

## *Euastacus diversus* Orbost Spiny Crayfish

### Taxonomy

*Euastacus diversus* Riek, 1969

### Current conservation status

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 1992).

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

### Proposed conservation status

Endangered in Australia

Criteria B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)

### Species Information

#### Description and Life History

The Orbost Spiny Crayfish is a small species of spiny crayfish with a maximum recorded occipital carapace length (OCL) of 35 mm (McCormack 2012). It is an aggressive, territorial species, spending most of its time in its burrow system, being more active at night, though in heavily shaded streams it can be active during the day (McCormack 2012). Most species of *Euastacus* are moderate burrowers, seeking refuge under rock ledges and amongst submerged, in-stream tree roots (Zeidler 1982). *E. diversus* is an extensive burrower, building extensive burrow systems under shelter in the stream or into the stream bank, generally at the water level. The diet of spiny freshwater crayfish consists primarily of aquatic to semi-aquatic vegetation and benthic invertebrates (Goddard 1988). Fungi and bacteria found in rotting detrital matter is also consumed (DCE 1992): *E. diversus* is a scavenger (McCormack 2012).

Sexual maturity is reached at 35 mm OCL and mating commences in May-June. Eggs are large but fecundity appears to be low, and eggs are carried under their tail of the female (McCormack, 2012). After hatching from eggs, the dependent juvenile crayfish are carried beneath the tail until their release. The yolk of the egg is retained by the young hatchlings as a yolk sac supplying food during early growth. Once the yolk sac has been completely absorbed, the juveniles disperse to fend for themselves.

#### Generation Length

The generation length of the Orbost Spiny Crayfish is inferred to be 5 to 15 years. Several reproductive studies show *Euastacus* mature late with females only becoming reproductive at >5-8 years in most species (Honan and Mitchell 1995, Turvey and Merrick 1997, Furse and Wild 2004). The minimum generation is therefore set at 5 years. Studies on large species of *Euastacus* show ages of up to 30 years and above (e.g. Turvey and Merrick 1997). As a small species, (maximum of 59 mm OCL) the generation length for *E. diversus* is nominally set at 15 years. There has been no research into age in this species.

#### Distribution

Orbost Spiny Crayfish has a small distribution in the mountains of the Victorian portion of the Snowy River system, being found in the upper tributaries of the Rodger and Yalmy rivers, the mid to upper Brodribb River system, and

the upper tributaries of the Bonang River system. (Morgan 1986, McCormack 2012, Coughran et al. 2015). It is found between about 200 to 1400 m in elevation.

## Habitat

The taxon is usually found in clear and flowing rivers and streams and also in smaller intermittent streams with abundant riparian vegetation, including rainforest.

## Threats

The major threat to taxa of spiny crayfish in Victoria is the decline in quality and quantity of habitat, both underground and at the surface. This can be caused by a range of factors, many of which are predicted to be exacerbated by climate change. These include decline in quantity and quality of streamflows and/or groundwater; decline or loss of vegetation due to removal or disturbance; soil disturbance; sedimentation or smothering from overland debris flow during high rainfall events following soil disturbance; the impact of chemicals and loss of areas of suitable soil profile in which to construct burrows.

These threats may be driven by a range of land and water management activities, including urban and agriculture development, road construction and maintenance, bushfire prevention and suppression, water extraction and forestry operations. These threats may also be triggered or exacerbated by natural events such as droughts, floods and bushfires.

Bushfires have the potential to degrade water quality and alter the dynamics of stream ecosystems. Most critical effects occur if there is heavy rain soon after fire, as loss of vegetation and altered soil structure can make fire-affected soils more erodible. Runoff can carry sediments and pollutants that affect aquatic environments and consequently aquatic species.

Loss of food resources due to soil disturbance or loss of riparian vegetation can lead to various ecological changes, particularly sedimentation affecting instream processes, increased water temperature from greater incidence of light, and reduction in the type and amount of debris accumulation in streams, changes which generally reduce the suitability of streams as habitat for *Euastacus* species. The coarse woody debris provides important crayfish habitat and the finer debris would provide an important food source for the species.

The introduction of exotic biota could also be a threat due to predation, competition, or the spread of disease (Horwitz 1990b). Introduced fish, including Brown Trout *Salmo trutta*, occur throughout many of the river systems within the taxon's range, and predation may have a detrimental impact on populations of the crayfish.

The overall level of threat and the relative contribution of each of the land management activities and natural events varies according to the circumstances of each species. The Flora and Fauna Guarantee action statement provides further details of potential threats to this taxon (DSE 2003).

Most of the distribution of the Orbost Spiny Crayfish is within forested public land, including parks and reserves and State forest. This taxon and its habitat have been impacted by the 2019-20 bushfires; the majority of the known range was fire-affected (DELWP 2020).

Spatial analysis of catchments occupied by this taxon on all land tenures indicates that 54% occurs within the Comprehensive, Adequate and Representative (CAR) reserve system, including parks and reserves and special protection zones in State forest. A further 8% is excluded from timber harvesting as it falls within the Immediate Protection Areas set aside for the protection of the Greater Glider and other threatened species. Species-specific prescriptions for the Orbost Spiny Crayfish are included in the Victorian Code of Practice for Timber Production 2014. General forestry prescriptions such as protection and buffering of waterways also provide protection from forestry operations. In recent years, modified harvesting and forest regeneration practices have been implemented in native forest that are designed to further mitigate the potential threat from forestry operations to threatened species and their habitats.

### 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> <ul style="list-style-type: none"> <li>(a) direct observation [except A3]</li> <li>(b) an index of abundance appropriate to the taxon</li> <li>(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat</li> <li>(d) actual or potential levels of exploitation</li> <li>(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</li> </ul>			

### Evidence:

#### Eligible under Criterion A3 as Vulnerable

The population reduction over the next 15 to 45 years is projected to be 30%, based on (c) and (e) above.

This figure is based on the assumption that the known threats will continue to impact the taxon (i.e. habitat disturbance, predation by alien species, and reduction in quality and quantity of habitat due to climate change).

# *Euastacus diversus* Orbost Spiny Crayfish

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 (EEO)	< 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 653 km<sup>2</sup>, based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA) and on the available records from field work.

It is estimated to have one location, based on the main threats impacting all subpopulations at one time e.g. climate change induced impacts such as drought, fire, etc.

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

### Eligible under Criterion B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 76 km<sup>2</sup>, 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).

# Euastacus diversus Orbost Spiny Crayfish

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

There is insufficient evidence to determine the number of mature individuals.

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 estimated to be very restricted.

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

## References

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