



## Consultation Document on Listing Eligibility and Conservation Actions

### *Miniopterus orianae bassanii* (Southern Bent-wing Bat)

You are invited to provide your views and supporting reasons related to:

- 1) the eligibility of *Miniopterus orianae bassanii* (Southern Bent-wing Bat) for retention on the EPBC Act threatened species list in the Critically Endangered category; and
- 2) the necessary conservation actions for the above species.

Evidence provided by experts, stakeholders and the general public are welcome. Responses can be provided by any interested person.

Anyone may nominate a native species, ecological community or threatening process for listing under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or for a transfer of an item already on the list to a new listing category. The Threatened Species Scientific Committee (the Committee) undertakes the assessment of species to determine eligibility for inclusion in the list of threatened species and provides its recommendation to the Australian Government Minister for the Environment and Energy.

Responses are to be provided in writing either by email to:  
[species.consultation@environment.gov.au](mailto:species.consultation@environment.gov.au)

or by mail to:

The Director  
Marine and Freshwater Species Conservation Section  
Biodiversity Conservation Division  
Department of the Environment and Energy  
PO Box 787  
Canberra ACT 2601

**Responses are required to be submitted by 3 July 2019.**

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## General background information about listing threatened species

The Australian Government helps protect species at risk of extinction by listing them as threatened under Part 13 of the EPBC Act. Once listed under the EPBC Act, the species becomes a Matter of National Environmental Significance (MNES) and must be protected from significant impacts through the assessment and approval provisions of the EPBC Act. More information about threatened species is available on the department's website at:

<http://www.environment.gov.au/biodiversity/threatened/index.html>.

Public nominations to list threatened species under the EPBC Act are received annually by the department. In order to determine if a species is eligible for listing as threatened under the EPBC Act, the Threatened Species Scientific Committee (the Committee) undertakes a rigorous scientific assessment of its status to determine if the species is eligible for listing against a set of criteria. These criteria are available on the Department's website at:

<http://www.environment.gov.au/biodiversity/threatened/pubs/guidelines-species.pdf>.

As part of the assessment process, the Committee consults with the public and stakeholders to obtain specific details about the species, as well as advice on what conservation actions might be appropriate. Information provided through the consultation process is considered by the Committee in its assessment. The Committee provides its advice on the assessment (together with comments received) to the Minister regarding the eligibility of the species for listing under a particular category and what conservation actions might be appropriate. The Minister decides to add, or not to add, the species to the list of threatened species under the EPBC Act. More detailed information about the listing process is at:

<http://www.environment.gov.au/biodiversity/threatened/nominations.html>.

To promote the recovery of listed threatened species and ecological communities, conservation advices and where required, recovery plans are made or adopted in accordance with Part 13 of the EPBC Act. Conservation advices provide guidance at the time of listing on known threats and priority recovery actions that can be undertaken at a local and regional level. Recovery plans describe key threats and identify specific recovery actions that can be undertaken to enable recovery activities to occur within a planned and logical national framework. Information about recovery plans is available on the department's website at:

<http://www.environment.gov.au/biodiversity/threatened/recovery.html>.

## Privacy notice

The Department will collect, use, store and disclose the personal information you provide in a manner consistent with the Department's obligations under the Privacy Act 1988 (Cth) and the Department's Privacy Policy.

Any personal information that you provide within, or in addition to, your comments in the threatened species assessment process may be used by the Department for the purposes of its functions relating to threatened species assessments, including contacting you if we have any questions about your comments in the future.

Further, the Commonwealth, State and Territory governments have agreed to share threatened species assessment documentation (including comments) to ensure that all States and Territories have access to the same documentation when making a decision on the status of a potentially threatened species. This is also known as the '[common assessment method](#)'. As a result, any personal information that you have provided in connection with your comments may be shared between Commonwealth, State or Territory government entities to assist with their assessment processes.

The Department's Privacy Policy contains details about how respondents may access and make corrections to personal information that the Department holds about the respondent, how respondents may make a complaint about a breach of an Australian Privacy Principle, and how the Department will deal with that complaint. A copy of the Department's Privacy Policy is available at: <http://environment.gov.au/privacy-policy>.

## **Information about this consultation process**

Responses to this consultation can be provided electronically or in hard copy to the contact addresses provided on Page 1. All responses received will be provided in full to the Committee and then to the Australian Government Minister for the Environment.

In providing comments, please provide references to published data where possible. Should the Committee use the information you provide in formulating its advice, the information will be attributed to you and referenced as a 'personal communication' unless you provide references or otherwise attribute this information (please specify if your organisation requires that this information is attributed to your organisation instead of yourself). The final advice by the Committee will be published on the department's website following the listing decision by the Minister.

Information provided through consultation may be subject to freedom of information legislation and court processes. It is also important to note that under the EPBC Act, the deliberations and recommendations of the Committee are confidential until the Minister has made a final decision on the nomination, unless otherwise determined by the Minister.

# *Miniopterus orianae bassanii*

## Southern Bent-wing Bat

### Taxonomy

Generally accepted as *Miniopterus orianae bassanii* (Cardinal & Christidis 2000).

The taxonomy of *Miniopterus* is unsettled at several levels. The genus has recently been moved from the family Vespertilionidae to its own family Miniopteridae (Miller-Butterworth et al. 2007). The taxon considered here was previously classified as a subspecies of *Miniopterus schreibersii* (*M. s. bassanii*). However, in recent decades molecular and genetic studies have indicated that the *Miniopterus* complex is a paraphyletic assemblage comprising many species, with speciation and differentiation occurring along geographical lines (Appleton et al. 2004; Christidis et al. 2014). The species in Australia is now recognised as being distinct from *M. schreibersii*, which is restricted to southern Europe, northern Africa and the Near East (Maeda 1982; Cardinal & Christidis 2000; Appleton et al. 2004; Tian et al. 2004).

