



Consultation Document on Listing Eligibility and Conservation Actions

Crocidura trichura (Christmas Island shrew)

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

- 1) the eligibility of *Crocidura trichura* (Christmas Island shrew) for inclusion 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.

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 March 2017.

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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>.

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.

Crocidura trichura

Christmas Island shrew

Taxonomy

Conventionally accepted as *Crocidura trichura* (Dobson, 1888).

The Christmas Island shrew is the only member of the shrew family (*Soricidae*) recorded in an Australian territory. Its taxonomic status has been contested. It has mostly been considered a (Christmas Island endemic) subspecies of the far more widespread *C. attenuata* (Indo-chinese Shrew, Long-tailed Shrew or Asian Grey Shrew), although it was originally described as a subspecies of the White-toothed Shrew *C. fuliginosa*. More recent genetic studies demonstrate that it is closer to *C. orientalis*, but that it should be treated as specifically distinct (Eldridge et al., 2009, 2014). No subspecies are recognised.

Species/Subspecies Information

Description

The Christmas Island shrew is a small insectivorous mammal that varies from light-brown or reddish-brown to dark-slate grey in colouration, and weighs 4.5–6 g (Schulz 2004). All members of the *Crocidura* genus are small, with a head and body length of 40–180 mm and tail length of 40–110 mm, and a distinctly pointed muzzle (Schulz 2004).

Distribution

The Christmas Island shrew is endemic to Christmas Island. The area of the island is 135 km², of which approximately 30 km² has been cleared and mined for phosphate. At the time of European settlement the species was widespread on Christmas Island, occurring in rainforest on both the plateau and on terraces adjacent to the shoreline, and was described as being 'very abundant' or 'extremely common' (Lister 1888; Andrews 1900). It declined rapidly following settlement, and was feared extinct by 1908, but rediscovered in 1958. Its current distribution on the island is unknown; the last two individuals were captured in 1984 and 1985 (Woinarski et al., 2014).

Relevant Biology/Ecology

Little is known of the ecology of the Christmas Island shrew. At the time of settlement it occurred widely in rainforest (Lister 1888; Andrews 1900), but it was not recorded whether the shrew occurred within other forest communities, or whether karst terrain (e.g. caves, rock crevices, cliffs) was important to the species.

The most recent records are of single individuals from tall plateau rainforest in deep soils (Tranter pers. comm., cited in Schulz 2004) and terrace rainforest with shallow soils (Goh pers. comm., cited in Schulz 2004), with one recorded from a fallen bird's nest fern (Meek 2000). The majority of remaining primary plateau and terrace rainforest, including the locations of the 1984 and 1985 sightings, is now protected within the Christmas Island National Park. It is unknown whether the shrew occurs in post-mined secondary regrowth, and there are no records from areas of human habitation on the island.

The Christmas Island shrew was recorded to shelter in holes in rocks and the roots of trees, and foraged predominantly on small beetles (Andrews 1900). Other *Crocidura* species either dig their own burrows in loose soil or leaf mould, frequently under fallen trees and rocks, or use the burrows of other animals (Nowak 1999). An important component of habitat occupied by some *Crocidura* shrews is the presence of a high degree of ground cover with associated deep leaf litter and moister soils (Dickman 1995). These preferences are linked to increased prey availability and predator avoidance, but may also facilitate burrow construction (Dickman 1988,

1995). It is not known whether the Christmas Island shrew favours these microhabitats within the rainforest.

For other *Crocidura* species, age at sexual maturity is about three months and longevity up to three years (Jones et al., 2009). Generation length for the Christmas Island shrew is assumed to be two years (Woinarski et al., 2014).

Threats

It is feasible that the factor that caused the initial (1900s–1910) population collapse of the Christmas Island shrew is no longer operating, or is no longer the major threat to the remaining population. However, other severe potential threats remain (Table 1).

