Engaeus spinicaudatus

Scottsdale burrowing crayfish

TASMANIAN THREATENED SPECIES LISTING STATEMENT

Engaeus spinicaudatus
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Scientific name: ***Engaeus spinicaudatus*** **Horwitz, 1990**

Common name: Scottsdale burrowing crayfish

Group: Invertebrate, Crustacean, family Parastacidae

Status: *Threatened Species Protection Act 1995*: **endangered**

Environment Protection and Biodiversity Conservation Act 1999: **Endangered**

IUCN Red List: **Critically Endangered**

Distribution: Endemic status: **Endemic to Tasmania**

Tasmanian NRM Region: **North**

Tasmanian IBRA region: **Ben Lomond, Furneaux**

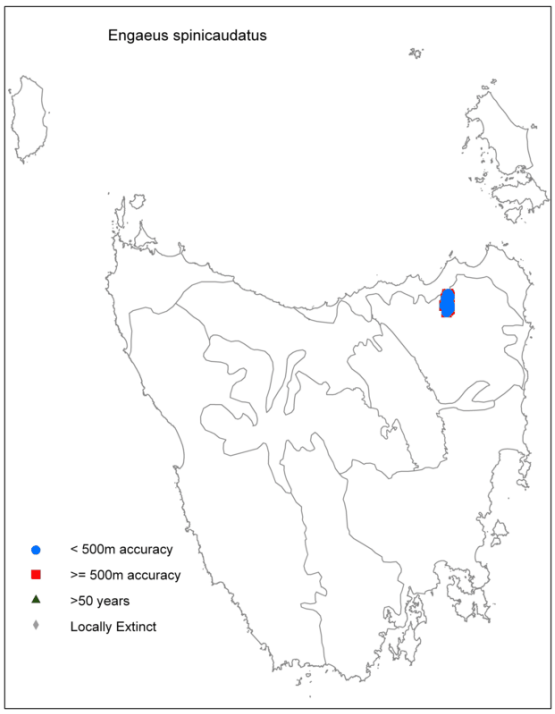

Figure 1. The distribution of *Engaeus spinicaudatus*, showing IBRA regions (from Natural Values Atlas)

Plate 1. Scottsdale burrowing crayfish *(Engaeus spinicaudatus)* © Niall Doran

SUMMARY: The Scottsdale burrowing crayfish (*Engaeus spinicaudatus*) is a medium-sized burrowing crayfish with an adult carapace length of about 25 mm. It is usually brown or purplish in colour with the terminal spines on its tail fan readily distinguishing it from other *Engaeus* species. The Scottsdale burrowing crayfish is only found to the northeast of Scottsdale, in northeastern Tasmania. The species is found in wet buttongrass and heathy plains, but also occurs in surface seepages, the floodplains of creeks, and wet areas converted to pasture. The principal threats to the Scottsdale burrowing crayfish are loss and degradation of habitat due to land clearance and conversion, and associated alterations to the water table. Other threats include the downstream effects on water quality and quantity resulting from road construction and quarrying, the impacts of fire regimes that cause declines in biodiversity and thus habitat and food availability, and competition from other burrowing crayfish species.

IDENTIFICATION AND ECOLOGY

The Scottsdale burrowing crayfish (*Engaeus spinicaudatus*) is a medium-sized burrowing crayfish with an adult carapace length of about 25 mm. It is commonly brown but occasionally presents as green-brown or purple-brown. A complete description is given by Horwitz (1990). It is unusual in being the only *Engaeus* species (and one of only a very small number of Tasmanian burrowing crayfish) to have terminal spines on the tail fan (Plate 3). Three other species bearing these spines belong to the genus *Spinastacoides* (Hansen & Richardson 2006); the function of the spines is unclear (Richardson & Swain 2002). *Engaeus spinicaudatus* can be distinguished from other *Engaeus* species by presence of these spines, and its range does not overlap with *Spinastacoides* (Hansen & Richardson 2006).

Tasmania supports a diverse fauna of native freshwater crayfish; 33 species in five genera are recognised, as well as one introduced Australian mainland species (*Cherax destructor*). The Scottsdale burrowing crayfish is one of 15 currently described species in the genus *Engaeus*, 13 of which are endemic to Tasmania, while two are also found in Victoria and on some Bass Strait islands.