The specific name to replace *schreibersii* for the Australian species has been unsettled. However, the name *orianae* was recently accepted by the Australian Faunal Directory, following Woinarski et al. (2014) and Jackson & Groves (2015). It is noted that Appleton et al. (2004), Tian et al. (2004) and Armstrong (2011) use the species name *oceanensis*.

Within the Australian range of *M. orianae* (Common Bent-wing Bat), three subspecies are currently recognised based on genetic and skull morphological differences:

- *M. o. bassanii* (Southern Bent-wing Bat) – western Victoria to eastern South Australia;
- *M. o. oceanensis* (Eastern Bent-wing Bat) – northern Queensland to southern Victoria;
- *M. o. orianae* (Northern Bent-wing Bat) – northern parts of Western Australia and the Northern Territory (Cardinal & Christidis 2000).

There is some evidence that these subspecies may warrant specific-level recognition (Reinhold et al. 2000; Wood & Appleton 2010), but this has yet to be resolved (Jackson & Groves 2015; Lumsden & Jemison 2019).

### Species/Subspecies Information

#### Description

The Southern Bent-wing Bat is an insectivorous, obligate cave-dwelling bat. It has dark reddish-brown to dark-brown fur on the back, grey-brown fur underneath and pale brown areas of bare skin. It has a distinctive short muzzle, a high crowned/domed head and small eyes. The ears are short, rounded and roughly triangular. It is the largest of the three subspecies of Common Bent-wing Bat, having a mean weight of 15.7 g, head and body length of 52–58 mm, and forearm length of 45–49 mm. It has the longest wing length of all the Miniopteridae, being nearly two and a half times longer than the head and body. The last phalanx on the third finger of the wing is about four times the length of the middle phalanx, giving a bent wing appearance (Churchill 2008).

The three subspecies are morphologically similar but form separate maternity colonies (Lumsden & Jemison 2019). The distribution of the Southern Bent-wing Bat and the Eastern Bent-wing Bat overlap in western Victoria, and currently they cannot be reliably distinguished using traditional field-based techniques (Lumsden & Jemison 2019). The two subspecies roost together in some caves (Holz et al. 2016).

#### Distribution

The Southern Bent-wing Bat is distributed from south-eastern South Australia (around Robe, Naracoorte and Port MacDonnell) to south-western Victoria (Lorne and Pomborneit) (Cardinal & Christidis 2000). Two regularly-used maternity sites are currently known: Naracoorte Bat Cave, which lies within Naracoorte Caves National Park in South Australia; and a cave near

Warrnambool, which is situated on private land on a sea cliff in Victoria (Dwyer & Hamilton-Smith 1965). The two maternity caves are separated by approximately 220 km, and migrations between them are rare (Dwyer 1969). Efforts to determine the subspecies' distribution and location of non-breeding roost sites have been undertaken since 2000 (Lumsden & Jemison 2019). There are 48 known non-breeding caves in South Australia, some of which are key roosting sites (Mott & Aslin 2000; Bourne 2010; Lear 2012a), and several in Victoria (Lumsden & Jemison 2019).

## **Relevant Biology/Ecology**

### Life cycle and breeding

Sexual maturity is reached at around two years of age (Dwyer 1963). Mating occurs in late autumn to early winter, with a gestation period of 6–7 months (Dwyer 1963). In August, the majority of the population commences the annual migration from roosting caves to one of the two regularly-used maternity caves, using transition caves along the way (Churchill 2008). Breeding females, and a proportion of the males and non-breeding females, congregate in these maternity caves. The Southern Bent-wing Bat is unique, compared to the other subspecies, in having males within the maternity caves (Dwyer 1969).

Females give birth to a single young from mid-November to January (Kerr & Bonifacio 2009; Lumsden & Jemison 2019). The maternity caves have specific structural characteristics which allow heat and humidity to build up, creating conditions suitable for nursing young (Dwyer 1965). The young develop rapidly and are weaned and independent by February – March (Lumsden & Jemison 2019). At this time, the majority of adults disperse to non-breeding caves. Some individuals, possibly young of the year, can remain in the maternity caves over winter, especially in the Warrnambool maternity cave (Lumsden & Jemison 2019).

During the winter months when food availability is low, the bats select cool roost sites to facilitate entry into torpor, when they lower their body temperature to reduce energy expenditure (Hall 1982). During this time they are highly susceptible to human disturbance.

The Southern Bent-wing Bat may live up to 22 years of age (Lumsden & Gray 2001). Generation length is estimated to be 10–12 years (Woinarski et al. 2014).

### Habitat and diet

The Southern Bent-wing Bat predominantly roosts in limestone caves, but also roosts in lava tunnels, coastal cliff rock crevices and man-made tunnels. Different caves are used depending on the season, as the bats seek the appropriate microclimatic conditions. Colony sizes in non-breeding caves are considerably smaller than those found in maternity caves, and individuals may also roost singly (Lumsden & Jemison 2019).

