Australian Government
Department of the Environment

Consultation Document on Listing Eligibility and Conservation Actions

Pseudomys shortridgei (heath mouse)

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

1) the eligibility of *Pseudomys shortridgei* (heath mouse) for inclusion on the EPBC Act threatened species list; 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.

This document contains draft information for your consideration of the eligibility of this species for listing and information associated with potential conservation actions for this species. To assist with the Committee's assessment, there are a series of specific questions which seeks your guidance.

Responses are to be provided in writing either by email to:
species.consultation@environment.gov.au

or by mail to:

The Director
Marine and Freshwater Species Conservation Section
Wildlife, Heritage and Marine Division
Department of the Environment
PO Box 787
Canberra ACT 2601

Responses are required to be submitted by 15 April 2016.

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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 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 available on the Department's website 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.

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.

Pseudomys shortridgei

Heath mouse

Note: The information contained in this conservation advice was primarily sourced from 'The Action Plan for Australian Mammals 2012' (Woinarski et al., 2014). Any substantive additions obtained during the consultation on the draft will be cited within the advice. Readers may note that conservation advices resulting from the Action Plan for Australian Mammals show minor differences in formatting relative to other conservation advices. These reflect the desire to efficiently prepare a large number of advices by adopting the presentation approach of the Action Plan for Australian Mammals, and do not reflect any difference in the evidence used to develop the recommendation.

Taxonomy

Conventionally accepted as *Pseudomys shortridgei* (Thomas 1907).

No subspecies are currently recognised. Cooper et al. (2003) reported that there is only limited genetic difference between extant subpopulations from south-eastern and south-western Australia. A subsequent study using microsatellite and mitochondrial DNA identified differences, and proposed that the species comprises two highly-divergent lineages either side of the Nullarbor Plain that should be defined as separate Evolutionary Significant Units (Salinas et al., 2009). However, no subspecies have been formally described.

Species/Subspecies Information

Description

The heath mouse (family Muridae) is a small rodent native to Australia and is one of the largest members of the genus *Pseudomys*. It grows to between 55 and 90 g in weight and 95–120 mm in head and body length. The tail is hairy, non-annulated and 85–100 mm in length, with a distinct bicoloured pattern of dark above and white below. The body is quite stocky and the head is relatively large, with a blunt face, bulging eyes and relatively large, rounded ears. The coat has long black guard hairs and brown underfur, giving it a brindled appearance. The underparts are pale grey or white and the upper surfaces of the feet are covered with long grey hairs. Juveniles have a more sleek appearance than adults (Meulman 1997; Menkhorst & Knight 2010).

Distribution

The heath mouse is endemic to Australia where sub-fossil records indicate it used to be widespread across the south-west of Western Australia and south-eastern Australia (Lee 1995; Cancilla & Johnson, 2006; Woinarski et al., 2014). In the south-west of Western Australia and South Australia, sub-fossils indicate the species was widespread from near Shark Bay to the southern edge of the Nullarbor Plain (Menkhorst et al., 2008); extending into South Australia including Eyre Peninsula (McDowell 1997; McDowell & Medlin 2010), Yorke Peninsula (McDowell et al., 2012) and near Adelaide (Cooper et al., 2003).

The species is now restricted to a small number of locations in Western Australia, South Australia and Victoria (Lee 1995; Menkhorst et al., 2008). The population trend of the heath mouse is decreasing (Menkhorst & Morris 2008). The first collection was near Pingelly in the Western Australian wheatbelt. Since 1987, it has been trapped in several localities in the southern parts of Western Australia: Reserve No. 31111, approximately 6 km north of Burngup, near Lake Biddy, Dragon Rocks Nature Reserve, Lake Magenta Nature Reserve, Fitzgerald River National Park and the Ravensthorpe Range area (Sanders et al., 2012).

