Australian Government
Department of Agriculture, Water and the Environment

Consultation on Species Listing Eligibility and Conservation Actions

Potorous tridactylus trisulcatus
(Southern Long-nosed Potoroo)

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

1) the eligibility of *Potorous tridactylus trisulcatus* (Southern Long-nosed Potoroo) for inclusion on the EPBC Act threatened species list in the Vulnerable category; and

2) the necessary conservation actions for the above species.

The purpose of this consultation document is to elicit additional information to better understand the status of the species and help inform on conservation actions and further planning. As such, the below draft assessment should be considered to be **tentative** as it may change following responses to this consultation process.

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 by email to: species.consultation@environment.gov.au. Please include species scientific name in Subject field.

or by mail to:

The Director
Bushfire Affected Species Assessments Section
Department of Agriculture, Water and the Environment
John Gorton Building, King Edward Terrace
GPO Box 858
Canberra ACT 2601

Responses are required to be submitted by 18 May 2021.

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/system/files/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2018.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' (CAM). 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: https://www.awe.gov.au/about/commitment/privacy .

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.

CONSULTATION QUESTIONS FOR POTOROUS TRIDACTYLUS TRISULCATUS (SOUTHERN LONG-NOSED POTOROO)

SECTION A - GENERAL

1. Is the information used to assess the nationally (New South Wales and Victoria) threatened status of the subspecies 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 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. Are you aware of any genetic data not presented in this draft CA, specifically with regards to subspecies boundaries (particularly those on Bass Strait islands), effective population sizes, subpopulation boundaries and gene flow between populations.

6. Do you have any additional information on the ecology or biology of the subspecies not in the current advice?

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

Population size (N.B. there is no total population size estimate for this subspecies in the Conservation advice)

7. To your knowledge have there been estimates of adult population or subpopulation size?

8. Do you consider the estimates of current subpopulation size (<100) to be representative of most other subpopulations?

9. Can you provide an estimate of the current population size of mature adults of the subspecies (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:

   ☐ <10 000 ☐ 10 000 – 20 000 ☐ 20 000 – 30 000 ☐30 000 – 40 000 ☐ >40 000

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)

10. 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

11. Are you able to provide an estimate of the total population size in 2010 *(at or soon after the start of the most recent 10 year 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:

    ☐ <10 000 ☐ 10 000 – 20 000 ☐ 20 000 – 30 000 ☐30 000 – 40 000 ☐ >40 000

    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

12. Are you able to comment on the extent of decline in the species' total population size over the last approximately 10 years? 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

13. 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

14. Can you confirm that the listed subpopulations in the conservation advice are true subpopulations in the sense that they are geographically or genetically distinct groups with little demographic or genetic exchange of less than one migrant per year?

15. Can you provide presence/absence or abundance trend data for any of the subpopulations of this species?

16. Does the assessment consider the entire geographic extent and national extent of the subspecies? Or is the current geographic extent smaller than that presented? Please provide justification for your response.

17. Has the survey effort for this subspecies been adequate to determine its national distribution? If not, please provide justification for your response.

18. Is the distribution described in the assessment accurate? If not, please provide justification for your response and provide alternate information.

19. Are you aware of any subpopulations that are no longer extant?

20. 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.

21. 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^2 ☐ 100 – 5 000 km^2 ☐ 5 001 – 20 000 km^2 ☐ >20 000 km^2

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^2 ☐ 11 – 500 km^2 ☐ 501 – 2000 km^2 ☐ >2000 km^2

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

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

23. 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^2 ☐ 100 – 5 000 km^2 ☐ 5 001 – 20 000 km^2 ☐ >20 000 km^2

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^2 ☐ 11 – 500 km^2 ☐ 501 – 2000 km^2 ☐ >2000 km^2

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)

24. Do you consider that all major threats have been identified and described adequately?

25. To what degree are the identified threats likely to impact on the subspecies in the future?

26. Are the threats impacting on different populations equally, or do the threats vary across different subpopulations?

27. Can you provide additional or alternative information on past, current or potential threats that may adversely affect the subspecies at any stage of its life cycle?