The subspecies has a fast, direct flight pattern and typically forages in open spaces (Dwyer 1965). Where there are trees it typically forages above the canopy, but can fly closer to the ground in more open areas. The bats can travel long distances from the roost site, up to 35 km (Grant 2004; Bourne 2010). Common foraging habitat includes forested ridgelines and wetlands, with open pastures and Radiata Pine (*Pinus radiata*) plantations utilised less frequently (Grant 2004). Wetlands and swamps may be prone to seasonal inundation (Stratman 2005). The subspecies probably feeds predominantly on moths, as moth wings are frequently found in the entrances to caves (Lumsden & Jemison 2019). The bats access water from water bodies, and by licking droplets of water from drip sites in caves (Bourne & Hamilton-Smith 2007).

Habitat critical to survival includes the two regularly-used maternity caves, non-breeding roost sites used by a significant proportion of the population or at key times during the yearly cycle, and key foraging areas (yet to be defined) (Lumsden & Jemison 2019). Due to the severe decline in numbers, all populations are important.

## Threats

A range of threats have been identified as potentially impacting on the Southern Bent-wing Bat (Table 1). However, the main cause(s) of the severe decline in numbers and the mechanisms of that decline are unclear (Lumsden & Jemison 2019). In addition, studies have revealed a significant drop in genetic variation in the Southern Bent-wing Bat over the first decade of this century, which may have a detrimental impact on the long-term viability of the subspecies (Wood & Appleton 2010).

**Table 1:** Threats impacting the Southern Bent-wing Bat in approximate order of severity of risk, based on available evidence

Number	Threat factor	Threat type and status	Evidence base
1.0	Habitat loss and degradation		
1.1	Damage or destruction of roost sites	Known past and potential	<p>There have been historic losses of major roost sites due to the extraction (mining) of bat guano, which entailed enlarging holes in cave roofs (Lewis 1977). In some cases this alteration significantly changed the cave microclimate, rendering it unsuitable to bats (Simpson &amp; Smith 1964; Hamilton-Smith 1998; Baudinette et al. 1994).</p> <p>Some roost sites have been abandoned by bats due to their use as rubbish dumps, or intentionally closed as part of risk mitigation or for the protection of Aboriginal rock art (Kerr &amp; Bonifacio 2009). Bent-wing bats generally do not tolerate gates installed over cave entrances, even those designed to allow the movement of bats (Slade &amp; Law 2008).</p> <p>While the Naracoorte maternity cave is managed for bat conservation, the Warrnambool cave is on private land with limited conservation management. The roof of the Warrnambool cave is very thin and susceptible to collapse from heavy agricultural machinery driven over its surface, with the potential for catastrophic consequences for its viability as a breeding site (Lumsden &amp; Jemison 2019). The cave is also in a dynamic section of the coast which puts it at risk from collapse. Parts of the cave have collapsed in recent years due to natural weathering, and increased storm frequency due to climate change may exacerbate the rate of collapse (Lumsden &amp; Jemison 2019).</p>
1.2	Clearing and modification of foraging habitat	Known past and potential	<p>Historic land clearing and the draining of large wetland complexes have greatly reduced foraging habitat for the Southern Bent-wing Bat. Habitats surrounding the two regularly-used maternity roosts have been significantly modified and fragmented; further destruction of the remaining habitats in these areas could be highly detrimental to the survival of the subspecies (Lumsden &amp; Jemison 2019). Weed growth around the entrance of caves can also obstruct flight space (Lumsden &amp; Jemison 2019).</p>
2.0	Disease		

2.1	Disease	Known past and potential	<p>There is some documentation of severe mortalities due to disease. In 1967 an unidentified virus reduced the numbers at the Naracoorte site from &gt;100 000 to 60 000 individuals (E Hamilton-Smith pers. comm. 2010, cited in Lumsden &amp; Jemison 2019).</p> <p>In 2008 there was a high mortality of pups at the Naracoorte site, with some individuals suffering from severe ulcerative skin lesions and malnutrition (Bourne 2010). In 2009, a large proportion of the population was observed with small ulcers that were attributed to parasites and a pox virus (Bourne 2010). However, it is unclear whether these lesions and ulcers affected the bats' survival.</p> <p>In North America, White-nose Syndrome (WNS) caused by the fungus <i>Pseudogymnoascus destructans</i> has resulted in millions of deaths in cave-roosting bats since 2006 (Puechmaille et al. 2010). It has spread rapidly across the United States of America, and has also been recorded in Canada and Europe (Puechmaille et al. 2010). It has not yet been recorded in Australia, but were it inadvertently introduced it could have devastating consequences for Australian cave-dwelling bats (Lumsden &amp; Jemison 2019). Many of the overwintering caves for the Southern Bent-wing bat are in the temperature range suitable for the fungus (Lumsden &amp; Jemison 2019). A risk-assessment for bats in Australia concluded that the introduction of WNS into Australia was 'almost certain' over the next 10 years, and that the Southern Bent-wing Bat would be the taxon most impacted (Holz et al. 2016).</p>
3.0	Climate change		
3.1	Climate change	Suspected past and potential	<p>Drought may impact on reproductive success and adult survival by reducing water availability, and prey availability if critical wetland foraging sites dry up. The drought in conjunction with unusually low temperatures during the breeding season in 2006 are believed to have been the cause of significant mortalities in the Naracoorte maternity cave, with large numbers of emaciated pups observed and &gt;500 dead pups recorded (Bourne &amp; Hamilton-Smith 2007). Periods of low rainfall are likely to increase under ongoing climate change.</p>
4.0	Human disturbance		
4.1	Human visitation to caves	Known past and current	<p>The Southern Bent-wing Bat is highly susceptible to human disturbance. Many caves used by the bats receive significant levels of human visitation, although visitation to the Naracoorte maternity cave is strictly regulated (Lumsden &amp; Jemison 2019).</p> <p>The young are particularly vulnerable during the breeding season; disturbance may lead to young being dislodged from the ceiling and falling to the floor, where they are unlikely to be reunited with their mother and will die. Adults in torpor are also</p>