In Victoria, the Heath Mouse occurs in the Grampians Range and 60 localities in that area, extending south to Lower Glenelg National Park and into south-eastern South Australia (Menkhorst et al., 2008; Le Duff et al., 2009).

One individual was found on Kangaroo Island in 1967. However, surveys in 1990 (Robinson & Armstrong, 1990) and in 2009 (Jones et al., 2010) did not locate the species, but it should be noted that the survey was not directed specifically towards this species (Menkhorst & Morris 2008). The status of the species on Kangaroo Island is unknown.

Relevant Biology/Ecology

Across its range the heath mouse frequently inhabits species-rich dry heathland, and open woodland and forest habitats with a heath understorey (Seebeck & Menkhorst 2000; Watson et al., 2003). In both the western and eastern subpopulations there appears to be a preference for a structurally complex heath (Cancilla & Johnson 2006).

In Western Australia, the heath mouse has been trapped mostly in species-rich heath but also in mixed scrub and mallee. The species has not been located in vegetation less than 10 years post-fire and it has been known to attain high densities in heath 30 years post-fire.

In Victoria, the heath mouse is most frequently found in species-rich dry heathland that has been burnt within the last 5−15 years, but it also occurs in dry brown stringybark (*Eucalyptus baxteri*) and *E. arenacea* open woodland and open forest with a heath understorey (Cockburn 1978; Meulman 1997). The species is able to exploit unproductive heathlands by colonising patches a few years after fire. However, where individuals occur in heathy woodland, they can inhabit much older vegetation, up to 25 years post-fire (Mitchell 2007; Di Stefano et al., 2011; Menkhorst et al., 2008).

Breeding takes place in late spring and summer. Adults form pairs that remain together for the four-month breeding season, producing one or two litters of three young. Longevity is unknown but is unlikely to exceed four years (Menkhorst et al., 2008), and may be less in the wild. Generation length is assumed to be approximately 2 years.

Threats

Threats to the heath mouse are outlined in the table below (Woinarski et al., 2014).

Threat factor	Consequence rating	Extent over which threat may operate	Evidence base
Habitat clearing from agriculture and industry	Severe-catastrophic	Moderate	There has been widespread clearing of heath mouse habitat across the species' range (Lee 1995; Watson et al., 2003; Menkhorst & Morris 2008). This clearing has resulted in extensive loss of habitat, as well as fragmentation and isolation of remaining habitat, thus limiting the potential for dispersal and genetic exchange. Habitat loss and fragmentation is a threat across a moderate extent of the species' range, and this has severe to catastrophic consequences as the species cannot occur outside natural bush and requires large areas of vegetation.
Habitat degradation by *Phytophthora*	Moderate	Moderate	*Phytophthora* may have a significant impact on the heath mouse as it is dependent upon species-rich and structurally complex heath communities, and most sites where the heath mouse occurs are dominated by

			plants susceptible to *Phytophthora* (Menkhorst 2012). Infection could potentially lead to changes in the composition of these important habitats. *Phytophthora* is a threat across a moderate extent of the species' range.
Increased fire frequency and intensity	Moderate	Entire	The heath mouse preferentially inhabits vegetation of certain post-fire ages (5−30 years). Less frequent burns can lead to large-scale bushfires that cause a loss of habitat used by the heath mouse and can result in extensive areas of vegetation of uniform post-fire age-class, thus providing limited areas for dispersal. Large-scale and frequent bushfires can result in increased predation by introduced species. Altered fire regimes are a threat across the entire extent of the species' range (Woinarski et al., 2014).
Predation by cats (*Felis catus*)	Moderate	Entire	It is likely that predation by cats is a current threat to the species across the entire extent of the species' range, however the extent of the threat is unknown (Lee 1995; Watson et al., 2003).
Predation by foxes (*Vulpes vulpes*)	Moderate	Large	It is likely that predation by foxes is a current threat to the species across a large extent of the species' range, however the extent of the threat is unknown (Lee 1995; Watson et al., 2003).

