Threatened Species Assessment

Hemiphlebia mirabilis
Ancient Greenling Damselfly

Taxonomy

Hemiphlebia mirabilis Selys, 1869

Current conservation status

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 1991).

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

Proposed conservation status

Endangered in Victoria

Criterion B2ab(iii,v)

Additional sites have been located for this species in the past decade in the southwest of Victoria. Whilst still fragmented and a poor disperser, the population may support considerable numbers. Desiccation due to climate change is considered a significant future threat.

Species Information

Description and Life History

This is the only living representative of the family Hemiphlebiidae and is endemic to Australia. Its predecessors are found solely in fossil records from Brazil to Russia (New 2007, Crowther, 2011). Both larvae and adults of the species are small and cryptic, with the adults having a wingspan of 22 mm (Davies, 1985). The larvae are carnivorous, preying on a wide range of small aquatic invertebrates (Yen et al. 1990). At maturity larvae reach 14 mm or less in length (Theischinger and Endersby 2009 cited in Crowther 2011).

Adult males tend to be slightly larger than females. Data from Long Swamp in southwestern Victoria gave mean body size (including anal appendages) of 25.1 ± 0.05 (n=160) mm for males and 23.9 ± 0.06 (n=86) for females (Cordero-Rivera, 2017). Body size decreases over time, which is a common feature in many univoltine odonate species (Cordero-Rivera, 2017). Flight season is between November and February (Sant and New, 1988, Yen et al. 1990).

Adults are typically bright metallic green with white anal appendages (Wells et al. 1983), although there has been recent work showing there is some variation in colouration (Cordero-Rivera, 2017). This damselfly is of unusual scientific interest as it exhibits primitive and unique structural features in both adult and larval stages (New 2007) and has unusual display behaviour - abdominal flicking (Sant and New, 1988) done by both males and females (Cordero-Rivera 2016). One of the most unique features of the species is the openness of the fore wing discoidal cell (Cordero-Rivera, 2016, 2017). In addition to the abdominal flicking, this species also rotates suddenly while on a perch to focus on other damselflies or prey, this behaviour occurring regularly, about 2 times every 10 minutes (Cordero-Rivera 2016).

Limited data from a mark and recapture study indicates that tenerals become juveniles one day after emergence, and that it takes a minimum of 4-5 days to reach sexual maturation (Cordero-Rivera, 2017). *H. mirabilis* is a univoltine species, having one generation per year, flying early in spring, but little is known about larval development (Sant and New, 1988 cited in Cordero-Rivera, 2017). New (2007) states that the larvae tend to be small in early spring, with most growth occurring from August to November, with 9 or 10 instars.

The frequency of mating is low, even in populations with large numbers of individuals. The period of emergence is long, but there are little to no data on egg laying behaviour and the larvae (Cordeo-Rivera, 2017). Life span after maturation is short, with males only surviving around 7 days and females around 4 days after maturation (Cordeo-Rivera, 2017). Although oviposition has not been observed the fact that the females have a serrated ovipositer indicates they insert their eggs into aquatic vegetation like most other damselfly (Sant and New, 1988; Corwther, 2011).

Adults are considered to be weak fliers (Yen et al. 1990) potentially limiting dispersal. Cordero-Rivera (2016) reported only 20 short distance (<50cm) and one long distance (>50cm) flights per hour, suggesting that the species would only move about 100m in a 12 hour period (assuming short flights were 40cm). This flight capability is similar to some other similar sized non-territorial damselflies (Cordero-Rivera 2016). This however does not account for the isolated populations and further work is required to determine the genetic relationships between populations.

Generation Length

The generation length of *Hemiphlebia mirabilis* is estimated to be 10 to 15 months. This is based on life history of the taxon, despite the little information on oviposition, the larvae and cues for emergence.