			vulnerable; if disturbance causes them to arouse from torpor they use up valuable fat reserves, and may starve to death if this occurs a number of times over the cooler months. If disturbance occurs repeatedly a roost site may be abandoned (Kerr & Bonifacio 2009).
5.0	Introduced predators		
5.1	Feral cats ( <i>Felis catus</i> ), foxes ( <i>Vulpes vulpes</i> ) and black rats ( <i>Rattus rattus</i> )	Suspected past and current	Both feral cats and foxes have been recorded preying on bats as they exit caves, sometimes taking significant numbers (Lumsden & Jemison 2019). Dwyer (1966) reported the accumulated remains of 476 Eastern Bent-wing Bats taken by a fox at a cave in NSW over a two year period. The impact of introduced predators on the Southern Bent-wing Bat is unknown, however a fox and numerous fox scats have been observed in the Warnambool maternity cave (Lumsden & Jemison 2019). Black rats have been observed in both maternity caves, and are likely to prey on bats. Cats have been trapped in and around the Naracoorte maternity cave (Lumsden & Jemison 2019).
6.0	Infrastructure		
6.1	Inappropriate fencing	Suspected past and current	Bats are known to become trapped in barb wire. Barb wire fences placed in flight paths to/from a roost site may result in locally significant levels of mortality (Lumsden & Jemison 2019).
6.2	Windfarms	Potential	Windfarm developments pose a number of risks to bats, including cave destruction, mortalities due to collisions, barotrauma (a result of changing air pressure around moving blades), and altered access to foraging areas (Kerr & Bonifacio 2009). The impact of windfarms on the Southern Bent-wing Bat are unknown, but any windfarms close to a roosting site may potentially have a major impact on that population (Lumsden & Jemison 2019).  International studies suggest that there may be cumulative impacts of windfarms on migratory species, with impacts greater at particular times of the year or under certain weather conditions (Johnson et al. 2004; Kunz et al 2007). The risk increases with proximity of the windfarm to an important site, particularly a maternity site, or migration path.
7.0	Fire		
7.1	Severe bushfire	Potential	The impact of fire on bats is not well understood. Severe bushfire has been shown to reduce the relative abundance of Eastern Bent-wing Bats (Jemison et al. 2012). Fire could impact roosting bats if smoke was drawn into the caves, and could potentially impact foraging habitat and prey availability (Lumsden & Jemison 2019).
8.0	Accumulation of toxins		



8.1	Accumulation of pesticides or other toxins	Potential	<p>A range of pesticide residues, including DDT and DDE, have been found in Southern Bent-wing Bats and bat guano at both maternity sites (Mispagel et al. 2004; Allinson et al 2006). It is unknown if these chemicals have contributed to the decline in numbers of the subspecies, but sub-lethal exposure to DDE has been reported to increase metabolic rates, which may lead to reduced body weight and over-winter survival of the bats (Allinson et al 2006).</p> <p>Agricultural pesticides may also severely reduce the abundance of prey species, such as moths and their larvae (Lumsden &amp; Jemison 2019).</p>
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### **Assessment of available information in relation to the EPBC Act Criteria and Regulations**

<b>Criterion 1. Population size reduction (reduction in total numbers)</b>				
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4				
		<b>Critically Endangered Very severe reduction</b>	<b>Endangered Severe reduction</b>	<b>Vulnerable Substantial reduction</b>
<b>A1</b>		<b>≥ 90%</b>	<b>≥ 70%</b>	<b>≥ 50%</b>
<b>A2, A3, A4</b>		<b>≥ 80%</b>	<b>≥ 50%</b>	<b>≥ 30%</b>
A1	Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.	<div style="display: flex; align-items: center;"> <div style="font-size: 4em; margin-right: 10px;">}</div> <div> <p><i>base d on any</i></p> </div> </div>		
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) <i>cannot be used for A3</i> ]			
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.			
			(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:**

This criterion considers population trends over the most recent three generation period (36 years), from 1983 to 2019. Estimates of overall population size are based on counts at the two main maternity caves, as the majority of individuals congregate in these caves over summer for breeding. However, not all bats migrate to these caves during the breeding season, and consequently population counts do not include the entire population. To obtain more accurate estimates, individuals roosting in other caves at this time of the year need to be considered (Lumsden & Jemison 2019).

#### **Warnambool maternity cave (Victoria)**

In 1963–1964, the maternity colony at Warnambool was estimated to contain 10 000 – 20 000 individuals, based on the estimated size of clusters of bats on the ceiling of the cave (Dwyer &

Hamilton-Smith 1965). Dwyer and Hamilton-Smith (1965) described the estimates as highly variable, however considered them satisfactory to determine general population size.

In 2003–2004, numbers at Warrnambool were estimated at 10 000 – 15 000 individuals, based on exit counts (Grant & Reardon 2004; Gray 2000). Video-recorded exit counts taken during summer between 2000 and 2004 suggest a decline from 15 000 individuals to less than 10 000 individuals over this period (C Grant pers. comm. 2010, cited in Lumsden & Jemison 2019). Further estimates are required to determine if the population has continued to decline.

Assuming that the population size has not increased since 2004, the population size at this site is estimated to have declined by at least 30 percent over the past three generations (30–36 years).

