Threatened Species Assessment

Engaeus curvisuturus
Curve-tail Burrowing Crayfish

Taxonomy

Engaeus curvisuturus Horwitz, 1990

Current conservation status

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 2005).

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

Proposed conservation status

Endangered in Australia

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

Species Information

Description and Life History

The Curve-tail Burrowing Crayfish is a small terrestrial burrowing crayfish belonging to the southern hemisphere crayfish family Parastacidae. The species is separated from all other taxa in the genus by the combination of tuberculate rostral carinae and a distinctive curve on the transverse suture on the outer ramus of the uropod and has a maximum recorded occipital carapace length of approximately 31 mm (Horwitz 1990). It builds burrow systems into the soil on the floodplain; females are buried in late spring to early summer (Horwitz 1990) and little else is known about its life history.

Burrowing crayfish spend most of their time underground and freshly excavated soil at burrow entrances is the most obvious sign of their presence. Surface activity is suspected to be nocturnal (Richardson and Swain 1980) and is linked to dispersal and foraging (Shaw 1996) and breeding (Van Praagh and Hinkley 1999). Activity is commonly related to seasonal rainfall (Morey and Hollis 1997, Van Praagh and Hinkley 1999). The cryptic behaviour of burrowing crayfish means little is known about their life history and ecology, including the Curve-tail Burrowing Crayfish. Poor dispersal, slow maturation and confinement to discontinuous habitats are common to short-range endemics (Harvey 2002) such as the Curve-tail Burrowing Crayfish. The diet of burrowing crayfish is predominantly plant-based and consists of roots, decomposing leaves and occasionally, small invertebrates (Lake and Newcombe 1975, Suter and Richardson 1977, Growns and Richardson 1988). Males surface during late spring and early summer to search for mates and then enter the burrows of females (Van Praagh and Hinkley 1999). Females incubate egg clusters under the abdomen and the juveniles hatch in late summer (Van Praagh and Hinkley 1999).

Generation Length

The generation length of the Curve-tail Burrowing Crayfish is inferred to be 3 to 4 years. Life history and larval development studies on two Tasmanian species (*E. cisternarius* and *E. fossor*) suggest the life span may be 3-4 years for these species (Suter 1977). The Tasmanian species share some similarities with *E. urostrictus* in occupying wet forest habitats (Horwitz, 1990) so the generation length has been suggested as the same.

Engaeus curvisuturus
Curve-tail Burrowing Crayfish

Distribution

The 35 known species of the genus *Engaeus* are endemic to south-east Australia, with most occurring in Victoria and Tasmania (Horwitz 1994). The distribution of the Curve-tail Burrowing Crayfish is poorly known. It has been recorded from only three sites, one in the upper Yarra catchment at Warburton, and two in the upper La Trobe River near Noojee. There is further Museum record from the Baw Baw area, but this may not be valid because the crays do not occur at that altitude.

Habitat

The Curve-tail Burrowing Crayfish occurs predominantly in Wet Forest on private property or within State forest, however the forest at the Warburton location was partially cleared. All locations are on the floodplain, though sometimes extending further away from the stream. The species constructs burrow systems in grey clay or silty soils, consisting of two to three openings which are each capped with a conical soil chimney and each descending to a depth of 60-70 cm where they converge to a wide, common descending tunnel, which can usually be blocked with silt. In addition, the burrow can also have one or more blind tunnels which ascend but do not open on the surface (Horwitz 1990).

Threats

The major threat to this taxon is the decline in quality and quantity of habitat, both underground and at the surface. This can be caused by a range of threats, many of which are predicted to be exacerbated by climate change. These include declines in quantity and quality of groundwater and surface run-off as a result of drought, water extraction or alteration to stream flows; decline or loss of vegetation due to removal or disturbance (e.g. urban or agricultural development, forestry operations, fire); soil disturbance (e.g. mechanical disturbance from agriculture, forestry operations or fire suppression activities, and erosion during floods); sedimentation/smothering from overland debris flow during high rainfall events following soil disturbance; impact of chemicals from agriculture or public land management operations including fire suppression activities; loss of areas of suitable soil profile in which to construct burrows; loss of food resources due to soil disturbance or loss of vegetation leading to various ecological changes; and trout predation. Changes to river discharge patterns can reduce the preferred adult macrohabitats, and siltation from catchment erosion can smother the preferred spawning habitat (rocks).

