

Lovettia sealii Australian Whitebait

Taxonomy

Lovettia sealii (Johnston, 1883)

The Australian Whitebait is regionally divided into three well differentiated genetic stocks: northern and southern Tasmanian coasts and mainland Australia. The mainland population is therefore not only geographically isolated, but genetically isolated from other known populations of the species (Schmidt et al. 2013).

Current conservation status

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 1994).

Categorised as Critically endangered in the 2013 Advisory list of threatened vertebrate fauna in Victoria (DSE 2013).

Proposed conservation status

Critically Endangered in Victoria

Criteria A2ace+3ce+4ce; B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v); C2a(ii)

Species Information

Description and Life History

In Tasmania, mature adult Australian Whitebait enter estuaries and migrate upstream to just below the upper tidal limit, where spawning occurs over successive days from August to December (Blackburn 1950, Fulton and Pavuk 1988). Following spawning at approximately one year of age, nearly all individuals die, with less than 1% living to two years old and spawning for a second time (Blackburn 1950). Adults do not die immediately, but gradually lose condition and deteriorate (Fulton and Pavuk 1988). Schools of spent Australian Whitebait have been recorded upstream of estuaries in Tasmania, suggesting adults that survive the first spawning may remain within river systems (Blackburn 1950). Recent otolith microchemistry analysis suggests that Australian Whitebait are a semi-anadromous, or an estuarine dependant marine species, as residence in pure freshwater does not appear to occur during the lifecycle (Schmidt et al. 2014).

The sex ratio of populations is variable, however populations are most commonly dominated by males (Blackburn 1950). Fecundity of mature females is positively correlated with fish length, ranging from 128-206 oocytes (maximum 350) for fish 40-54 mm in length (Blackburn 1950, Fulton and Pavuk 1988). Unshed mature oocytes are approximately 1.0 mm in diameter (Blackburn 1950), while extruded eggs are adhesive and generally found attached to submerged substrates, such as logs, branches, sticks, stones and other vegetation-free surfaces below low water level, in areas with strong current flow and aeration (Blackburn 1950, Fulton and Pavuk 1988). The site of spawning and egg deposition in estuaries is likely to be determined to some extent by river discharge and the effect of flow on water salinity. It is unclear if fertilisation occurs before or after deposition (Blackburn 1950). Eggs hatch in about 14-23 days (Blackburn 1950, Fulton and Pavuk 1988), however, hatching time can be delayed by low temperatures and possibly low salinity (Fulton and Pavuk 1988).

Newly hatched larvae are approximately 6 mm in length, have a yolk sac, mouth, a median fin fold which is continuous and lacks fin rays, rudimentary pectoral fins, a caudal fin which is diphycceral, pigmented eyes, and a narrow band of melanophores in the mid-ventral line between the head and anus (Blackburn 1950). Slightly older larvae sampled drifting in the water column in late October were 7 mm long, lacked a yolk sac, possessed

developing caudal and pectoral fin rays, and melanophores along the mid-lateral line were more developed (Blackburn 1950). Larvae wash downstream to more saline areas where development and growth is completed (Blackburn 1950, Raadik 2008). Whether all larvae enter the open ocean, or grow and develop close to shore or in marine inlets, has not been verified. At least a portion of the larvae are, however, suggested to remain within estuaries and inlets (Fulton and Pavuk 1988, Schmidt et al. 2014). Natal homing (the return of fish to the river in which they hatched) although unknown (McDowall 2003, IFS 2006), is strongly suggested, with the only mainland population appearing to be confined to Anderson Inlet/Tarwin River. This limited distribution may, however, be due to the entire life cycle of individuals in the Anderson Inlet/Tarwin River population being confined within the system.

Diet of the Australian Whitebait is poorly known; the little information which exists has been gathered from the examination of upstream migrating mature or spent fish. The stomachs of these fish contained zooplankton, amphipods, insects (including nymphs, larvae and pupae), cannibalised eggs and fry (Blackburn 1950, IFS 2006).

Generation Length

The generation length of the Australian Whitebait is estimated to be 12 to 18 months. Following spawning at approximately one year of age, nearly all individuals die, with less than 1% living to two years old and spawning for a second time (Blackburn 1950).

Distribution

This taxon was originally named the Tasmanian Whitebait due to it being historically only known to occur in coastal regions in the north, west and south of Tasmania (Johnston 1883, McCulloch 1915, Lord and Scott 1924, Blackburn 1950, Fulton 1990). The discovery of a population in a coastal tributary (Tarwin River estuary/Andersons Inlet) on mainland Australia in 1993, led to the taxon being renamed the Australian Whitebait (Raadik 2008). In Victoria the taxon has been collected in the Tarwin River from downstream of the bridge on the Tarwin Lower Road to Anderson Inlet (Raadik 2008, Schmidt et al. 2014). The total extent of range of Australian Whitebait in the Tarwin River has, however, not been fully investigated, it is nevertheless suggested to be extremely restricted. The presence of the taxon in Anderson Inlet itself was reconfirmed in 2007 and 2014, indicating long-term persistence of the population. Despite intensive sampling of fish communities in estuaries and inlets across Victoria's coastal catchments, Anderson Inlet/Tarwin River remains the only known locality for the taxon in Victoria and on mainland Australia (Raadik 2008, Tarmo Raadik unpub. data, Wayne Koster unpub. data). No information is available on the historical distribution of this taxon on mainland Australia, prior to 1993.