Distribution

The taxon was thought to have become extinct by the 1970s, largely as a result of habitat loss through agricultural land use practices (New, 2007). In the mid 1980s, a population was found on Wilsons Promontory, then two more in the Goulburn Valley near Alexandra and Yea. By 2008 it was known from a few small and fragmented populations, most of which were known to have declined since 2001. In December 2008 a large population was discovered in the southwest of Victoria (Crowther 2011). Since 2009 there have been a number of targeted surveys for this species (Ritcher 2009, Crowther, 2011, Haywood and Ritcher, 2013, Cordero-Rivera, 2016, Just, 2018), with several new locations identified, mainly in the southwest corner of the state, but also west of the Grampians. The taxon is also recorded from Flinders Island and in north east Tasmania (Trueman et al. 1992) and has also been found in South Australia (Haywood and Ritcher 2013).

Habitat

The habitat is variably described as including densely vegetated seasonal swamps/ billabongs/ lagoons, with shallow (often 20-60 cm deep) water and with the margins seasonally dry. In Long Swamp in the southwest of the state the preferred microhabitat is Baumea juncea which his used for the perching behaviour. New (2007) suggested fringing areas with dense reeds or other emergent vegetation appear to be critical habitat components. The persistence of the taxon in seasonal marshes suggests that it may have a mechanism to cope with dry periods, with a number of researchers suggesting eggs may be desiccation or drought resistant (Davies 1985, Sant and New 1988, Trueman et al. 1992, New 2007), but this has not been confirmed (Crowther 2011).

Threats

The Yea and Alexandra populations are threatened by lack of water coming onto the floodplain, due to agricultural practices and river regulation. The Wilsons Promontory population was severely threatened by the fire that destroyed the reeds, which were the *H. mirabilis* habitat. Predation by introduced fish, such as eastern gambusia, is also a significant threat to this species.

Declines in numbers due to drowning of key habitat and introduction of predatory fish at Long Swamp, are yet to be confirmed with further targeted surveys required. The affected area of the Long Swamp complex represents approximately 10-20% of the greenling habitat at the site. It was predicted that once the changed hydrological conditions at Long Swamp had persisted for a few years, the preferred habitat would re-established as the vegetation adapted to the new water levels (M. Bachmann pers. comm. 2016), although this doesn't appear to be occurring, with the taxon's habitat being replaced with deeper Aquatic Herbland/Aquatic Sedgeland (K. Just, pers. comm. 2019). It remains unclear as to whether the taxon will be able to re-colonise these areas, as published literature suggest that it is a poor disperser (Cordero- Rivera 2016).

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

The past population reduction does not meet the threshold for eligibility under criterion A2, and the future population reduction does not meet the threshold for eligibility under criterion A3.

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 B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 120 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the Victorian Biodiversity Atlas.

The taxon is estimated to be severely fragmented. It has been recorded at several widely separated sites in Victoria. It is regarded as poor flier which suggests isolation and that the population is severely fragmented

It is inferred to have 3 locations, based on the assumption that regional areas may be subject to different stochastic events. Climate change effects and loss of habitat may be a major future threat to the species. The Grampians and Lower Glenelg are considered one location.

It has a continuing decline in (iii) and (v) above, based on the likelihood that the current threats are likely to continue to affect the habitat. Climate change is considered a significant threat.

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 populations identified up until recently were scattered, however this is most likely due to the species being small and cryptic. Recent populations found in the southwest of the state suggest a much greater population than previously thought.

Cordero-Rivera (2016) states that there is no quantitative estimation of basic demographic parameters available prior to his work. He estimated that population size at one location of the Long Swamp complex in Discovery Bay had densities from 0.6 individuals/m2 to 4.2 individuals/m2. From his data he extrapolated that the local population oscillated between 174,000 to over 1,274,000 individuals. This number is disputed by other researchers and has not been supported by recent surveys of the same and nearby habitat (D. Crowther, Arthur Rylah Institute and K. Just, independent consultant, pers. comm. 2019). Surveys of previously populated areas of Long Swamp in December 2018 failed to find any individuals at one site which in previous years hundreds of animals had been recorded (K. Just, pers. comm. 2019).

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:

Ineligible under Criterion D

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

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

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