#### Naracoorte maternity cave (South Australia)

In November to December 1963, numbers at Naracoorte were estimated at 100 000 – 200 000 individuals based on a mark-recapture study (Dwyer & Hamilton-Smith 1965). In 1967, numbers declined to around 60 000 due to a viral epidemic and drought (E Hamilton-Smith pers. comm. 2010, cited in Lumsden & Jemison 2019). However, in the early 1980s and mid-1990s the population was assessed qualitatively several times, with estimates suggesting that numbers had returned to the early 1960s level (E Hamilton-Smith pers. comm. 2010 and confirmed by other cavers during this period, cited in Lumsden & Jemison 2019). In 2000, a mark-recapture study estimated 65 000 individuals in the population, but there was high uncertainty around this estimate (Reardon 2001).

In order to provide more precise estimates and reduce disturbance to the bats caused by mark-recapture, an alternative survey technique was subsequently developed, with exit counts undertaken using video recording (Grant & Reardon 2004). These counts revealed a steady decline in numbers from 35 000 to 20 000 over the period 2001–2009 (Bourne 2010; Kerr & Bonaficio 2009). The survey technique was then refined further using an automated counting system based on thermal imaging technology (Lear et al. 2012). Using this technique, exit counts undertaken several times a week during the 2011/12 breeding season recorded 25 000 – 37 000 individuals (Lear 2012b). It is unclear whether these counts represent an increase in numbers since 2009 or a more accurate estimate, as counts from previous years were typically estimated on only one to three occasions per summer (Lear 2012b).

Based on middle estimates from the early 1980s (150 000 individuals) and 2011/12 (31 000 individuals), and assuming the population size has not changed since the last estimate, over the past three generation period (1983–2019) the population size at Naracoorte is estimated to have declined by around 79 percent (but ranging from 63 to 88 percent if upper and lower population estimates are used).

#### Conclusions

Based on the available data from both maternity colonies, the total population size of the Southern Bent-wing Bat is estimated to have declined from around 165 000 to around 41 000 over the past three generation period (30–36 years). This represents an overall past decline of around 75 percent, which meets the threshold for Endangered under subcriterion A2(b).

A risk-assessment for White-nose Syndrome in bats in Australia concluded that it was “almost certain” that White-nosed Syndrome will be introduced into Australia in the next 10 years, and that it was “likely” that Australian bats will be exposed to it (Holz et al. 2016). The pathogen was assessed as likely to reduce the population size of the Southern Bent-wing Bat by 30–50 percent (a timeframe for this reduction was not provided in the risk-assessment), which meets the threshold for Vulnerable under subcriterion A3(e).

The data presented above appear to demonstrate that the subspecies is eligible for listing as **Endangered under Criterion 1 A2(b)**, and as **Vulnerable under Criterion 1 A3(e)**. However,

the purpose of this consultation document is to elicit additional information to better understand the subspecies' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

<b>Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy</b>			
	<b>Critically Endangered Very restricted</b>	<b>Endangered Restricted</b>	<b>Vulnerable Limited</b>
B1. Extent of occurrence (EOO)	< 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 indicating distribution is precarious for survival:			
(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:**

The Extent of Occurrence (EOO) is estimated at 19 452 km<sup>2</sup>, and the Area of Occupancy (AOO) estimated at 8 km<sup>2</sup> which meets the threshold for Critically Endangered under subcriterion B2. These figures are based on the mapping of roost sites from 1998 to 2018, obtained primarily from state governments and museums (DoEE 2018). The EOO was calculated using a minimum convex hull, and the AOO calculated using 2x2 km grid cells around maternity roosts only (being the smallest area essential at any stage to the survival of existing populations), based on the IUCN Red List Guidelines 2017.

The term 'location' is defined in the IUCN Red List Guidelines 2017 as a geographically or ecologically distinct area in which a single threatening event (based on the most serious plausible threat) can rapidly affect all individuals of the taxon present. Although there are two maternity sites of the Southern Bent-wing Bat, a single threat (the potential introduction of White-nosed Syndrome) could rapidly and severely impact the whole population due to movements of the bats between caves. Therefore the subspecies is classified as occurring in a single location, which meets subcriterion (a). The range is fragmented, but not severely fragmented because the majority of the population does not occur in many subpopulations.

There is a projected continuing decline in the EOO, number of mature individuals and extent/quality of foraging habitat, due to likely impacts from climate change and disease. This meets subcriterion (b)(i,iii,v). The subspecies is not known to undergo extreme fluctuations.

The information presented above appear to demonstrate that the subspecies is eligible for listing as **Critically Endangered under Criterion 2 B2(a),(b)(i,iii,v)**. However, the purpose of this consultation document is to elicit additional information to better understand the subspecies' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 3. Population size and decline			
	Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals	< 250	< 2,500	< 10,000
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	Very high rate 25% in 3 years or 1 generation (whichever is longer)	High rate 20% in 5 years or 2 generation (whichever is longer)	Substantial rate 10% in 10 years or 3 generations (whichever is longer)
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(a) (ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b) Extreme fluctuations in the number of mature individuals			

#### Evidence:

The most recent population estimates for the subspecies are 10 000 individuals in 2004 for the Warnambool site, and 25 000 – 37 000 in 2011/12 for the Naracoorte site (see Criterion 1). This results in a total population size of approximately 41 000 individuals.

The Warnambool maternity colony is comprised of breeding females, non-breeding females and males, which typically represent around 30–40 percent, 30–40 percent and 30 percent of the adult population respectively (L Lumsden & P Gray 2001, unpublished data). Assuming that approximately 35 percent of the individuals in the maternity caves are non-breeding females, the total number of mature individuals in the population is estimated to be 27 000, which is not limited.

