

## *Pseudocalliax tooradin* Ghost shrimp

### Taxonomy

*Pseudocalliax tooradin* (Poore & Griffin, 1979)

This species was originally described as *Callianassa tooradin*. *Calliax tooradin* was accepted as the correct classification by the World Register of Marine Species (WoRMS) in 2010. However, Sakai (2011) has reclassified this species again as *Pseudocalliax tooradin*, which is accepted on WoRMS as a type taxon of the genus *Pseudocalliax* (Sakai, 2011). Here, records for *Callianassa tooradin*, *Calliax tooradin*, *Paraglypturus tooradin*, *Eucalliax tooradin* and *Pseudocalliax tooradin* are considered to refer to accounts of the same species (Sakai, 2011; Taylor and Poore, 2011).

### Current conservation status

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 2002).

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

### Proposed conservation status

Endangered in Australia

Criteria B1ab(ii,iii)+2ab(ii,iii)

### Species Information

#### Description and Life History

*Pseudocalliax tooradin* belongs to the infraorder Axiidea, commonly known as 'ghost shrimps'. Axiideans typically occur in marine environments within soft sediments, found in most of the world's oceans with the exception of the high latitude polar regions. More than 95% of axiideans occur within shallow, intertidal and subtidal habitats of less than 200 m in depth (Dworschak, 2015). Known for their cryptic behaviour and ecological importance, axiideans are bioturbating infauna with burrows that can exceed 50cm in depth in the sediment, forming complex architectures. The burrows within the sediment, as well as the bio-irrigation activity of the ghost shrimp create a deep extension of the aerobic surface sediment, facilitating aerobic microbial activities (Bird et al., 2000 cited in Wilson et al., 2012) as well as aiding sediment turnover and recycling organic matter and nutrients. Axiideans are also an important food source for shorebirds and fish species (Peiró et al., 2014; Butler and Bird, 2010)

Despite its potential ecological importance, little is known of the reproductive biology of *P. tooradin*, or family from which it belongs. This may be due to the difficulty in surveying soft-sediment infauna (Butler and Bird 2007).

The range of the number of eggs produced by each female varies widely between axiideans, with some species producing less than 1000 eggs and other species up to 10,000 eggs per clutch (Tamaki et al., 1997; Peiró et al., 2014). Moreover, the life history of axiideans can be greatly impacted by environmental factors (Peiró et al., 2014), such that different populations of the same species from different type localities may have varied fecundity and reproductive timing (Butler et al., 2009).

Cooler water species may have smaller clutch sizes as a 'trade-off' for larger embryos containing more nutrients to withstand stressful conditions brought about by cold conditions (Paschke et al., 2004; Kubo et al., 2006). Studies on two axiideans from the same type locality as *P. tooradin* (i.e. Crib Point, Western Port, Victoria), suggest that *P. tooradin* may have as many as six larval development stages; females may have a fecundity of between 96 and

313 with the reproductive period restricted to spring and summer. Individuals may have a life cycle of between one to two years (Butler et al., 2009).

Information available for similar species belonging to the genus Callianassidae suggests that two successive cohorts are recruited each year, with sexual maturity occurring between 1 to 1.5 years and reproduction occurring 2 to 3 times over a 2 to 2.5 year life span (Tamaki et al., 1997). Based on the lack of information specific to *P. tooradin* and the variability in reproductive biology of ghost shrimps, it is impossible to extrapolate how many eggs, or clutches, each female would produce in its lifetime without further research.

### Generation Length

The generation length of *Pseudocalliax tooradin* is inferred to be 1 year, inferred from studies on other species within the same Infraorder (Tamaki et al., 1997).

### Distribution

The taxon is considered to be endemic to Victoria (O'Hara 2002), but may prove to be more widespread than currently known due to the difficulty in sampling their preferred habitat (O'Hara 2002). However, an extensive survey specifically targeting ghost shrimps in Western Port (1977) did not produce a single specimen of the species (Coleman and Poore, 1980).

The taxon is currently known from Swan Bay, Port Phillip Bay and Crib Port, Western Port, Victoria. (Edmunds et al. 2010).

Estimates of population size are particularly difficult for this species as surveys require destructive habitat sampling methods. It is assumed that this species is restricted to the known localities, and that it is potentially a short range endemic. It is one of only five known marine species endemic to Victoria.

### Habitat

*P. tooradin* occurs in intertidal mudflats and fine sands and sediments between 2 to 5 m depth (Taylor and Pearce, 2011; O'Hara and Barmby, 2000; Sakai, 2011).

### Threats

Threats encountered by this taxon are based on those listed in O'Hara (2002) as being specific to vulnerable marine habitats in which this species is found: namely embayment's and the intertidal/subtidal shallow zone. The threats include impacts associated with fishing practices, recreational activities, changed inflows and nutrient sedimentation loads from rivers feeding into the systems, pollutions, and climate change.

### 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 km <sup>2</sup>	< 5,000 km <sup>2</sup>	< 20,000 km <sup>2</sup>
B2. Area of occupancy (AOO)	< 10 km <sup>2</sup>	< 500 km <sup>2</sup>	< 2,000 km <sup>2</sup>
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 165 km<sup>2</sup>, based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA).

The taxon is inferred to be severely fragmented, considering the limited dispersal ability of the taxon, the barriers to dispersal, or lack of habitat separating them.

It is estimated to have 1 location as all key identified threats apply across its range and can rapidly affect all individuals of the taxon present.

It has a continuing decline in (ii) and (iii) above. Area, extent and/or quality of the habitat are likely to continue to decline as a result of fishing practices, recreational activities, changed inflows and nutrient sedimentation loads from rivers feeding into the systems, pollution, and climate change.

### Eligible under Criterion B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 16 km<sup>2</sup>, based on 2 x 2 km grids derived from accepted, post-1970 records in the VBA. As above, it is inferred to be severely fragmented, has 1 location and a continuing decline in (ii) and (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.

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 km <sup>2</sup> 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.**

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