The diet of *Engaeus* species consists mainly of subterranean plant material, supplemented by soil-dwelling invertebrates (Suter & Richardson 1977). Like other *Engaeus* species, the Scottsdale burrowing crayfish is a strong burrower, creating type 2 burrows (Horwitz & Richardson 1986), which are connected to the water table, as opposed to streams or lakes (type 1), or run off (type 3) (Doran 2000). The burrows of *Engaeus spinicaudatus* are typically shallow compared to some other *Engaeus* species. *Engaeus* burrows are commonly seen along streams in forests, swamps, ditches, and other wet places, but the animals are rarely sighted above ground. Burrow entrances are often identified by a chimney of discarded soil pellets excavated by the crayfish (Plate 2). Heavy rainfall and soil type influence the persistence of chimneys, leaving burrow entrances exposed with no sign of a chimney at some locations.

Female Scottsdale burrowing crayfish become reproductively mature once they reach an occipital carapace length (OCL) of about 16 mm. Mating occurs between mid-November and late December and is thought to represent the only time that crayfish are found openly wandering on the surface in search of a mate. Female burrowing crayfish carry eggs and juveniles beneath their tail through December and January (Doran 2000). Independent juvenile crayfish may be found occupying the same burrow as the adult female in March (Horwitz 1990a). No information exists regarding the growth rate, survivorship and recruitment, age, or number and frequency of breeding events (e.g., biennial, or annual) for this species (Doran 2000).

Plate 2. *Engaeus spinicaudatus* burrows showing the characteristic chimneys at the entrance © Iona Mitchell

SURVEY TECHNIQUES

Desktop Assessment – Presence and occupancy may be inferred from records of previous surveys on publicly available databases such as the Natural Values Atlas (NVA). Location data of individual *Engaeus* species is available on the NVA, which can aid in determining sites where multiple species are more likely to be present.

Visual Search – A visual search for burrows and the characteristic entrance chimneys within suitable habitat is the first step taken when surveying for burrowing crayfish. A minimum time of one hour per hectare is the recommended search effort to indicate presence/absence of this species. (DSEWPC 2011).

Burrow Excavation – Burrow excavations are undertaken to identify species in areas where distributions of threatened and non-threatened burrowing crayfish overlap, where confirmation of species level identity is required, or for extension surveys. Burrows from a variety of microhabitats on site should be targeted for excavation to determine which species are present. It may be assumed that burrows within a particular microhabitat contain the same species of *Engaeus* across distances of less than one hectare (DSEWPC 2011), but this is not always the case.

Further advice must be sought from the Threatened Species Section prior to conducting burrow excavations. Excavation and identification of burrowing crayfish requires specialist training and a permit to disturb/take threatened fauna for scientific purposes, issued under the Tasmanian *Threatened Species Protection Act 1995* and the *Nature Conservation Act 2002*.

Confusing species

The range of the Scottsdale burrowing crayfish overlaps with *Engaeus mairener* and *E. tayatea*, species from which it is readily distinguishable by the presence of median terminal spines (Plate 3) on the inner pair of uropods of its tail fan.

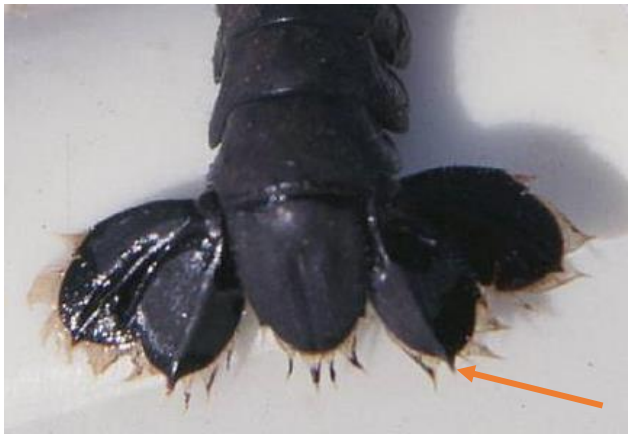

Plate 3. The tail of the Scottsdale burrowing crayfish, and its median terminal spines. © Karen Richards

DISTRIBUTION AND HABITAT

The Scottsdale burrowing crayfish is endemic to a small region of Tasmania, northeast of Scottsdale, occurring within an area of approximately 35 km^2 (Doran & Richards 1996, Richards 1997). The extent of the species' distribution has previously been well defined. The Scottsdale burrowing crayfish overlaps with the distributions of *Engaeus mairener, E. tayatea*, and is closely bounded by *E. leptorhynchus* and the Mt Arthur burrowing crayfish, *E. orramakunna*. (Doran and Richards 1996; Wapstra et al. 2006). The range of the Mt Arthur burrowing crayfish occurs within 5 km of the southern extent of the Scottsdale burrowing crayfish (Wapstra et al. 2006).