Spatial analysis of likely habitat for Curvetail Burrowing Crayfish on all land tenures indicates that 54% occurs within the Comprehensive, Adequate and Representative (CAR) reserve system, including parks, reserves and special protection zones within 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. There are no species-specific protections for the Curvetail Burrowing Crayfish in the Victorian Code of Practice for Timber Production 2014 however other more general prescriptions such as protection and buffering of rainforest, old growth and waterways provide protection from timber harvesting. 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%

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:

Eligible under Criterion A3 as Vulnerable

The population reduction over the next 10 to 12 years is projected to be 30%, based on (c) above. This is based on the assumption that the known threats will continue to impact the taxon.

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 259 km², based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA) and on the available records from field work.

The taxon is inferred to be severely fragmented. There are three small isolated subpopulations that are all at risk from the identified threats, such that there is increased extinction risk and little or no probability of recolonisation should subpopulations become extinct.

It is estimated to have one location. It has a continuing decline in (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 16 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the VBA records from field work. As above, the taxon is inferred to be severely fragmented, is estimated to have 1 location and has a continuing decline in (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:

Ineligible under Criterion C as Data Deficient

There is insufficient evidence to determine the number of mature individuals. The taxon was last targeted and located in 1982-83 (Horwitz 1990). Since then there has been no monitoring of these populations or targeted surveys.

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.

References

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)

Growns, I.O. and Richardson, A.M.M. (1988). Diet and burrowing habits of the freshwater crayfish. *Parastacoides tasmanicus tasmanicus* Clark (Decapoda: Parastacidae). *Australian Journal of Marine and Freshwater Research* 39: 525-534.

Harvey, M.S., (2002). Short-range endemism among the Australian fauna: some examples from non-marine environments. *Invertebrate Systematics* 16, 555-570.

Horwitz, P. (1990). A taxonomic revision of species in the freshwater crayfish genus *Engaeus* Erichson (Decapoda: Parastacidae). *Invertebrate Taxonomy* 4: 427-614.

Horwitz (1994). A new species of the freshwater crayfish genus *Engaeus* Erichson (Decapoda: Parastacidae) from north-western Tasmania. *Memoirs of the Museum of Victoria* 54 (2), 439-445.

Horwitz, P.H.J., Richardson, A.M.M. and Boulton, A. (1985). The burrow habitat of two sympatric species of land crayfish, *Engaeus urostrictus* and *E. tuberculatus* (Decapoda: Parastacidae). *Victorian Naturalist* 102 (6), 188-197.

Lake, P.S. and Newcombe, P.S. (1975). Observations on the ecology of *Parastacoides tasmanicus* (Decapoda: Parastacidae) from south western Tasmania. *Australian Journal of Zoology* 18: 197-214

Morey, J. and Hollis, G. (1997). Australia's most diverse crayfish habitat? *Memoirs of the Museum of Victoria* 56, 667-669.

Richardson, A.M.M. and Swain, R. (1980). Habitat requirements and distribution of *Engaeus cisternarius* and three subspecies of *Parastacoides tasmanicus* (Decapoda: Parastacidae), burrowing crayfish from an area of south western Tasmania. *Australian Journal of Marine and Freshwater Research* 31: 475-484.

Shaw, J. (1996). Australia's rarest crayfish? - A survey of the Labertouche Creek and tributaries in West Gippsland to extend the known range of the Warragul burrowing crayfish (*Engaeus sternalis*). Department of Natural Resources and Environment, Victoria, Australia.

Suter, P.J. (1977). The biology of two species of *Engaeus* (Decapoda: Parastacidae) in Tasmania II. Life history and larval development, with particular reference to *E. cisternari*us. *Australian Journal of Marine and Freshwater Research* 28: 85-93.

Suter, P.J. and Richardson, A.M.M. (1977). The Biology of Two Species of *Engaeus* (Decapoda: Parastacidae) in Tasmania. 111 Habitat, Food, Associated Fauna and Distribution. *Australian Journal of Marine and Freshwater Research* 28: 95-103.

SAC (2005). Flora and Fauna Guarantee Scientific Advisory Committee: Final Recommendation on a Nomination for Listing. Nomination No. 740 *Engaeus curvisuturus*.

Van Praagh, B. and Hinkley, S. (1999). Distribution of four species of burrowing crayfish, the Warragul burrowing crayfish *Engaeus sterna*lis (Clark); the Narracan burrowing crayfish *E. phyllocercus* (Smith and Schuster); the Strzelecki burrowing crayfish *E. rostrogaleatus* (Horwitz); and the Lilly Pilly burrowing crayfish *E. australis* (Riek); in the Gippsland Regional Forest Agreement area. Museum Victoria, Report prepared for the Department of Natural Resources and Environment.