28. Can you provide additional information on the historical loss of suitable habitat and the causes (e.g. specific types of land use change)?

29. 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)

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

31. Can you recommend any additional or alternative specific threat abatement or conservation actions that would aid the protection and recovery of the species?

32. Would you recommend translocation (outside of the species' historic range) as a viable option as a conservation actions for this species?

33. Under the Information and Research Priorities section – can you identify the top five research priorities for action, providing some justification for your selection.

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

34. 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?

35. Are you aware of any cultural or social importance or use that the subspecies has?

36. Are there any sub-populations of subspecies that are co-managed by First Nations Peoples which are not currently recognised in the Cultural and Community Significance section of the Draft Conservation Advice.

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

38. How aware of this subspecies are land managers where the subspecies is found?

39. What level of awareness is there with individuals or organisations around the issues affecting the 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

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

Consultation Document on Listing Eligibility and Conservation Advice for *Potorous tridactylus trisulcatus* (Southern Long-nosed Potoroo)

This document combines the approved conservation advice and listing assessment for the species. It provides a foundation for conservation action and further planning.

Potorous tridactylus trisulcatus from Potoroo Palace, Merimbula, NSW © Copyright, Leo Berzins (Left)
A camera trap image of *Potorous tridactylus trisulcatus* from a night-time survey in Victoria © Copyright, Department of Environment, Land, Water and Planning, Victorian Government (right).

Conservation status

Potorous tridactylus trisulcatus (Southern Long-nosed Potoroo) is not currently listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwth) (EPBC Act).

Potorous tridactylus trisulcatus (Southern Long-nosed Potoroo) was assessed by the Threatened Species Scientific Committee to be eligible for listing as Vulnerable under criteria 1 and 2. The Committee's assessment is at Attachment A. The Committee's assessment of the species' eligibility against each of the listing criteria is:

- Criterion 1: A4ce: Vulnerable
- Criterion 2: B2ab(ii,iii,iv,v): Vulnerable
- Criterion 3: Not Eligible
- Criterion 4: Not Eligible
- Criterion 5: Insufficient data to determine eligibility

The main factors that make the species eligible for listing in the Vulnerable category are the predicted decline of 33 percent but as high as 56 percent (80 percent confidence interval) in the next three generations as a result of the 2019-2020 bushfires, compounding existing threats from habitat degradation and predation by European red fox (*Vulpes vulpes*) and cats (*Felis catus*) both feral and domestic. The species requires habitat that has been unburnt for a long

period (>20 years). The species is unlikely to recover to pre-fire population abundance before the next major bushfire event impacting a significant proportion of the species' range.

Species can also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see the Species Profile and Threat Database.

Species information

Taxonomy

Conventionally accepted as *Potorous tridactylus trisulcatus* (Frankham et al. 2012), though previously recognised as *Hypsiprymnus trisulcatus* McCoy, F (1865).

Potorous tridactylus (Kerr, 1792) has three subspecies (*Potorous tridactylus tridactylus*; *Potorous tridactylus trisulcatus* and *Potorous tridactylus apicalis*). *Potorous tridactylus apicalis* occurs in Tasmania and Bass Strait islands (Frankham et al. 2020), and the two mainland subspecies, *Potorous tridactylus tridactylus and Potorous tridactylus trisulcatus* occur on the south-eastern mainland of Australia.

A taxonomic division of *Potorous tridactylus* into northern and southern mainland subspecies occurs north and south of the Sydney Basin (approximately 33 degrees south) and is robustly supported by three mitochondrial and four nuclear genetic markers (Department of the Environment and Energy 2010; Frankham et al. 2012; Frankham et al. 2016; ABRS 2020).

In this document, *Potorous tridactylus trisulcatus* will be referred to as the Southern Long-nosed Potoroo, *Potorous tridactylus tridactylus* as the Northern Long-nosed Potoroo and *Potorous tridactylus apicalis* as the Tasmanian Long-nosed Potoroo. Where general observations are made that are thought to apply to all subspecies, the species will simply be referred to as the Long-nosed Potoroo.

