and environmental conditions prior to and during flowering, as well as grazing pressures, impact heavily on detectability and population size estimates.

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

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

Assessment Outcome: Met for Endangered ( $\leq 250$  individuals)

Justification: Copeland (2021) counted 18 mature individuals on a single-day survey, but previous estimates have reported up to 100 plants (Backhouse 2018).

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

Assessment Outcome: Met for Critically Endangered (90-100%)

Justification: There is only one known population of this species occurring within a two-hectare area along Teatree Creek. All mature individuals consequently occur in a single sub-population.

- b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Data Deficient

Justification: As with all terrestrial orchids, there are no data to suggest that extreme fluctuations in mature individuals occurs in this species.

## *Criterion D Very small or restricted population*

Assessment Outcome: Endangered under Criterion D

Justification: The total number of mature individuals of *Caladenia amnicola* in December 2021 was 18 (Copeland 2021) but may be as high as 100 (Backhouse 2018). All population estimates are very low ( $< 250$  mature individuals) and render the species particularly susceptible to stochastic events in addition to ongoing threats. Although there is some possibility that additional populations in the surrounding locality may be discovered in the future, clearing of these areas would indicate that undiscovered large populations are unlikely to exist.

Whilst Criterion D is met for Endangered, D2 is additionally and independently assessed, as it is relevant to Clause 4.7 of the NSW Biodiversity Conservation Regulation 2017.

- D2. Restricted area of occupancy (typically  $< 20 \text{ km}^2$ ) 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: Vulnerable

Justification: *Caladenia amnicola* has a restricted distribution (AOO of  $4 \text{ km}^2$ ) is found at only one location, and the number of mature individuals is

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estimated to be very low (currently 18 mature individuals, but in the past, no more than 100) occupying habitat very close to a main road. This makes the only known population prone to the effects of human activities (see threats section) or stochastic events in an uncertain future. Recurrent drought over successive years may drive the species to CR or EX in a very short time.

## *Criterion E      Quantitative Analysis*

Assessment Outcome: Data Deficient

Justification: Population viability analysis has not been undertaken for this species. Therefore, there is insufficient information to determine its eligibility for listing in any category under this criterion.

## **Conservation and Management Actions**

This species is currently not listed on the NSW *Biodiversity Conservation Act 2016*. The following actions are derived from the threat information above but do not represent a comprehensive management plan which would need to consider many interrelated actions. Following publication of a Final Determination by the NSW Threatened Species Scientific Committee, a conservation project will be developed by the NSW Department of Planning and Environment under the Saving our Species (SoS) program. The conservation project will identify priority locations, critical threats and required management actions to secure the species in the wild for the next 100 years.

### Habitat loss, disturbance and modification

- Ensure that the locations of all individuals are recorded on relevant state databases, including those used by land management and fire response agencies.
- De-identify public records. The inclusion of precise geolocations and the creek name in location notes leaves the species vulnerable to illegal collection.
- Prevent any collecting, including by botanists, as any collecting will reduce numbers in an already very low population.
- Protect individuals in close proximity to Bundarra Road (current or future) from trampling and accidental damage using protective fencing.
- Any future roadworks should manage and monitor topsoil removal with a regard to retaining any seeds that may be present in a soil seedbank.

### Invasive species

- Monitor invasive grass and weed populations in the area and undertake appropriate control techniques as required. Use of herbicides should be prohibited at all times, but particularly during actively growing periods.
- Monitor feral herbivore populations and install exclusion fencing if shown to be negatively impacting on individuals of their habitat.

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## Ex situ conservation

- Develop a targeted seed collection program for ex situ seed banking.
- Explore the feasibility of establishing an ex-situ collection to enhance seed production and consider a translocation program in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia* (Commander et al. 2018). Monitor all translocated individuals to maturity, seed set, and recruitment to ensure they are viable and are contributing to a reduction in the extinction risk of the species.

## Fire impacts

- Avoid out-of-season fires in autumn-winter when plants may have depleted starch reserves in their tubers and have limited capacity to resprout.
- Undertake research to enable development of an appropriate fire regime for the species, focusing particularly on the impact of fire on the species' survival. Given the extremely limited nature of the species, such research should focus on opportunistic fire events.

## Stakeholders

- Inform landowners and managers of sites where the species is known to occur and consult with these groups regarding options for conservation management and protection of the species.
- Where research identifies potential habitat for the species in areas that are privately owned, liaise with landholders to provide information on the species and its habitat requirements, and encourage reporting of any sightings.

## **Survey and Monitoring priorities**

- Monitor for increased habitat degradation.
- Undertake regular, multi-day surveys each flowering season to enable more confidence in assessing total population size and to determine whether there is a decline in the population.
- Monitor for recruitment/herbivory/illegal collections.

## **Information and Research priorities**

- Identify an optimal fire regime for the taxon by assessing population-level responses to a range of fire regimes and model population viability across all fire scenarios noting that such fire impacts may be too severe to risk the use of experimental fire.
- Investigate the presence of feral herbivores and determine if they are likely to pose a direct threat to the species.
- Investigate the ecological requirements of *Caladenia amnicola* that are relevant to persistence and recruitment, including:
  - Reproductive status, longevity, fecundity, and frequency and size of recruitment events.

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- The effect of drought on mortality and emergence rates of the species.
- Pollinator identity, biology, and requirements.
- Population genetic structure, levels of genetic diversity, and minimum viable population size.
- Mycorrhizal interactions and impacts of potential absences of suitable mycorrhizae on germination.

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## Expert Communications

- Paul Sheringham (Department of Planning and Environment) [consented on nomination form for non-confidentiality]

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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:

*Caladenia amnicola* was found to be Endangered under Clause 4.5 (b).

#### 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: Data Deficient

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,

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	(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: Data Deficient**

<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,
	(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: Endangered**

<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**

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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