Threatened Species Assessment

Austrogammarus australis
Dandenong Freshwater Amphipod

Taxonomy

Austrogammarus australis (Sayce, 1901)

The taxon's synonomised name is *Gammarus australis* (Sayce, 1901)

Current conservation status

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 1991).

Categorised as Endangered in the 2009 Advisory list of threatened invertebrate fauna in Victoria (DSE 2009).

Proposed conservation status

Critically Endangered in Victoria

Criterion B1ab(i,ii,iii,iv,v)c(iv)

Species Information

Description and Life History

The taxon's ecological and biological information is limited to only a few studies for *Austrogammarus australis*, with most of the following text relating to amphipods in general, unless otherwise stated. Amphipods, or scuds, are diverse and common in both surface and subterranean freshwater environments. A. australis belongs to the Family Paramelitidae which has four Australian genera, the most common being *Austrogammarus*. Amphipods are all omnivores mostly feeding on decaying plant material although they will also feed on other animals as well. They include shredders, filter feeders and grazers (Gooderham and Tsyrlin 2002). *A. australis* feeds predominantly on coarse particulate organic matter sourced from the riparian vegetation (Kerr 2003).

A. australis typically range up to 10-12mm (curled length) (Kerr 2003), with ovigerous females only being observed when sizes reach 7mm. The smallest berried female observed by Kerr (2003) was 7.5mm (straight length). The maximum brood size recorded was on a 12.5mm (straight length) female with 32 eggs, with the mean berried female length being 11.5mm and mean brood size recorded of 17 eggs (Kerr 2003).

Female amphipods oviposit into a brood pouch called a marsupium, and offspring development is direct. The size of the brood will vary across species and can increase with increasing body size. Female amphipods exhibit passive maternal care to developing embryos by carrying them until the free-swimming juveniles hatch and emerge from the brood pouch. Active maternal care may also occur with some species beating their pleopods more often while carrying a brood; this may be more prevalent when water quality is poor. In most species, a female's eggs can only be fertilised shortly after they molt, so it is common to see males guard the females to make sure they capture the brief time for fertilisation. Mate guarding is well studied in both amphipods and isopods (Wellborn et al. 2015).

Amphipods have direct development with the embryos carried in the brood pouch then released as juveniles that look the same as the adults. The molt cycle is driven by hormones and amphipods continue to molt and grow after reaching maturity, although the proportional body size increase gets less for each molt after maturity is reached. Many, but not all, amphipod species are univoltine, having a single generation a year. Egg number and number of embryos carried generally increases with body size within species, and larger species often produce more eggs than smaller species (Wellborn et al. 2015).

Kerr (2003) did not observe a trend in female or ovigerous female abundance despite observations of large increase in immature individuals in the summer months, and attributed this to the monthly sampling regime. Also he suggested that the constant abundance of ovigerous females implied a continuous breeding cycle, although further research is required to confirm this. Kerr (2003) stated that the different breeding patterns display by Australian amphipods make it difficult to draw conclusions regarding the breeding cycle of *A. australis* from other amphipod species.

Generation Length

The generation length of *A. australis* is inferred to be 1 year.

Distribution

The taxon appears to be restricted to the Dandenong Ranges in southern Victoria, Australia (Doeg et al. 1996, Papas and Crowther 2007). In 2001/2002 Papas and Crowther (2002) looked for this species in the Yarra Ranges, an area located close by to the Dandenong Ranges, with similar topography, stream types and vegetation, but failed to locate any specimens.

The known distribution of A. australis increased between 1995 and 1999, with the species recorded from five additional sites in the Dandenong Ranges. The numbers of specimens collected also increased up to ten-fold (Papas et al. 1999). Papas et al. (1999) were uncertain why these numbers had increase but suggested natural annual variation in population size; unusually dry conditions between 1996 and 1999 and small variations in the sampling effort and/or strategy may have contributed to the higher number of specimens collected. Papas et al. (1999) also stated that areas of organic debris, which provide favourable habitats for the species, were targeted during sampling, and thus could explain the higher numbers of specimens collected in 1999.

A 13 year study of four creek systems in the Dandenong Mountain Ranges investigated the impacts of drought on A. australis (Imberger et al. 2016). Data from this study also suggests that this species may exhibit fluctuations in population size in response to antecedent conditions.