Table 1 – Threats impacting the Christmas Island shrew, based on available evidence. Threats are not listed in order of severity of risk, due to insufficient information to assess their relative severity

Threat factor	Threat type and status	Evidence base
Disease		
<i>Trypanosomes</i> spread via the introduction of black rats (<i>Rattus rattus</i>)	known past and potential current	Likely cause of the contemporaneous extinction of the Christmas Island endemic <i>Rattus</i> species (Wyatt et al., 2008) and plausible cause of the rapid decline of the Christmas Island shrew.
Predation		
Predation by feral cats (<i>Felis catus</i>)	suspected past and current	No direct evidence, but feral cats are common and widespread on Christmas Island and are known to cause declines and extinctions in small mammals generally.
Predation by introduced black rats	suspected past and current	No direct evidence, but black rats are common and widespread on Christmas Island, and have been associated with small vertebrate extinctions on other islands.
Reverberative impacts of extinctions of other native species	potential past and current	The rapid extinction of two endemic Christmas Island rodents – Maclear’s rat (<i>Rattus macleari</i>) and bulldog rat (<i>Rattus nativitatis</i>) – may have allowed for a major increase in the abundance of some terrestrial crab species (e.g. red crabs (<i>Gecarcoidea natalis</i>)), that have subsequently increased predation pressure on the shrew.
Predation by yellow crazy ants (<i>Anoplolepis gracilipes</i>)	suspected past and current	In supercolonies, yellow crazy ants will consume (or simply kill) small vertebrates. Before extensive control efforts began, supercolonies extended over 5–25% of the island.
Habitat loss and degradation		
Clearing of habitat	potential past and current	About a third of the rainforest has been cleared for phosphate mining. Any proposals to clear primary rainforest outside Christmas Island National Park may apply additional pressure on any remaining shrew populations (Schulz 2004).
Impacts of yellow crazy	suspected past and	Supercolonies of crazy ants lead to extensive changes in understorey characteristics, and some mortality of canopy

ant supercolonies	current	trees. It is not clear whether this disadvantages shrews, but it is likely that breeding, shelter and foraging sites would be severely affected.
Loss of food sources	suspected current	Large quantities of fipronil have been used to control crazy ants. Neonicotinoids and fipronil (which acts in the same manner and has a similar toxicity and persistence profile to neonicotinoids: Grant et al., 1998) exhibit very high toxicity to a wide range of invertebrates, particularly insects (Pisa et al., 2015).
Poisoning		
Indirect poisoning by fipronil	suspected current	Insectivorous species may be susceptible to secondary poisoning. Neonicotinoids and fipromil have been found to be toxic to many birds and most fish (Gibbons et al., 2015).
Small population size		
Increased risk of inbreeding depression and stochastic events	suspected current	Small population size increases the risk of extinction through inbreeding depression and stochastic events (Caughley & Sinclair 1994).

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%
<p>A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</p> <p>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.</p> <p>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]</p> <p>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.</p>	<p>(a) direct observation [except A3]</p> <p>(b) an index of abundance appropriate to the taxon</p> <p>(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat</p> <p>(d) actual or potential levels of exploitation</p> <p>(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</p> <p><i>based on any of the following</i></p>		

Evidence:

Notwithstanding a range of approaches, including analysis of stomach contents of hundreds of feral Cats (Tidemann et al., 1994), trapping, hair-tubing, Anabat recording and pitfall trapping (Meek, 2000), very extensive active searches (including scraping litter and log-rolling) (James, 2006), and recently including remote cameras and ink pads, no survey method has been successful in detecting this species in recent decades.

The data presented above appear to demonstrate 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 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
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:

Based on suitable habitat on Christmas Island, the extent of occurrence is estimated at around 100 km² and possibly less. From the 1984 and 1985 records, the area of occupancy is estimated at anywhere from <10 km² to around 50 km². The estimates for EOO and AOO both meet the threshold for listing as Endangered.

The species exists at a single location, Christmas Island, which satisfies condition (a). A continuing decline in the area of occupancy, habitat quality and number of mature individuals is inferred (Woinarski et al., 2014), which satisfies condition (b)(ii,iii,v).

The data presented above appear to demonstrate that the species is **eligible for listing as Endangered** 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:

At the time of settlement of Christmas Island, the shrew was reported to be very common: ‘this little animal is extremely common all over the island, and at night its shrill squeak, like the cry of a bat, can be heard on all sides’ (Andrews 1900). Within the next few years, it declined suddenly (coinciding with the extinction of the two endemic *Rattus* species) and was not reported again until two were found in 1958 (Meek 1997). Subsequently, two were found on separate occasions in the 1985 (Schulz 2004). If still extant, it is likely to be extremely rare with a very low population size.

A continuing decline in the number of mature individuals is inferred, and a single subpopulation is assumed (Woinarski et al., 2014), which satisfies Criterion C2(a)(ii).

The data presented above appear to demonstrate that the species is **eligible for listing as Critically Endangered** 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:

No records of the species have been found since 1985. If still extant, the species is likely to be extremely rare with no more than 250 mature individuals.