Habitat

The habitat occupied by Australian Whitebait is poorly known, yet is suggested to be highly variable. Anecdotal sightings of Australian Whitebait schools several kilometres out to sea suggests adults principally inhabit shallow coastal waters, excluding times of spawning (Blackburn 1950). In Tasmania, the taxon has, nevertheless, been captured in estuaries (at salinities of < 0.1-2.1 ppt) from early August to December, and on mainland Australia, in Anderson Inlet/Tarwin River estuary, from April to September (Blackburn 1950, Fulton and Pavuk 1989, Schmidt et al. 2014, Raadik, T., unpub. Data, Koster, W., unpub. data). As residence in freshwater reaches of rivers (salinity < 0.01 ppt) does not appear to occur during the lifecycle of the taxon, Australian Whitebait appears to be unique among the Galaxiidae (Schmidt et al. 2014).

Threats

Although only limited knowledge exists of the taxon, there are a range of threats likely to impact it including predation of all life history stages by alien taxa, instream barriers in tidal reaches of coastal streams, deteriorating water quality and waterborne pollution, altered flow regimes into estuaries, altered hydrology within estuaries/inlets, reduction or removal of spawning/egg deposition sites and spawning substrates, alteration to larval/ juvenile and adult habitat and food sources. Aspects of the biology of the taxon which make it particularly susceptible to threats are its short lifecycle, low fecundity, and requirement to migrate upstream into lower tidal reaches of coastal streams to complete its lifecycle. Thus, the presence of a single, apparently restricted Victorian population, genetically isolated from the Tasmanian populations, dramatically increases the risk of extinction of the mainland population.

Predators of Australian Whitebait are also poorly known, with existing knowledge based on incidental observations: Barracouta (*Thyrssites atun*), Rock Cod (*Physiculus barbatus*), Australian Salmon (*Arripis* spp.), School Shark (*Notogaleus rhinophanes*), Yellow-eye Mullet (*Aldrichetta forsteri*), Eels (*Anguilla* spp.), the alien Brown Trout

(*Salmo trutta*) and birds (Blackburn 1950). The taxon likely forms a component of the diet of many other fish species found in inlets and estuaries, in particular the native piscivore Estuary Perch (*Macquarie colonorum*) in Anderson Inlet/ Tarwin River. Australian Whitebait have also been found to be infected with internal trematode and nematode parasites, subdermal trematode cysts, and the immature stage of a parasitic amphipod on pelvic and anal fins (Crowcroft 1947).

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%
<p>A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</p> <p>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.</p> <p>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]</p> <p>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.</p> <p style="text-align: center;"><i>based on any of the following:</i></p> <p>(a) direct observation [except A3]</p> <p>(b) an index of abundance appropriate to the taxon</p> <p>(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat</p> <p>(d) actual or potential levels of exploitation</p> <p>(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</p>			

Evidence:

Eligible under Criterion A2 as Critically Endangered

The population reduction over the past 10 years is inferred to be 90 to 99%, based on (a), (c) and (e) above.

Historic surveys, conducted approximately 20 years ago captured several thousand individuals in a single night (Andrew Pickworth pers. comm. 2019). Based on this observation the population is estimated to have contained >60,000 individuals at the time. Based on the most recent survey data, there has been a severe decline in the number of individuals present in the population, with mature individuals now estimated to number between 100 and 300 individuals. Based on this rate of decline, 10 years ago, the population likely contained up to 30,000 individuals.

The causes of the reduction may not have ceased, be understood or be reversible.

Eligible under Criterion A3 as Critically Endangered

The population reduction over the next 10 years is projected to be 100%, based on (c) and (e) above.

Only a small number of individuals have been captured in Victoria during recent long term surveys, suggesting that the number of individuals in the population is in decline. If this trend continues, total extinction of the mainland population is likely.

Eligible under Criterion A4 as Critically Endangered

The population reduction over any 10 year period, including both past and future, is projected to be 90 to 100%, based on (c) and (e) above and on past and likely future declines.

The causes of reduction may not have ceased, be understood or be reversible.

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 ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
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 4 km², based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA). The EoO has been made equal to the AoO. Only a single geographically isolated Australian whitebait population is known to be present on mainland Australia (i.e. Anderson Inlet/Tarwin River estuary).

It is estimated to have 1 location. There is only one very small, restricted subpopulation, and a single threatening event can therefore rapidly affect all individuals of the taxon present. The single known population is likely to become extinct in the very near future because of the known threats.

It has a continuing decline in (i), (ii), (iii), (iv) and (v) above.

Eligible under Criterion B2 as Critically Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 4 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the VBA. As above, it is estimated to have 1 location and has a continuing decline in (i), (ii), (iii), (iv) and (v) 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:

Eligible under Criterion C2 as Critically Endangered

It is estimated that there are 100 to 300 mature individuals. Only a small number of individuals have been captured in Victoria during recent long term surveys of the Tarwin River.

The number of mature individuals is inferred to continue to decline, and the percentage of mature individuals in one subpopulation is 90-100 %.

Criterion D. Very small or restricted populations				
		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 ² or number of locations ≤ 5

Evidence:

Eligible under Criterion D as Endangered

It is estimated that there are 100 to 300 mature individuals.

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

References

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