The information presented above appears to demonstrate the subspecies is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the subspecies' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low (Medium-term future) <sup>1</sup>
Number of mature individuals	< 50	< 250	< 1,000
D2 <sup>1</sup> Only applies to the Vulnerable 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: area of occupancy < 20 km <sup>2</sup> or number of locations ≤ 5

<sup>1</sup> The IUCN Red List Criterion D allows for species to be listed as Vulnerable under Criterion D2. The corresponding Criterion 4 in the EPBC Regulations does not currently include the provision for listing a species under D2. As such, a species cannot currently be listed under the EPBC Act under Criterion D2 only. However, assessments may include

information relevant to D2. This information will not be considered by the Committee in making its recommendation of the species' eligibility for listing under the EPBC Act, but may assist other jurisdictions to adopt the assessment outcome under the [common assessment method](#).

### Evidence:

The total population size of the Southern Bent-wing bat is estimated to be 27 000 mature individuals (see Criterion 3), which is not low.

The information presented above appears to demonstrate the subspecies is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the subspecies' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

### Evidence:

Population viability analysis for the Southern Bent-wing bat appears not to have been undertaken; there are insufficient data to demonstrate if the species is eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the subspecies' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

## Conservation Actions

### Recovery Plan

A draft National Recovery Plan for the Southern Bent-wing Bat has been prepared by the Victorian Department of Environment, Land, Water and Planning (Lumsden & Jemison 2019). The plan is currently being finalised and expected to be published in 2019.

The Conservation Actions below are based on the actions in the draft recovery plan.

### Primary Conservation Actions

1. Protect all maternity sites, key non-breeding sites and key foraging areas.
2. Undertake long-term monitoring to assess changes in population status, evaluate the success of management actions, and inform adaptive management.
3. Determine the main cause(s) of the decline in population.

### Conservation and Management priorities

- Habitat loss and modification
  - Protect all maternity sites and key non-breeding sites from loss and damage.
  - Protect all key foraging areas from clearing and degradation; implement management actions to increase the condition and extent of foraging habitat, including restoring connectivity with key roosting sites.

- Establish conservation covenants, or management agreements, on private land containing important roost or foraging sites.
- Provide a list of the locations of all maternity sites, key non-breeding sites, and key foraging areas to local councils for inclusion in their planning processes.
- Investigate and trial options for restoring caves previously used by the bats, but rendered unsuitable due to guano mining or other anthropogenic activities.
- Disease
  - Develop and publicise a hygiene protocol for White-nose Syndrome for researchers and cavers.
  - Enforce restrictions on items introduced into Australia that may contain soil or other materials capable of carrying the fungus that causes White-nose Syndrome.
- Climate change
  - If microclimatic conditions within the maternity caves become suboptimal, artificially modify the temperature and humidity if feasible.
- Human disturbance
  - Erect and maintain signs to restrict or discourage human access to important roost sites, and educate the public of the species' threatened status and risks from human disturbance.
  - In conjunction with caving organisations, develop and promote a code of conduct for cave visits which includes a full assessment of the risk of disturbance to the bats for all proposed activities.
- Introduced predators
  - Control introduced feral predators at maternity sites and important non-breeding sites, where regular monitoring for evidence of predation indicates that control measures are required.
- Infrastructure
  - Do not site wind turbines near important sites or potential migration routes.
- Fire
  - Provide the locations of maternity sites and key non-breeding sites to fire management authorities for inclusion in their planning processes.
  - Manage risks to maternity sites, key non-breeding sites and key foraging habitat from fuel reduction burning, within the context of relevant state bushfire risk management policies.
- Accumulation of toxins
  - Constrain the use of pesticides that have secondary impacts on this subspecies.
  - Implement a public relations campaign to change perceptions of landowners towards pesticide use and promote the use of alternatives.
- Stakeholder Engagement
  - Continue to work with the landholder at the Warrnambool maternity site to implement management actions, including measures to reduce the risk of roof collapse and reduce impacts from human access and invasive predators.

- Increase public awareness (but do not publicise locations of individual roosting sites) of the Southern Bent-wing Bat, including its threatened status, conservation requirements, and benefits to the community.
- Involve community groups in the implementation of conservation actions.
- Develop closer links with Indigenous groups to ensure multi-objective management is undertaken at caves with cultural heritage values.

### **Survey and Monitoring priorities**

- Undertake systematic surveys of caves, across all seasons, to locate additional roosting sites.
- Undertake regular monitoring to determine population size and population trends:
  - during the breeding season – monitor numbers (including proportion of each age, sex and reproductive class) at the two main maternity sites at least monthly, with concurrent monitoring at other key roost sites, to determine total population size;
  - outside the breeding season – monitor numbers at key roost sites to determine the total over-wintering population, relative usage of each site and patterns of use, and whether there are regular migration routes and the timing of migration.
- Regularly monitor the health of individuals (across different age, sex and reproductive classes) at the two maternity sites and key roosting sites, to determine if ill-health, disease, pesticides or malnutrition are contributing to the population decline. Also monitor the sites for the presence of white-nose syndrome or other disease-causing fungi, and minimise disturbance during the health assessments.
- Monitor breeding success (numbers born and proportion surviving to weaning age) at the maternity sites annually.
- Collect demographic data to determine the survival rates of different age, sex and reproductive classes in the maternity caves, to determine whether particular cohorts are disproportionately contributing to the current decline.

