Threatened Species Assessment

Rhinolophus megaphyllus megaphyllus
Eastern Horseshoe Bat

Taxonomy

Rhinolophus megaphyllus megaphyllus J.E. Gray, 1834

Current conservation status

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

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

Proposed conservation status

Endangered in Victoria

Criterion B2ab(iii,v)

The area of occupancy is small, as there are only three known and one suspected maternity roost caves in Victoria, where all females congregate to give birth to their young. It has a disjunct distribution and is classified as having two subpopulations. Although it has a relatively wide distribution within these two subpopulations outside the breeding season, it is categorised as having only just two locations as one of the threats to the species (the introduction of White-nosed Syndrome which is currently killing millions of bats in the USA) could impact the whole of the Victorian population rapidly due to the interchange of bats between roosting caves, from either this species or the Eastern Bent-wing Bat which shares many of these roosts. A risk assessment has considered that White-nosed Syndrome is 'highly likely' or 'almost certain' to be introduced into Australia in the next 10 years, and it is 'likely' that bats will be exposed. Eastern Horseshoe Bats were considered one of the Australian species likely to be impacted.

Species Information

Description and Life History

The Eastern Horseshoe Bat is a medium-sized insectivorous bat. Mating occurs in June/July with immediate fertilisation. The gestation period is 4-4.5 months (Krutzsch et al. 1992). Pregnant females return to the maternity cave in spring and a single young is born in November or December. Young reach adult size in 5-6 weeks and are suckled for a total of 8 weeks (Dwyer 1966). Males are sexually mature in the second year of their life, while females commence breeding in their second or third year (Young 1975).

The flight of the Eastern Horseshoe Bat is slow and highly manoeuvrable. It typically preys on large, slow-flying insects, predominantly moths and beetles (Vestjens and Hall 1977, Pavey and Burwell 2004).

Generation Length

The generation length of the Eastern Horseshoe Bat is estimated to be 10 to 12 years. This is based on the generation length used in the Mammal Action Plan (Woinarski et al. 2014) for other species of Rhinolophus.

Distribution

The Eastern Horseshoe Bat has a disjunct distribution in Victoria. There is one cluster of records in East Gippsland, broadly encompassing the area from Bairnsdale, Lakes Entrance, Buchan to Mallacoota. The other cluster is within the Eastern Highlands in the Kinglake, Warburton, Eildon, Strathbogie Ranges area. There is a gap of approximately 150 km between these clusters where there are no records. In north-eastern Victoria there are two

single records of this taxon, one from near Mt Buffalo and another near Mitta Mitta. It is unknown if these individuals are part of one or other of the two main subpopulations, or represent an additional subpopulation. Until further information is obtained on colonies and roosting sites in this area, this assessment considers just the two main subpopulations.

Within the Eastern Highlands this taxon occupies disused mines constructed between the 1880s and 1930s. It was first recorded within this area in 1977 (Kerle 1979) and, as there are no suitable caves present, is believed to have extended its range into this area since European settlement (Lumsden and Menkhorst 1995). In East Gippsland it roosts both within natural caves and disused mines. Colony sizes are relatively small (compared to the Eastern Bent-wing Bat with which it shares many roosts). There are three known maternity sites in East Gippsland, with the largest colony being 2000-6000 individuals. In contrast the largest colony found to date in the Eastern Highlands is 40 individuals (Lumsden and Menkhorst 1995). No maternity roosts have yet been found in the Eastern Highlands, however heavily pregnant females have been recorded in the Eildon area, 200 km from the closest known maternity site in East Gippsland. This distance is considered too far for this slow-flying species to migrate. It is therefore assumed that there is a maternity roost within a disused mine somewhere within the Eastern Highlands.

Habitat

The bats roost in caves and disused mines (typically horizontal adits not vertical shafts). Roost caves are typically warm and humid, especially the maternity roosts (Hall et al. 1975). Foraging habitat is mainly within forested areas.

Threats

There are a range of threats to the Eastern Horseshoe Bat. Human disturbance at roost sites can result in the abandonment of a cave, or reduced survival rates of both adults and juveniles. The protection of the maternity sites is critical, as any disturbance during the breeding season could result in the loss of young, due to individuals falling to the ground. As the maternity site in the Eastern Highlands has not yet been located, it is critical to find this so it can be protected. Bats enter periods of torpor over the cooler months and are also vulnerable to disturbance, due to the need to use valuable fat reserves to warm up so that they can fly to escape.