Assessment of available information in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers) Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered Very severe reduction	**Endangered Severe reduction**	**Vulnerable Substantial reduction**
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.	*based on any of the followin*	(a) direct observation [*except A3*]
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.		(b) an index of abundance appropriate to the taxon
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*]		(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
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.		(d) actual or potential levels of exploitation (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

There is evidence to indicate that the heath mouse population is continuing to decline in both Western Australia and Victoria.

In Western Australia, the species is currently known only from a few sites within the Lake Magenta Nature Reserve. There have been no other records of the species in Western Australia since 2008 (K.D. Morris pers. comm., cited in Woinarski et al., 2014). The Lake Magenta subpopulation was monitored during 2004−2009, and a steady decline in abundance and distribution was observed.

In Victoria, the heath mouse is considered common in limited habitat (Menkhorst & Morris 2008). However, Morris (2007) only trapped 13 individuals in woodland west of Casterton over 5000 trap nights targeting the species, despite the species being recorded as common in the 1970s). Hill (2005) surveyed 16 historic sites in the Wimmera but the species was not recorded.

Woinarski et al. (2014) consider that the reduction in population size for the species is likely to be less than 30 percent over a ten year period.

The data presented above appear to demonstrate that the species is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' 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 2. Geographic distribution as indicators for either extent of occurrence AND/OR 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 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 is estimated at 337 570 km^2, and the area of occupancy estimated at 328 km^2. These figures are based on the mapping of point records from 1996 to 2016, obtained from state governments, museums and CSIRO. The extent of occurrence was calculated using a minimum convex hull, and the area of occupancy calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines 2014 (DotE 2015).

There is evidence of continuing decline. However, the distribution of the species is fragmented, but not severely fragmented, and the species is likely to be present at more than ten locations (Woinarski et al., 2014). Heath mouse numbers fluctuate with rainfall and time since fire, but there is no information to suggest there have been extreme fluctuations in the species distribution or abundance.

The data presented above appear to demonstrate that the species is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' 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**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

There are no robust estimates of population size. Monitoring at Lake Magenta Nature Reserve (Menkhorst & Morris 2008) determined that the subpopulation had approximately 4000 individuals. In Victoria it is considered very rare in terms of abundance and distribution (Vic DSE 2003). Woinarski et al. (2014) infer that the total population size is likely to be greater than 10 000 mature individuals.

Monitoring conducted in Western Australia (Menkhorst and Morris 2008) and in Victoria (Hill 2005; Morris 2007) indicate that the species is continuing to decline.

There is no information to suggest there have been extreme fluctuations in the number of mature individuals, but it is noted that there is no national monitoring program to elicit such information.

The data presented above appear to be insufficient 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 species' 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**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Woinarski et al. (2014) consider that the population size of the heath mouse is likely to be greater than 10 000 mature individuals (see Criterion 3).

The data presented above appear to demonstrate that the species is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' 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:

No population viability analysis has 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 species' 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.

Consideration for delisting

The heath mouse is currently listed as Vulnerable under the EPBC Act under Criterion 3. The assessment presented in this consultation document suggests the species may no longer be eligible to be listed under the EPBC Act as it may not satisfy the listing criteria in any category.

However, there is evidence that the species is continuing to decline in abundance, extent of occurrence and area of occupancy. A robust estimate of population size is unavailable, and it is possible that the species may meet Criterion 3. Given the uncertainty in the assessment and the population trajectory, there appears to be insufficient evidence to demonstrate that the heath mouse is no longer eligible to be listed as Vulnerable under the EPBC Act.

Inclusion of the heath mouse in the Vulnerable category is likely to be contributing to its survival, as the EPBC Act requires proponents to refer a proposed action for assessment if the action

may have a significant impact on a listed species. Where necessary, the Department issues conditions requiring proponents to avoid, minimise or mitigate impacts on the species.