### **Information and Research priorities**

- Refine monitoring techniques to more accurately estimate population numbers, survival rates and breeding success, while minimising disturbance.
- Determine the main cause(s) of the recent decline in population, and assess the relative impact of each threat to the subspecies.
- Assess the effectiveness of measures taken to stabilise and reduce disturbance at the Warrnambool maternity site. If there is a high residual risk of collapse, investigate the feasibility and potential benefits/risks of constructing an artificial maternity cave.
- Identify key foraging areas, particularly around the maternity sites.
- Investigate the subspecies' dietary requirements and important invertebrate prey items, and determine whether foraging resources are limiting.
- Collect baseline data on microclimatic conditions in the maternity caves and monitor over time. If conditions become sub-optimal, examine the feasibility of artificially modifying the temperature and humidity to increase survival and breeding success. Assess the use of free water within the cave as a source of water, and implications if this dries up.
- Undertake research into possible designs for gates that can be installed at cave exits to prevent human access, and undertake trials to assess effectiveness.
- Develop a field identification tool to distinguish between the Southern Bent-wing Bat and the Eastern Bent-wing bat.



- Collect and analyse genetic samples in central and western Victoria, to refine the distribution of the Southern Bent-wing Bat and Eastern Bent-wing Bat.
- Undertake genetic analyses to improve understanding of the subspecies' population structure and movement patterns, and the implications of low genetic variation. Investigate whether genetic material can be obtained from faecal matter in order to minimise disturbance.
- Maintain a database that includes for each roosting site: location, condition, management needs, and monitoring information (e.g. population size). Identify the most important roosting sites, those that require the most urgent management attention, and caves that were used in the past but have since been abandoned, in order to inform management strategies.

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## **Collective list of questions – your views**

### **SECTION A GENERAL**

1. Is the information used to assess the nationally threatened status of the species robust? Have all the underlying assumptions been made explicit? Please provide justification for your response.
2. Can you provide additional data or information relevant to this assessment?
3. Have you been involved in previous state, territory or national assessments of this species/subspecies? If so, in what capacity?

## **PART 1 – INFORMATION TO ASSIST LISTING ASSESSMENT**

### **SECTION B DO YOU HAVE ADDITIONAL INFORMATION ON THE ECOLOGY OR BIOLOGY OF THE SPECIES? (If no, skip to section C)**

#### **Biological information**

4. Can you provide any additional or alternative references, information or estimates on longevity, average life span and generation length?
5. Do you have any additional information in the ecology or biology of the species not in the current advice/plan?

### **SECTION C ARE YOU AWARE OF THE STATUS OF THE TOTAL NATIONAL POPULATION OF THE SPECIES? (If no, skip to section D)**

#### **Population size**

6. Has the survey effort for this taxon been adequate to determine its national adult population size? If not, please provide justification for your response.
7. Do you consider the way the population size has been derived to be appropriate? Are there any assumptions and unquantified biases in the estimates? Did the estimates measure relative or absolute abundance? Do you accept the estimate of the total population size of the species? If not, please provide justification for your response.
8. If not, can you provide a further estimate of the current population size of mature adults of the species (national extent)? Please provide supporting justification or other information.

If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible subspecies numbers, and also choose the level of confidence you have in this estimate:

Number of mature individuals is estimated to be in the range of:

☐ 15 000–20 000 ☐ 20 001–25 000 ☐ 25 001–30 000 ☐ 30 001–35 000 ☐ >35 000

Level of your confidence in this estimate:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on

☐ 31–50% - more than a guess, some level of supporting evidence

- ☐ 51–95% - reasonably certain, information suggests this range
- ☐ 95–100% - high level of certainty, information indicates quantity within this range
- ☐ 99–100% - very high level of certainty, data are accurate within this range

**SECTION D ARE YOU AWARE OF TRENDS IN THE OVERALL POPULATION OF THE SPECIES? (If no, skip to section E)**

9. Does the current and predicted rate of decline used in the assessment seem reasonable? Do you consider that the way this estimate has been derived is appropriate? If not, please provide justification of your response.

**Evidence of total population size change**

10. Are you able to provide an estimate of the total population size during the early 1980s (*at or soon after the start of the most recent three generation period*)? Please provide justification for your response.

If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible subspecies numbers, and also choose the level of confidence you have in this estimate.

Number of mature individuals is estimated to be in the range of:

- ☐ 40 000–80 000 ☐ 80 001–120 000 ☐ 120 001–160 000 ☐ >160 000

Level of your confidence in this estimate:

- ☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on
- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, information suggests this range
- ☐ 95–100% - high level of certainty, information indicates quantity within this range
- ☐ 99–100% - very high level of certainty, data are accurate within this range

11. Are you able to comment on the extent of decline in the species/subspecies' total population size over the last 30–36 years (i.e. three generations)? Please provide justification for your response.

If, because of uncertainty, you are unable to provide an estimate of decline, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of decline, and also choose the level of confidence you have in this estimated range.

Decline estimated to be in the range of:

- ☐ 1–30% ☐ 31–50% ☐ 51–80% ☐ 81–100% ☐ 90–100%

Level of your confidence in this estimated decline:

- ☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on

- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, suggests this range of decline
- ☐ 95–100% - high level of certainty, information indicates a decline within this range
- ☐ 99–100% - very high level of certainty, data are accurate within this range

12. Please provide (if known) any additional evidence which shows the population is stable, increasing or declining.

## **SECTION E ARE YOU AWARE OF INFORMATION ON THE TOTAL RANGE OF THE SPECIES? (If no, skip to section F)**

### **Current Distribution/range/extent of occurrence, area of occupancy**

13. Does the assessment consider the entire geographic extent and national extent of the species/subspecies? If not, please provide justification for your response.
14. Has the survey effort for this species/subspecies been adequate to determine its national distribution? If not, please provide justification for your response.
15. Is the distribution described in the assessment accurate? If not, please provide justification for your response and provide alternate information.
16. Do you agree that the way the current extent of occurrence and/or area of occupancy have been estimated is appropriate? Please provide justification for your response.
17. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the extent of occurrence and/or area of occupancy.