The Scottsdale burrowing crayfish has more specific habitat preferences than co-occurring *Engaeus* species and is commonly associated with shallower burrows in areas with permanently saturated surface soils (Horwitz 1991). It is found in wet buttongrass (Plate 4) and heathy plains (particularly with peaty and saturated soils), but also occurs in surface seepages, the floodplains of creeks (often with scrubby or taller tea-tree vegetation), wet areas converted to pasture, and some creekbanks in open dry eucalypt forest (Horwitz 1991, Richards 1997). As noted previously, burrows for this species tend to be type 2 (Horwitz 1990a), which connect to the water table underground.

Given the extremely restricted distribution of the Scottsdale burrowing crayfish, the entire natural habitat in which it occurs is considered essential habitat for the future of the species (Doran & Richards 1996).

Plate 4. Buttongrass Moorland in the Scottsdale area, known habitat of *Engaeus spinicaudatus* © Karen Fagg

POPULATION PARAMETERS

Number of subpopulations: 1
Number of locations: 3
Extent of occurrence (Minimum Convex Hull): 35.02 km^2
Extent of occurrence (as per IUCN criteria – to equal AOO): 56 km^2
Linear extent: 13.46 km
Area of occupancy (as per IUCN criteria) = 56 km^2
Number of mature individuals: 1.36–2.67 million (Horwitz 1991)

Horwitz (1991) estimated the population size for this species to be between 1.36 to 2.67 million individuals, although this needs revision given potential changes over the years due to drainage and modification of key habitat areas.

Long term monitoring plots were established for this species in 2005 (Wapstra et al. 2006); however, they have not been monitored for well over a decade.

Qualitative evidence exists for local population declines following drainage of swampland, and cattle trampling (K. Richards pers. comm. 2023).

RESERVATION STATUS

Within the extent of occurrence of the Scottsdale burrowing crayfish, 27% (9.5 km^2) of land occurs in Regional Reserves and a Conservation Covenant. The Regional Reserves are the North Scottsdale Regional Reserve and Mount Stronach Regional Reserve. A Conservation Covenant protects the riparian area along part of a drainage line to the east of the Great Forester River.

Habitat within the Scottsdale burrowing crayfish extent of occurrence primarily occurs on land managed by Sustainable Timber Tasmania that is categorised as Permanent Timber Production Zone Land (31% or 10.8 km^2) and in land reserved as Future Potential Production Forest (27% or 9.5 km^2) on Crown land. Private land makes up most of the remainder, at 12%, or 4.2 km^2.

CONSERVATION STATUS

Engaeus spinicaudatus was listed as vulnerable on the Tasmanian *Threatened Species Protection Act 1995* (TSP Act) in 1995, based on its restricted distribution and ongoing threats from land drainage, following previous recognition in *The Interim List of Native Invertebrates Which are Rare or Threatened in Tasmania* (Invertebrate Advisory Committee 1994).

The species was uplisted to endangered on the Schedules of the TSP Act in 2001, as a result of meeting the following criteria at that time: Criterion B (extent of occurrence estimated to be less than 5000 km^2 and area of occupancy less than 50,000 ha), specifically B1 (exists at no more than 5 locations) and B2 (potential continuing decline due to threatening processes).

Engaeus spinicaudatus was listed as Endangered under the Commonwealth, *Environment Protection and Biodiversity Conservation Act 1999* in 2001 and Critically Endangered on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species in 2010. Prior to this, it was included on the Red List as Vulnerable in 1994 and reassessed as Endangered in 1996 (IUCN 1994).

THREATS, LIMITING FACTORS AND MANAGEMENT ISSUES

There are five species of *Engaeus* currently listed on the schedules of the TSP Act, all of which have been assessed to be of conservation concern due to their restricted distribution, small area of occupancy, and presence of actively threatening processes within these areas (Horwitz 1990b; Doran & Richards 1996). Recognised threatening processes include those that affect water quality and quantity, soil, and food availability (Doran 2000).