The data presented above appear to demonstrate that the species is **eligible for listing as Endangered** 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:

Population viability analysis 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 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.

Conservation Actions

Recovery Plan

There is an existing *National Recovery Plan for the Christmas Island Shrew* (*Crocidura attenuata trichura*) (Schulz 2004), which is due to expire in 2017. Given that the Christmas Island shrew has not been sighted since 1985 and there is no known population or location on which to carry out recovery actions, a renewed recovery plan will not add significant conservation benefits for the species above an approved Conservation Advice.

Conservation and Management priorities

Disease

- Ensure tight quarantine controls to prevent the accidental introduction of new diseases and exotic pests to Christmas Island.

Invasive species and predation

- Control the abundance and spread of yellow crazy ants.
- Control the abundance of feral cats and black rats within primary plateau and terrace rainforest.

Habitat loss and degradation

- Until further information is obtained, all areas of primary plateau and terrace rainforest on the island should be considered as potential habitat critical to survival of the species.
- Ensure that any removal of primary plateau and terrace rainforest outside the Christmas Island National Park does not occur without intensive targeted surveys for the shrew, undertaken in accordance with the 'Survey guidelines for Australia's threatened mammals' (DSEWPaC 2011).
- If any populations are located in an area, protect the area by allowing no further habitat loss within at least 1 km of the outer limits of the population.
- Minimise the spread of exotic weeds in potential habitat.
- Undertake measures to minimise wildfires within potential habitat.

Breeding and other ex situ recovery actions

- If any populations are located, establish a captive breeding program (preferably on Christmas Island).

Stakeholder Engagement

- Implement a community awareness program to increase the probability of recording the species – including developing and disseminating an information brochure to assist with identifying the species, and confirmation of reported sighting by qualified experts.
- If any populations are located outside the National Park, prepare a management strategy for the shrew with input from local experts, relevant interest groups, landowners and managers.

Survey and Monitoring priorities

- Undertake targeted surveys (should a method of detection be developed) in potential habitat to determine the current status and distribution of the shrew, and whether it is still extant.
- Develop and implement an effective methodology for detection, taking crab interference into consideration.
- If any populations are located:
 - Design and implement a population monitoring program.
 - Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.

Information and research priorities

- If any populations are located:
 - Identify habitat critical to survival, including habitat requirements for foraging, breeding and shelter.
 - Assess the usage of regrowth areas, sites infested by crazy ants and weeds, and the importance of edge effects.
 - Identify current threatening processes and their relative impact on populations.
 - Identify key dietary requirements and life history characteristics.

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Consultation questions

1. Do you agree with the current taxonomic position of the Australian Faunal Directory for this taxon (as identified in the draft conservation advice)?
2. Can you provide any additional references, information or estimates on longevity, age of maturity, average life span and generation length?
3. Has the survey effort for this taxon been adequate to determine its national distribution and adult population size?
4. Do you accept the estimate provided in the nomination for the current population size of the taxon?
5. For any population with which you are familiar, do you agree with the population estimate provided? If not, are you able to provide a plausible estimate based on your own knowledge? If so, please provide in the form:
 - Lower bound (estimated minimum):
 - Upper bound (estimated maximum):
 - Best Estimate:
 - Estimated level of Confidence: %
6. Can you provide any additional data, not contained in the current nomination, on declines in population numbers over the past or next 10 years or 3 generations, whichever is the longer?
7. Is the distribution as described in the nomination valid? Can you provide an estimate of the current geographic distribution (extent of occurrence or area of occupancy in km²) of this taxon?
8. Has this geographic distribution declined and if so by how much and over what period of time?
9. Do you agree that the taxon is eligible for inclusion on the threatened species list, in the category listed in the nomination?
10. Do you agree that the threats listed are correct and that their effects on the taxon are significant?
11. To what degree are the identified threats likely to impact on the taxon in the future?
12. Can you provide additional or alternative information on threats, past, current or potential that may adversely affect this taxon at any stage of its life cycle?
13. In seeking to facilitate the recovery of this taxon, can you provide management advice for the following:
 - What individuals or organisations are currently, or need to be, involved in planning to abate threats and any other relevant planning issues?
 - What threats are impacting on different populations, how variable are the threats and what is the relative importance of the different populations?
 - What recovery actions are currently in place, and can you suggest other actions that would help recover the taxon? Please provide evidence and background information.
14. Can you provide additional data or information relevant to this assessment?
15. Can you advise as to whether this species is of cultural significance to Indigenous Australians?