If, because of uncertainty, you are unable to provide an estimate of extent of occurrence, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of extent of occurrence, and also choose the level of confidence you have in this estimated range.

**Current extent of occurrence** is estimated to be in the range of:

- ☐ <100 km<sup>2</sup> ☐ 100 – 5 000 km<sup>2</sup> ☐ 5 001 – 20 000 km<sup>2</sup> ☐ >20 000 km<sup>2</sup>

Level of your confidence in this estimated extent of occurrence

- ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on
- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, data suggests this range of decline
- ☐ 95–100% - high level of certainty, data indicates a decline within this range
- ☐ 99–100% - very high level of certainty, data is accurate within this range

If, because of uncertainty, you are unable to provide an estimate of area of occupancy, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of area of occupancy, and also choose the level of confidence you have in this estimated range.

**Current area of occupancy** is estimated to be in the range of:

☐ <10 km<sup>2</sup> ☐ 11 – 500 km<sup>2</sup> ☐ 501 – 2000 km<sup>2</sup> ☐ >2000 km<sup>2</sup>

Level of your confidence in this estimated extent of occurrence:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, data suggests this range of decline

☐ 95–100% - high level of certainty, data indicates a decline within this range

☐ 99–100% - very high level of certainty, data is accurate within this range

**SECTION F ARE YOU AWARE OF TRENDS IN THE TOTAL RANGE OF THE SPECIES?**  
(If no, skip to section G)

**Past Distribution/range/extent of occurrence, area of occupancy**

18. Do you consider that the way the historic distribution has been estimated is appropriate?  
Please provide justification for your response.

19. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the former extent of occurrence and/or area of occupancy.

If, because of uncertainty, you are unable to provide an estimate of past extent of occurrence, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of past extent of occurrence, and also choose the level of confidence you have in this estimated range.

**Past extent of occurrence** is estimated to be in the range of:

☐ <100 km<sup>2</sup> ☐ 100 – 5 000 km<sup>2</sup> ☐ 5 001 – 20 000 km<sup>2</sup> ☐ >20 000 km<sup>2</sup>

Level of your confidence in this estimated extent of occurrence

☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, data suggests this range of decline

☐ 95–100% - high level of certainty, data indicates a decline within this range

☐ 99–100% - very high level of certainty, data is accurate within this range

If, because of uncertainty, you are unable to provide an estimate of past area of occupancy, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of past area of occupancy, and also choose the level of confidence you have in this estimated range:

**Past area of occupancy** is estimated to be in the range of:

☐ <10 km<sup>2</sup> ☐ 11 – 500 km<sup>2</sup> ☐ 501 – 2000 km<sup>2</sup> ☐ >2000 km<sup>2</sup>

Level of your confidence in this estimated extent of occurrence:

- ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on
- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, data suggests this range of decline
- ☐ 95–100% -high level of certainty, data indicates a decline within this range
- ☐ 99–100% - very high level of certainty, data is accurate within this range

## **PART 2 – INFORMATION FOR CONSERVATION ADVICE ON THREATS AND CONSERVATION ACTIONS**

### **SECTION G DO YOU HAVE INFORMATION ON THREATS TO THE SURVIVAL OF THE SPECIES? (If no, skip to section H)**

- 20. Do you consider that all major threats have been identified and described adequately?
- 21. To what degree are the identified threats likely to impact on the species/subspecies in the future?
- 22. Are the threats impacting on different populations equally, or do the threats vary across different populations?
- 23. Can you provide additional or alternative information on past, current or potential threats that may adversely affect the species/subspecies at any stage of its life cycle?
- 24. Can you provide supporting data/justification or other information for your responses to these questions about threats?

### **SECTION H DO YOU HAVE INFORMATION ON CURRENT OR FUTURE MANAGEMENT FOR THE RECOVERY OF THE SPECIES? (If no, skip to section I)**

- 25. What planning, management and recovery actions are currently in place supporting protection and recovery of the species/subspecies? To what extent have they been effective?
- 26. Can you recommend any additional or alternative specific threat abatement or conservation actions that would aid the protection and recovery of the species/subspecies?
- 27. Would you recommend translocation (outside of the species' historic range) as a viable option as a conservation actions for this species/subspecies?

### **SECTION I DO YOU HAVE INFORMATION ON STAKEHOLDERS IN THE RECOVERY OF THE SPECIES?**

- 28. Are you aware of other knowledge (e.g. traditional ecological knowledge) or individuals/groups with knowledge that may help better understand population trends/fluctuations, or critical areas of habitat?
- 29. Are you aware of any cultural or social importance or use that the species has?

30. What individuals or organisations are currently, or potentially could be, involved in management and recovery of the species/subspecies?
31. How aware of this species are land managers where the species is found?
32. What level of awareness is there with individuals or organisations around the issues affecting the species/subspecies?
- a. Where there is awareness, what are these interests of these individuals/organisations?
  - b. Are there populations or areas of habitat that are particularly important to the community?

### **PART 3 – ANY OTHER INFORMATION**

33. Do you have comments on any other matters relevant to the assessment of this species?