The principal threats to the Scottsdale burrowing crayfish are clearance of native vegetation and alterations to the water table resulting from forest harvesting and agricultural activities. Other threats include the downstream effects of road construction and quarrying on water quality and quantity, and fire regimes on habitat and food availability that reduce biodiversity.

Habitat loss (land clearing and other habitat modification): Historically, forest harvesting activities including vegetation clearance, regeneration burning, and conversion of native forest to plantation may have imposed significant mechanical disturbance on stream headwaters and seepage channels, particularly on private lands, affecting crayfish and their habitat to varying degrees (Doran 2000). However, the provisions of the Permanent Native Forest Estate Policy and Forest Practices Code and associated species management prescriptions (such as the Significant Habitat Planning Guidelines) reduce direct impacts to the species on public lands (FPA 2013; 2020; 2021).

Agricultural processes including stock grazing, dam construction, clearance of riparian vegetation, stock access to streams, and ploughing have been identified as processes which degrade the habitat of the Scottsdale burrowing crayfish (Doran 2000). The creation of drains to lower the water table to improve pasture has also caused habitat loss for the species (A. Richardson pers. comm. 2023). Burrowing crayfish habitat can be severely degraded by the trampling of vegetation and compaction of soil resulting from grazing activities, which can also compact burrows and crush crayfish (TSS 2023). Clearance of native vegetation and artificial drainage of swampland (dominated by organic rich soils) reduces habitat suitability for the species. Specifically, this is due to the lowering of the water table and associated alterations of physico-chemical parameters of the water, which reduces suitability of the peat layer to the species (Horwitz 1991; Gaffney & Horwitz 1992; Doran & Richards 1996).

Road work / quarrying and associated drainage: Road construction and drainage works are known to impact seepage, wetland, and stream bank habitat quality, by degrading riverbank integrity and enhancing erosion (Doran 2000). Quarrying can degrade habitat by impacting drainage and siltation characteristics (TSS 2023). These activities can increase sediment loads and chemical pollutants, such as fertilisers, herbicides, and pesticides, entering waterways (Bryant & Jackson 1999). Heavy machinery operating in areas containing crayfish burrows can collapse burrows and crush or damage crayfish, and lead to severe degradation of habitat by damaging vegetation and compacting soil (TSS 2023).

Fire regimes that cause declines in biodiversity: An increase in fire frequency, intensity, and duration of the fire season can cause direct and indirect declines in species abundance, distribution, genetic diversity, or the function of ecological communities (DAWE 2022). High intensity fires pose a direct threat to the peaty soils in which the Scottsdale burrowing crayfish is found, but the absence of fire may promote successional change and eventual drying of the buttongrass communities upon them. The Scottsdale burrowing crayfish is particularly vulnerable to impacts from fire over the summer when the soil is at its driest, which also coincides with when the species is most likely to be on or near the surface (Horwitz 1991; Doran & Horwitz 2010).

Climate change: Within Australia, climate-mediated threats, including impacts on water temperature and availability, are putting the conservation status of two-thirds of all freshwater crayfish species at risk (Richman et al. 2015). Climate change may affect the Scottsdale burrowing crayfish if weather patterns alter water and drainage volumes, potentially resulting in broad scale habitat degradation or loss. The likely impacts to this species from climate change are not well understood, as projections suggest increased incidence of extreme weather events and increased temperatures, but also increased seasonal rainfall in areas of Tasmania including the northeast coast (Grose et al. 2010).

MANAGEMENT STRATEGY

Management objectives

The main objectives for the recovery of *Engaeus spinicaudatus* are to improve habitat protection for the species, increase public education and ensure persistence within the area of occupancy (Doran 2000).

What has been done?

The species is one of the better-known of Tasmania's threatened burrowing crayfish. Its range, habitat and population densities have been well described.

Engaeus spinicaudatus was one of three threatened burrowing crayfish species evaluated during the preliminary Tasmanian Regional Forest Agreement process (Doran & Richards 1996). It was then identified as a Priority Species requiring recovery action under the Tasmanian Regional Forest Agreement 1997 (Australia & Tasmania 1997), and a recovery plan was subsequently prepared for four burrowing crayfish species (Doran 2000).

Targeted surveys & monitoring:

The Scottsdale burrowing crayfish was well surveyed between 1990–2006 (Horwitz 1991; Richards 1997; Wapstra et al. 2006) and periodically by the Threatened Species Section at NRE Tas (TSS) and FPA zoologists between 2000–2010 (K. Richards pers. comm. 2023). No targeted monitoring of this species has been undertaken since 2006.

