Threatened Species Assessment

Attheyella dedeckkeri copepod

Taxonomy

Attheyella (Delachauxiella) dedeckkeri Hamond, 1987

Current conservation status

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

Proposed conservation status

Endangered in Victoria

Criteria B1ab(iii)+2ab(iii)

Species Information

Description and Life History

There are three subclasses in the Hexanauplia class: the Copepoda, the Tantulocarida and the Thecostraca, with only the Copepoda and Thecostraca having freshwater representatives. As a group, copepods originated from marine forms, but they have colonized all aquatic habitats, including hypersaline, brackish, and freshwater ecosystems, but also terrestrial and semi-terrestrial habitats. The harpacticoid copepods are the second most abundant group of species in the benthic environment and are an important component of the trophic structure of freshwater systems (Turesson et al., 2007) as they provide a food source for larger macroinvertebrates and fish, as well as recycle organic nutrients (Duggan and Hogg, 2015). In freshwater, they inhabit underground waters and reside in river sand associated with moist terrestrial vegetation and they occur in environments at both ends of the salinity and temperature scale (Dahmns and Qian, 2003).

Harpacticoid copepods are typically burrowers in the most superficial layers of sediments, with their main food source being organic matter either as coarse and fine particles, and possibly the microbial microfilm associated with it (Dole-Olivier et al., 2000 cited in Turesson et al., 2007).

Attheyella belongs to the family Canthocamptidae, which represents the most species-rich family of freshwater copepods within its order (Turesson et al., 2007) and is considered a cosmopolitan genus (Boxshall and Defaye, 2008). Considering their broad distribution, endemism in freshwater copepods is high, with approximately 90% of species found to occur in a single region (Boxshall and Defaye, 2008).

No information on the ecology or reproductive biology for *A. dedeckkeri* has been published since it was first described. However, life history of copepods is largely consistent (Hairston and Bohonak, 1998), such that *A. dedeckkeri* most likely shares the general life history traits of copepods such as sexual dimorphism and bisexual reproduction (however parthenogenesis has been hypothesised in freshwater harpacticoids (O'Doherty, 1985; Dahmns and Qian, 2003), fertilisation of eggs followed by brooding until hatching of nauplii (Dole-Olivier et al., 2000). *A. dedeckkeri* may be iteroparous, in that it may produce multiple clutches of eggs throughout its lifetime (Hairston and Bohonak, 1998). It likely has direct development with six naupliar stages which metamorphose in to five copepodite stages before becoming a mature adult (Turesson et al., 2007; Sarvala, 1977; Dahmns and Qian, 2003) and it may possess a diapause in one of its larval stages as a means of overcoming periods of unfavourable conditions (Dole-Olivier et al., 2000; Hairston and Bohonak, 1998).

Harpactacoid copepods typically exhibit life cycles which are shorter than a seasonal cycle, such that they do not actively persist through periods of nutritional shortages, instead may endure this period in the form of resting eggs

or diapausing copepodids (Dahmns and Qian, 2003). Information available for other closely related species (namely *Attheyella crassa*) suggests that it may have a generation time of approximately 6 to 8 weeks (Turesson et al., 2007). However, as development is highly dependent on environmental factors, it is impossible to estimate the true timing of development and maturity with any accuracy. As such, further taxa specific research is required.

Generation Length

The generation length of *A. dedeckkeri* is inferred to be 45 to 60 days. This is based on congeners and the closely related species (namely *Attheyella crassa*), which may have a generation time of approximately 6 to 8 weeks (Turesson et al., 2007).

Distribution

This taxon is confined to the highlands of eastern Victoria. It is known only to occur on Mt. Baw Baw and in the Yarra Ranges near Lake Mountain (Hamond, 1987) and has not been recorded again since it was described by Watson (1987). Harpaticoid copepods are typically found in the benthos and may not be sampled in standard aquatic invertebrate surveys. Also the habitat in which it is found is not sampled very often, so the low number of localities in which this species has been recorded is possibly a sampling artefact.

Habitat

A. dedeckkeri is known to occur in small, slow moving, shallow and muddy high-altitude streams amongst rotten plant-remains. It has also been found in or under high altitude sphagnum-cushions. The taxon has been found to co-occur with other Harpacticoids, *Canthocamptidae billwilliamsi, C. caecosetosus,* and *C.globulisetosus* (Hamond, 1987).