The heath mouse is listed as Vulnerable under the Western Australian *Wildlife Conservation Act 1950*, Threatened in Victoria under the *Flora and Fauna Guarantee Act 1988*, and Endangered in South Australia under the *National Parks and Wildlife Act 1972*. If delisted, the species will still be covered under state legislation.

Conservation Actions

Recovery Plan

A decision about whether there should be a recovery plan for this species has not yet been determined. The purpose of this consultation document is to elicit additional information to help inform this decision.

Primary Conservation Objectives

1. Clarify the causes of the recent decline in Western Australia
2. Maintain current range and relative abundance in Victoria

Conservation and Management Priorities

There is no national recovery plan or monitoring program currently in place for the species. Much of its current distribution is within conservation reserves, in which some threats are managed by state agencies. In Victoria, there is an Action Statement that provides recommended management actions (Vic DSE 2003). A captive breeding program was established in Victoria between 1993 and 1996, with individuals used for translocation attempts (Vic DSE 2003).

Recommended conservation and management actions are outlined in the table below (Woinarski et al., 2014).

Theme	Specific actions	Priority
Active mitigation of threats	Apply appropriate fire regimes to conservation estates containing heath mouse	Medium-high
	Manage cats at and around important subpopulations	Medium
	Restore habitat connectivity to subpopulations in habitat fragments	Low-medium
Captive breeding	Reintroductions may be required for Dirk Hartog Island (after 2018)	Low
Quarantining isolated populations	N/a	
Translocation	Reintroduce to Dirk Hartog Island after feral cats have been eradicated	Medium
Monitoring	Monitor selected subpopulations	Medium
Community engagement	Implement community awareness in Shark Bay concerning translocation proposal and feral cat eradication	Low

Survey and Monitoring priorities

Theme	Specific actions	Priority

Survey to better define distribution	An additional survey to establish the species' current status is required, especially in Western Australia, but also in Victoria and Kangaroo Island	Medium
	Estimate size of subpopulations	Medium

Information and Research priorities

Theme	Specific actions	Priority
Assess impacts of threats on species	Assess population-level impact of predation by cats	Medium
	Assess population-level impact of predation by foxes	Medium
	Assess responses to a range of fire regimes, and identify an optimal regime	Medium
Establish or enhance monitoring program	Develop an integrated monitoring program, linked to the measurement of management effectiveness	Medium
Assess effectiveness of threat mitigation options	Assess responses to fire management	Medium
Resolve taxonomic uncertainties	N/a	
Assess habitat requirements	N/a	
Assess diet, life history	N/a	
Undertake research to develop new or enhance existing management mechanisms	Develop broad-scale, targeted feral cat eradication methods	Medium

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Consultation questions

1. Can you provide any additional or alternative references, information or estimates on longevity, average life span and generation length?

2. Can you provide any information regarding the general requirements for recruitment?

3. Has the survey effort for this species been adequate to determine its national adult population size?

4. Do you accept the estimate provided of the total population size of the species?

5. Can you provide any additional data on the extent of decline in the species' total population size over the last approximately 10 years (i.e. three generations)?

6. Does the information consider the entire geographic extent and national extent of the species?

7. Has the survey effort for this species been adequate to determine its national distribution?

8. Is the distribution as described valid? If not, can you please provide an estimate or additional information on the current geographic distribution?

9. Do you agree that the way the current extent of occurrence and/or area of occupancy have been estimated is appropriate?

10. Do you agree that the threats listed are correct and that their effect on the species is significant?

11. To what degree are the identified threats likely to impact on the species in the future?

12. What threats are impacting on different subpopulations, how variable are the threats and what is the relative importance of the different subpopulations?

13. What planning, management and recovery actions are currently in place supporting protection and recovery of the species? To what extent have they been effective?

14. What individuals or organisations are currently, or potentially could be, involved in management and recovery of the species?

15. Can you provide additional data or information relevant to this assessment?