National/State Recovery Plan: A Recovery Plan for four species of threatened burrowing crayfish (including *Engaeus spinicaudatus)* was published in 2001 as a joint initiative between the Commonwealth and Tasmanian Governments. It details the ecology, conservation status, threats, and recovery actions of the species (Doran 2000).

Forest Practices: Under the Tasmanian Forest Practices system there are requirements to manage the species at known sites, and to survey for this species in areas of known and potential habitat on land subject to forest practices activities (FPA 2021). FPA (2022) defines significant, known and potential habitat for this species.

What is needed?

Agencies, groups, or individuals may assist with some or all of the following recovery actions (coordinated efforts may achieve the best and most efficient results):

Habitat loss and degradation

- Avoid the clearance and conversion of habitat for this species (e.g., conversion to pasture or cropping land; road building).
- Restrict the use of heavy machinery through and within areas of potential habitat.
- Maintain and improve native riparian vegetation and soil integrity within known habitat.
- Consider increasing the reservation status of known or potential habitat of the Scottsdale burrowing crayfish.
- Increase protection of the species on private land by increasing the extent of habitat under conservation covenants or developing other mechanisms to conserve the species.
- Increase buffering around activities that degrade or reduce habitat quality, within the known distribution of the Scottsdale burrowing crayfish.
- Encourage landowners to exclude livestock from areas of known habitat.

Water quality and quantity

- Ensure that the species' ecological requirements are considered in the development of water management plans.
- Avoid activities, including drainage and groundwater extraction, which may impact the water table level in areas of burrowing crayfish habitat.
- Ensure weed control operations, and the application of fertiliser, do not lead to entry of chemicals into burrowing crayfish habitat.
- Avoid activities which alter the hydrology in areas of habitat, including removal of native vegetation, earthworks, construction, and changes to drainage.
- Do not inundate known localities of burrowing crayfish through dam construction.

Improve ecological knowledge of the species

- Reinstate surveys (minimum five-yearly) at long-term monitoring sites for the Scottsdale burrowing crayfish. Assess survey results to identify any changes to the population trajectory and evaluate the effectiveness of recovery actions.
- To improve understanding of the conservation status and threats to the species – monitor known populations in relation to area of occupancy, condition of habitat and abundance of the species, and gauge their response to disturbance events (e.g. fire, loss of vegetation cover, stock grazing, drought, artificially lowered water table).
- To increase understanding of the ecology of the species – undertake ecological research of attributes including dispersal rates, genetic relatedness between subpopulations, feeding ecology, reproductive ecology, and effects of various potential threats, such as grazing.
- To improve the conservation status of the species – provide information and extension support to relevant Natural Resource Management committees, local councils, government agencies, the local community and development proponents on the locality, significance and management of known Scottsdale burrowing crayfish subpopulations and potential habitat.
- Investigate and implement eDNA technology into survey methods as/when it becomes available, to measure distributions and inform on *Engaeus* populations in a less invasive manner than traditional survey techniques (burrow excavations).

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Cite as: Threatened Species Section (2024). *Listing Statement for* Engaeus spinicaudatus *(Scottsdale burrowing crayfish)*. Department of Natural Resources and Environment, Tasmania.

View: www.naturalvaluesatlas.tas.gov.au

https://nre.tas.gov.au/conservation/threatened-species-and-communities/lists-of-threatened-species/full-list-of-threatened-species

www.threatenedspecieslink.tas.gov.au

Contact details: Threatened Species Section, Department of Natural Resources and Environment Tasmania, GPO Box 44, Hobart, Tasmania, Australia 7001. Ph: 1300 368 550.

threatenedspecies.enquiries@nre.tas.gov.au

Permit: It is an offence under Tasmanian legislation to collect, catch, damage, injure, destroy, or kill a threatened species listed under the *Threatened Species Protection Act 1995,* without a permit.

Version	Date	Author	Reason/purpose
1.0	10/1/2024	K. Fagg (TSS)	Initial draft prepared by Niall Doran in 2012. Revised by Karen Fagg (TSS) in 2023. The first version submitted and endorsed by the Threatened Species Scientific Advisory Committee.

