Threatened Species Assessment

Synemon selene
Pale Sun Moth

Taxonomy

Synemon selene Klug, 1850

The taxon is known to have five Victorian parthenogenetic morphs; Pale Morph, Terrick Terrick Morph, Nhill Morph, Narrow-winged Morph and Dark Morph.

Current conservation status

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

Proposed conservation status

Endangered in Victoria

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

Species Information

Description and Life History

The larval food plant of *Synemon selene* is unconfirmed but there is strong circumstantial evidence to indicate that it is wallaby-grasses (*Rhytidosperma* spp., formerly *Austrodanthonia* spp.) and spear- grasses (*Austrostipa* spp.). It appears that Bristly Wallaby-grass (*R. setacea*) may be a favoured larval food plant because the pupal exuviae of *S. selene* have been found protruding from the ground near this species of wallaby-grass on numerous occasions. The adults are strictly diurnal and only fly during periods of sunshine. They have cryptically patterned forewings in shades of fawn, black and white and brightly coloured hindwings that are pale orange or yellowish-orange with black markings.

The taxon is entirely parthenogenetic in Victoria but has one extinct and one extant non-parthenogenetic population in South Australia. The parthenogenetic females commence oviposition shortly after emergence (without mating) as males of the species do not occur in Victoria. Unlike most other Australian sun-moths, they do not oviposit into the ground at the base of the larval food plant but lay their ova with a long extensible ovipositor into small crevices in the cracking clay soil of their habitat. The larvae excavate and live in underground tunnels where they are thought to feed on the roots of their larval food plants. Pupation finally occurs in a more or less vertical tunnel to the soil surface that is sealed at it upper end with a thin cap of soil and larval silk. The pupa is able to move up or down this tunnel at will with the aid of several transverse rows of well sclerotized serrations on its abdominal segments. After adult emergence the pupal exuviae are left protruding from the ground and are sometimes found lying loose on the soil surface after being blown out of their pupal tunnels by strong wind.

The adult flight period is from the middle of February to early March with the peak in late February at most of the locations where the taxon occurs. The adults have a very small and non-functional haustellum (proboscis) and do not feed. For their brief adult lives of approx. 3 to 4 days they are sustained by nutrients that are stored in their bodies during the larval stage. This is a characteristic that *S. selene* shares with the better known Golden Sun-moth, *S. plana*.

Generation Length

The generation length of the Small Orange-spotted Sun-moth is inferred to be 24 months. This is based on the similar sized congener taxon *S. magnifica* (Common and Edwards 1981).

Distribution

This taxon occurs in Victoria and South Australia. In Victoria localised parthenogenetic populations occur on the northern plains near Mitiamo and Borung and in the Wimmera area from near Lubeck, westwards to Nhill.

Habitat

The taxon occurs in native perennial grassland and grassy woodland dominated by Wallaby-grasses (*Rhytidosperma*) species and Spear-grasses (*Austrostipa*) species on clayey or clay-loam soils. When trees are present in the habitat of *S. selene* the dominant species are usually Buloke (*Allocasuarina luehmannii*) and Black Box (*Eucalyptus largiflorens*).

Threats

Subpopulations and habitat are considered at risk from ecological succession in public land reserves, due to removal of grazing animals (i.e. sheep) or culled on adjacent private land (i.e. kangaroos). In the absence of sustained grazing the habitat, it progressively becomes unsuitable for the taxon and susceptible to invasion of exotic grasses and forbs (Douglas 2014, Douglas 2007). There is also ongoing loss of habitat on private land from native perennial grasslands being cultivated for agriculture (cropping) and/or limited clearing of native grassy woodland for the same purpose.

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. There is insufficient evidence to determine whether will be a future reduction in population size (criterion A3).

The taxon is unlikely to have declined significantly in recent years because the extant populations are either on crown reserves, or in areas that are unlikely to be cleared. However, a decline of 10 percent during the past ten years is suspected due to inappropriate management of habitat (i.e. removal of grazing animals and allowing invasion of exotic grasses and forbs) has caused ecological succession that renders the habitat to become progressively unsuitable.

It is unlikely to have a significant decline during the next ten years because extant populations occur in reserves and the broad scale clearing for agriculture in the species has now largely ceased. However, future management of some reserves where the species occurs could render the habitat to become progressively unsuitable.

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 and B2 as Endangered

The Extent of Occurrence (EoO) across the taxon's range is estimated to be 133 km², based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA).

The Area of Occupancy (AoO) across the taxon's range is estimated to be 34 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the VBA

Considering the limited dispersal ability of the taxon, the barriers to dispersal, or lack of habitat separating them, the individuals can be considered to be severely fragmented.

The taxon has a continuing decline in (i), (ii), (iii) and (v) above. The taxon is thought to have been under a slow and continuing decline due to inappropriate management of some reserves it occurs, and the habitat has then become progressively unsuitable.

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

It is suspected that there are 4500 mature individuals, but other thresholds under this criterion have not been met.

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

Common, I. F. B. & Edwards E. D. (1981). The life history and early stages of *Synemon magnifica* Strand (Lepidoptera Castniidae). *J. Aust. Ent. Soc*. 20: 295-302.

DSE (1999). *Advisory List of Threatened Invertebrate Fauna in Victoria 2009*. Department of Sustainability and Environment, Melbourne, Victoria. 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

Douglas, F. (2000). Sun Moths in the back paddock. In Barlow, T and Thorburn, R. (eds) *Balancing Conservation and Production in Grassy Landscapes:* Proceedings of the Bushcare Grassy Landscapes Conference, Clare, South Australia, 19-21 August 1999. Pp 56-57. Environment Australia: Biodiversity Group, Canberra, ACT.

Douglas, F. (2004). A dedicated reserve for the conservation of two species of Synemon (Lepidoptera: Castniidae) in Australia. *Journal of Insect Conservation*, 8 (2-3): 221-228.

Douglas, F. (2007a). MSc. The Sun-moths (Lepidoptera: Castniidae) of Victoria, with a detailed study of the Pale Sun-moth (*Synemon selene* Klug, 1850). University of Ballarat, Ballarat, Victoria.

Douglas, F. (2007b). A Review of the Conservation Status of Victorian Sun-moths (Lepidoptera: Castniidae). Unpublished report to the Arthur Rylah Institute for Environmental Research, Heidelberg, Victoria.

Douglas, F. (2014). The occurrence and management requirements of sun-moths, Synemon spp., Lepidoptera: Castniidae and the Grassland Froghopper, *Perelytrana rana*, Orthoptera: Acrididae on the northern plains of Victoria. Unpublished report to the Department of Environment and Primary Industries (Loddon-Mallee Region) Bendigo, Victoria.

Douglas, F. & Crouch, C. R. (2012). Management Plan for Gityauwil Ngarri (Menzel's) Reserve, a VicRoads Conservation Offset Property near Dimboola in NW Victoria. Unpublished report to VicRoads, Ballarat, Victoria.

Grund, R., Stolarski, A. & Stevens, M. (2018). Rediscovery of *Synemon selene* (Lepidoptera: Castniidae) in the mid-north of South Australia. *Transactions of the Royal Society of South Australia*. DOI: 10.1080/03721426.2018.1532270

.