Threats

No specific threats have been listed for *A. dedeckkeri*. General threats encountered by harpacticoid copepods include land use changes, water resource management and introduced predator species. Altered water regimes brought on by climate change, including changes in temperature, could also impact the taxon via reduced habitat quality and altered reproductive cues/rates, particularly as taxon species is alpine to subalpine. It is known to occur directly adjacent to a popular tourist destination. As such, it may be particularly at risk from commercial development and human recreational activities which impact on water quality.

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 Endangered

The Extent of Occurrence (EoO) across the taxon's range is estimated to be 168 km², based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA).

The taxon is inferred to be severely fragmented, based on the geographic separation of the two known subpopulations, such that there is increased extinction risk and little or no probability of recolonisation should subpopulations become extinct.

The taxon can be considered to occur in two locations because it occurs in two geographically or ecologically distinct areas in which a single threatening event can rapidly affect all individuals of the taxon present. It has a continuing decline in (iii) above.

Eligible under Criterion B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 16 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the VBA. As above, it is severely fragmented, has 2 location and has a continuing decline in (iii) 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 current population size of the species is available as no recent surveys have specifically targeted this species so there is no accurate way of estimating the past, current or future population size. The data for this species is over 30 years old.

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 inferred to be very restricted.

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

References

Boxshall, G. A., and Defaye, D. (2008). Global diversity of copepods (Crustacea: Copepoda) in freshwater. *Hydrobiologia*, 595(1), 195-207. https://doi.org/10.1007/s10750-007-9014-4

Dahms, H.-U., and Qian, P.-Y. (2004). Life histories of the Harpacticoida (Copepoda, Crustacea): a comparison with meiofauna and macrofauna. *Journal of Natural History*, 38(14), 1725-1734. https://doi.org/10.1080/0022293031000156321

Dole-Olivier, M.-J., Galassi, D. M. P., Marmonier, P., and Creuze Des Chatelliers, M. (2000). The biology and ecology of lotic microcrustaceans. *Freshwater Biology*, 44(1), 63-91. https://doi.org/10.1046/j.1365-2427.2000.00590.x

DSE (2009). *Advisory list of threatened invertebrate fauna in Victoria* - 2009. Department of Sustainability and Environment, Melbourne. Retrieved from: https://www.environment.vic.gov.au/__data/assets/pdf_file/0016/50452/Advisory_List_of_Threatened_Invertebrate_Fauna_2009_FINAL_Sept_2009.pdf

Hairston, N. G., and Bohonak, A. J. (1998). Copepod reproductive strategies: life-history theory, phylogenetic pattern and invasion of inland waters. *Journal of Marine Systems*, 15(1-4), 23-34. https://doi.org/10.1016/S0924-7963(97)00046-8

Hamond, R. (1987). Non-marine Harpacticoid Copepods of Australia. I. Canthocamptidae of the Genus *Canthocamptus* Westwood s.lat. and *Fibulacamptus*, gen. nov., and Including the Description of a Related New Species of *Canthocamptus* from New Caledonia. *Invertbr.Taxon.* 1. 1023-247

O'Doherty, E. C. (1985). Stream-dwelling copepods: Their life history and ecological significance1: Stream copepods. *Limnology and Oceanography*, 30(3), 554-564. https://doi.org/10.4319/lo.1985.30.3.0554

Sarvala, J. (1977) The naupliar development of six species of freshwater harpacticoid Copepoda. *Annales Zoologici Fennici*, 14,135-161.

Turesson, E. U., Stiernström, S., Minten, J., Adolfsson-Erici, M., Bengtsson, B.-E., and Breitholtz, M. (2007). Development and reproduction of the freshwater harpacticoid copepod *Attheyella crassa* for assessing sediment-associated toxicity. *Aquatic Toxicology*, 83(3), 180-189. https://doi.org/10.1016/j.aquatox.2007.04.002

Watson, N., Duggan, I., and Hogg, I. (2015). Assessing the diversity of New Zealand freshwater harpacticoid copepods (Crustacea: Copepoda) using mitochondrial DNA (COI) barcodes. *New Zealand Journal of Zoology*, 42(2), 57-67. https://doi.org/10.1080/03014223.2015.1011592