Attachment A – Listing Assessment for *Engaeus spinicaudatus*

ASSESSMENT PARAMETERS

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	1.36 million	1.36 million	2.67 million	Population estimates by Horwitz (1991). The minimum and maximum plausible value represent the lower and upper limits of the estimate.
Trend	Declining			Qualitative evidence exists for local population decline following drainage of swampland, and cattle trampling and competition from other *Engaeus* species (K. Richards pers. comm. 2023). Further monitoring is required to assess more recent trends.
Generation length (years)				Unknown. No information exists regarding the rate of growth, survivorship and recruitment, age, or number and frequency of breeding events (e.g. biennial or singular) for this species.
Extent of occurrence	35.02 km²	25 km² Doran & Horwitz 2010	56 km²	The EOO has been calculated in ArcGIS by creating a minimum convex hull around observations downloaded from the NVA. From IUCN Guidelines: "If EOO is less than AOO, EOO should be changed to make it equal to AOO to ensure consistency with the definition of AOO as an area within EOO."
Trend	Unknown.			Data deficient. Further field monitoring is required to assess trend.
Area of Occupancy	56 km²			Calculated in ArcGIS based on records used to calculate EOO using a 2x2km grid.
Trend	Unknown			Data deficient. Further field monitoring is required to assess trend.
Number of subpopulations	1	1	1	

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Unknown			Data deficient. Further field monitoring is required to assess trend.
Basis of assessment of subpopulation number	Subpopulations have not been quantified for this species due to the highly restricted range.			
No. locations	3	1	5	Locations are defined by known catchment areas of the Scottsdale burrowing crayfish, as the most likely threat is changing of the water table or drainage due to impacts from forest harvesting or agricultural activities.
Trend	Unknown			Data deficient. Further field monitoring is required to assess trend.
Basis of assessment of location number	Catchment areas are defined as the northern (Surveyors Creek and China Creek), central (Ruby Creek) and south-eastern (Forster River East).			
Fragmentation	While the Scottsdale burrowing crayfish has a limited distribution, it is not considered to be fragmented.			
Fluctuations	Data deficient. While the Scottsdale burrowing crayfish is not considered to be subject to extreme fluctuations, supporting recent monitoring data is lacking.			

IUCN ASSESSMENT

Overall assessment result: Endangered under Criterion B2ab(iii)

CRITERION 1:

Population size reduction (reduction in total numbers) Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered **Very severe reduction**	**Endangered** **Severe reductio**	**Vulnerable** **Substantial reduction**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

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

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

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

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

based on any of the following

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

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

(d) actual or potential levels of exploitation

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

Assessment result

Data deficient.

Justification

There is insufficient evidence to demonstrate a substantial population size reduction.

CRITERION 2:

Geographic distribution is precarious for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered **Very restricted**	**Endangered** **Restricted**	**Vulnerable** **Limited**
B1. Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**

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

Assessment result

Criterion for Endangered met under B2 Area of Occupancy (52 km² <500 km²). The Extent of Occurrence meets criteria for Critically Endangered (52 km² < 100 km²). Criterion for Endangered under (a) number of locations met (≤ 5). Criterion met for (b), due to inferred decline in area, extent and or/quality of habitat.

Justification

EOO is less than 100 km² and AOO is less than 500 km². Decline in area, extent and or /quality of habitat is inferred from the impacts of forest harvesting and agricultural activities. For a full description please refer to the threats section of the Listing Statement.

CRITERION 3:

Small population size and decline			
	Critically Endangered **Very low**	**Endangered** **Low**	**Vulnerable** **Limited**
Estimated number of mature individuals	**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future	**Very high rate** **25% in 3 years or 1 generation** **(whichever is longer)**	**High rate** **20% in 5 years or 2 generation** **(whichever is longer)**	**Substantial rate** **10% in 10 years or 3 generations** **(whichever is longer)**
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
(a) (ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b) Extreme fluctuations in the number of mature individuals			

Assessment result

Criterion not met.

Justification

Horwitz (1991) estimated the population to be between 1.36 and 2.67 million. It is recognised this population estimate is over 30 years old and requires more contemporary assessment.

CRITERION 4:

Very small population			
	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
Number of mature individuals	< 50	< 250	< 1,000

Assessment result

Criterion not met.

Justification

Estimated population size > 1.36 million (Horwitz 1991). It is recognised this population estimate is over 30 years old and requires more contemporary assessment.

CRITERION 5:

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

Assessment result

Data deficient.

Justification

No quantitative analysis of extinction risk has been undertaken.