There is a large amount of data which indicates that amphipods, in general, are very poor overland dispersers. Amphipods do not have desiccation resistant life stage (Strachan et al. 2015) and lack adaptions for active or passive overland dispersal. Despite this many species are able to establish large populations. Warm water species typically show large fluctuations in population density linked to changes in temperature. Numbers may reach into the thousands per square meter in summer with smaller populations in winter and early spring. Large fluctuations are less common in cold water species, with food availability, depth, predators and water quality/chemistry also affecting population densities (Wellborn et al. 2015).

Habitat

All sites where *A. australis* was located were characterised by undisturbed, riparian zones with native vegetation (Papas and Crowther, 2007). The species typically occurs in the headwaters of cool freshwater streams dominated by riparian vegetation, in areas with a canopy cover > 75% and with no major urbanization or upstream roadway development (Doeg et al. 1996, Kerr 2003). This species may be photosensitive, with no records for the species in areas of creeks without canopy cover from riparian vegetation (Papas et al. 1999, Kerr 2003). Instream the amphipods are predominantly found among organic litter, with riparian vegetation being the key source of coarse organic material. Kerr (2003) found that litter weight and percentage litter cover were the main factors explaining the occurrence and abundance of *A. australis* in the streams he studied, supporting the key role of allochthonous input for the maintenance of suitable in-stream habitat for this species.

Threats

This taxon is threatened by urbanization, run-off from roads (both sealed and unsealed), damage to or removal of riparian vegetation and weed invasion of the riparian zone.

High velocity water flow via drainage systems associated with impervious surfaces has the potential to remove or reduce the litter available as preferred habitat, with Kerr (2003) observing the lowest abundances in reaches affected by frequent high flow discharge events.

Imberger et al. (2016) showed that *A. australis* is substantially more sensitive to drought than other amphipod species, with it failing to recolonise lower Lyrebird Creek five years after a cease to flow event ended and perennial flows returned. This was despite the species being found only 2 km upstream, both pre and post the drought

(Imberger et al. 2016). Imberger et al. (2016) stated there was no research on the species individual traits, habitat requirements, or life history strategies that could explain the failure to recolonise areas that underwent complete drying.

Large scale stochastic events such as wildfire could also threaten this species via loss of canopy cover and source of organic matter into streams.

IUCN Criteria

Criterion A. Population size reduction.
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred or suspected in the past 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

Evidence:

Ineligible under Criterion A

There is insufficient evidence to determine whether there has been or will be a reduction in population sufficient to meet any threshold for Criterion A.

Criterion B. Geographic range in the form of either B1 (extent of occurrence) and/or B2 (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; (iv) number of mature individuals			

Evidence:

Eligible under Criterion B1 as Critically Endangered

The Extent of Occurrence (EoO) across the taxon's range is estimated to be 48 km², based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA).

Individuals of the taxon are estimated to be severely fragmented, considering the limited dispersal ability of the taxon, the barriers to dispersal, or lack of habitat separating them (S. Imberger pers. comm. 2019).

It is estimated to have one location. It has a continuing decline in (i), (ii), (iii), (iv) and (v).

It is suspected that this taxon undergoes frequent fluctuations in numbers (S. Imberger pers. comm. 2019). Field data from various surveys has indicated considerable variability in populations.

Eligible under Criterion B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 48 km², based on 2 x 2 km² grids derived from accepted, post-1970 records from the VBA. As above, it is severely fragmented, has 1 location, has a continuing decline in (i), (ii), (iii), (iv) and (v) and extreme fluctuations in (iv) above.

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

Evidence:

Ineligible under Criterion C as Data Deficient

No reliable estimate of the total population size of the species is available. There is a need for more targeted surveys across a wider range of locations in order to establish population sizes. Kerr (2003) collected only limited (i.e. not a full year's data), so cohorts and number of mature individuals were not adequately sampled.

Criterion D. Very small or restricted population			
	Critically Endangered	Endangered	Vulnerable
Number of mature individuals (observed or estimated)	< 50	< 250	< 1,000
D2 Only applies to the VU category Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time.	-	-	D2. Typically: AoO < 20 km2 or number of locations ≤ 5

Evidence:

Eligible under criterion D2 as Vulnerable

The taxon is estimated to be very restricted.

Criterion E (Quantitative Analysis) was not addressed as the taxon does not have a detailed Population Viability Analysis.

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