Roosting habitat is currently being lost due to the collapse of disused mines which are now typically 100-150 years old, and this is likely to increase in the future as they continue to age. In addition, some mines used as roosts have been intentionally closed due to human safety risks (L. Lumsden unpublished data).

Loss of habitat, including clearing of forest environments can reduce the availability of foraging habitat. This may be exacerbated during droughts and periods of low rainfall, which reduce prey availability. Low rainfall or hydrological changes can also reduce the movement of water through caves, lowering the humidity which is critical for this species, making them less suitable as roosting sites. At least two of the maternity caves previously had streams running through the cave, resulting in high levels of humidity. However, in recent years these streams have become intermittent, potentially impacting on this critical habitat requirement. In the future, climate change is likely to result in more extremes and variability in climatic conditions, including a reduction in rainfall and greater likelihoods of droughts. This has the potential to increasingly impact on the survival and breeding success of the Eastern Horseshoe Bat.

Little is known of the impact of fire on bats, although fire could impact roosting bats if smoke was drawn into caves. Fire could also impact foraging habitat and prey availability for bats, with large, high intensity fires within foraging range of significant roosting sites potentially reducing food availability for Eastern Horseshoe Bats.

A significant future threat is the introduction of White-nose Syndrome (WNS) to Australia. WNS is caused by the fungus *Pseudogymnoascus destructans* which is currently decimating populations of hibernating, cave-roosting bats in North America (Lorch et al. 2016). Millions of bat deaths have been attributed to the fungus since 2006, as this disease has rapidly spread across USA and Canada, with mortality rates approaching 100% in some caves. It has not yet been recorded in Australia (Holz et al. 2018). However, were it to be inadvertently introduced, it could have equally devastating consequences for Australian cave-dwelling bat species. The fungus grows optimally at temperatures of between 5 and 10 degrees C, with an upper growth limit of approximately 20 degrees C (Blehert et al. 2008). Many of the over-wintering caves used by the Eastern Horseshoe Bat are within the temperature range suitable for the fungus. A risk assessment concluded that the introduction of White-nosed Syndrome to Australia was 'very likely/almost certain' over the next 10 years and that Eastern Horseshoe Bat was one of the species likely to be impacted (Holz et al. 2016). This risk assessment considered the risk to this species was relatively low at a national scale because the species also occurs in northern Australia, however a subsequent paper by Turbill and

Welbergen (2019) considered this risk was higher in the context of south-eastern Australia. The movements of bats between roosting caves would result in the rapid spreading of the fungus were it to be introduced, either from this species, or from the more mobile Eastern Bent-wing Bat which shares many roosting caves with the Eastern Horseshoe Bat.

Feral Cats (*Felis catus*) and Red Foxes (*Vulpes vulpes*) have been recorded preying on bats as they exit caves, sometimes taking significant numbers. For example, feral cats have been recorded preying on Eastern Horseshoe Bats as they exited the main Victorian maternity cave (Tony Mitchell unpublished data).

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 30 to 36 years is suspected to be 20 to 60% (midpoint 35%), based on (c) and (e) above.

With the loss of roosting habitat, impact of climate change, and risk of WNS it is more likely that numbers will decrease in the future than increase, however these numbers are very speculative.

Eligible under Criterion A4 as Vulnerable

The population reduction over any 30 to 36 year period, including both past and future, is suspected to be 15 to 60% (midpoint 35%), based on (c) and (e) above.

This is based on possible past declines, and the likely threats of habitat loss, climate change and WNS.

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 16 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the Victorian Biodiversity Atlas. This is based on the three known maternity caves in East Gippsland, and at least one presumed maternity site in the Eastern Highlands,

It is estimated to have 2 locations, as all adult females breed in one of three known maternity caves in Gippsland and one yet to be located maternity cave in the Eastern Highlands, and then migrate to non-breeding caves spread throughout these two regions. This is because if White nosed Syndrome was to be introduced, all individuals in each of the two regions could be impacted due to the high level of movement and mixing, both due to this species and the Eastern Bent-wing Bat which coexists in many of these caves and is considerably more mobile than the Eastern Horseshoe Bat..

It has a continuing decline in (iii) above. Quality of habitat is declining due to a loss of roost sites in mines, which are gradually collapsing leading to a loss of habitat. Others are being closed due to human safety issues. The humidity in the maternity caves may have decreased in recent years, due to a reduction in stream flow through the caves. In future, habitat may decline further due to climate change impacting insect availability.

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 inferred that there are 3,200 to 12,000 (midpoint 7,500) mature individuals, but this qualifier is too weak and 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.

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