Description

The Long-nosed Potoroo is a compact, medium-sized marsupial with a maximum body and head length of 31–34 cm, a tail length of 23 cm and a weight range of 660–1640 g (Johnston 2008). The species name '*tridactylus*' translates to three-toed, although the Long-nosed Potoroo technically has five toes (the second and third digits are conjoined). The hind limbs are 85–88 cm long and well developed, enabling the animals to hop at great speeds. Their forearms are shorter and muscular with short, strong claws, well adapted to digging. The species has small rounded ears, large eyes and, as its name suggests, a long muzzle with a bare tip. The body has two fur layers, a soft, short dark grey fur on the back with coarser hair protruding from it and which can range in colour from yellow-white to brown with a black tip. The underside of the animal is covered in coarse white fur, with a grey base layer. Females have a well-developed pouch that opens anteriorly and contains four mammae (Johnston 2008).

Johnston and Sharman (1976) report a longitudinal gradient in body size in the Tasmanian Long-nosed Potoroo, where smaller animals were observed in the wetter north-west and larger animals in the drier north-east of the island. No such cline was found in either the Northern or Southern Long-nosed Potoroo (on the mainland).

The Southern Long-nosed Potoroo has a smaller average body size than the Northern Long-nosed Potoroo and typically weighs under one kilogram (where the Northern subspecies is heavier than one kilogram) (Norton et al. 2010; Frankham et al. 2011). The Southern Long-nosed Potoroo also has a longer and thinner muzzle in comparison with the Northern subspecies. A white tip to the tail is seen more often in southern subpopulations (Johnston & Sharman 1976).

Distribution

The Southern Long-nosed Potoroo has a broad and fragmented distribution. It occurs between the Great Dividing Range, generally up to 800 m above sea level, and the coastal plains. The species is restricted to habitats receiving an annual rainfall greater than 760 mm (Seebeck 1981; Johnston 2008).

The most northern records of occurrence are at Barren Grounds Nature Reserve and Budderoo National Park in New South Wales (Norton et al. 2010; NSW Office of Environment and Heritage 2016). The subspecies occurs in isolated habitat patches along the coastal plains of southern New South Wales and Victoria and inland to the slopes and foothills of the Great Dividing Range. One island population exists at French Island in Western Port Bay, Victoria.

Historical distribution

Historically, subpopulations of Long-nosed Potoroos were abundant (Lunney & Leary 1988) and much more widespread than now (Johnston 2008). Between 1882 and 1920, Pasture Protection Boards paid bounties for small-mammal pelts from any native animal deemed noxious, which included all “kangaroo rats” (Bettongs and Potoroos) (Short 1998). Bounty payment records suggest potoroid species were broadly distributed across New South Wales on the slopes and tablelands between 1908–1910 though the records demonstrate a species range contraction over time, as by 1918, potoroid pelts were only taken in the far north of New South Wales (Short 1998).

Both fossil evidence (Seebeck 1981; Johnston 2008) and genetic analysis (Frankham et al. 2016) support the hypothesis that populations of both Northern and Southern Long-nosed Potoroos were formerly more abundant and widespread and experienced a higher level of subpopulation connectivity than is the case today. Frankham et al. (2016) found Southern Long-nosed Potoroos had a history of broadscale connectivity, though contemporary populations experienced reduced gene flow, most likely due to anthropogenic processes (e.g. habitat loss and fragmentation). Genetic structure analysis of Southern Long-nosed Potoroo placed them into seven groups (Barren grounds and Buderoo in New South Wales; East Gippsland, Lake Tyers, Wilson’s Promontory, French island, Naringal and Mount Clay State Forest and west to the South Australian border). Admixture between those groups was only detected between two locations on French Island, which were less than eight kilometres apart and geographically connected by large areas of native habitat. Seebeck (1981) proposed a similar grouping of six distinct regions in Victoria: East Gippsland, Wilson’s Promontory, Westernport (French Island), Otway Ranges, the Grampians and the lower Glenelg Conservation Park (where the subpopulation extends just over the border into South Australia).

Sites

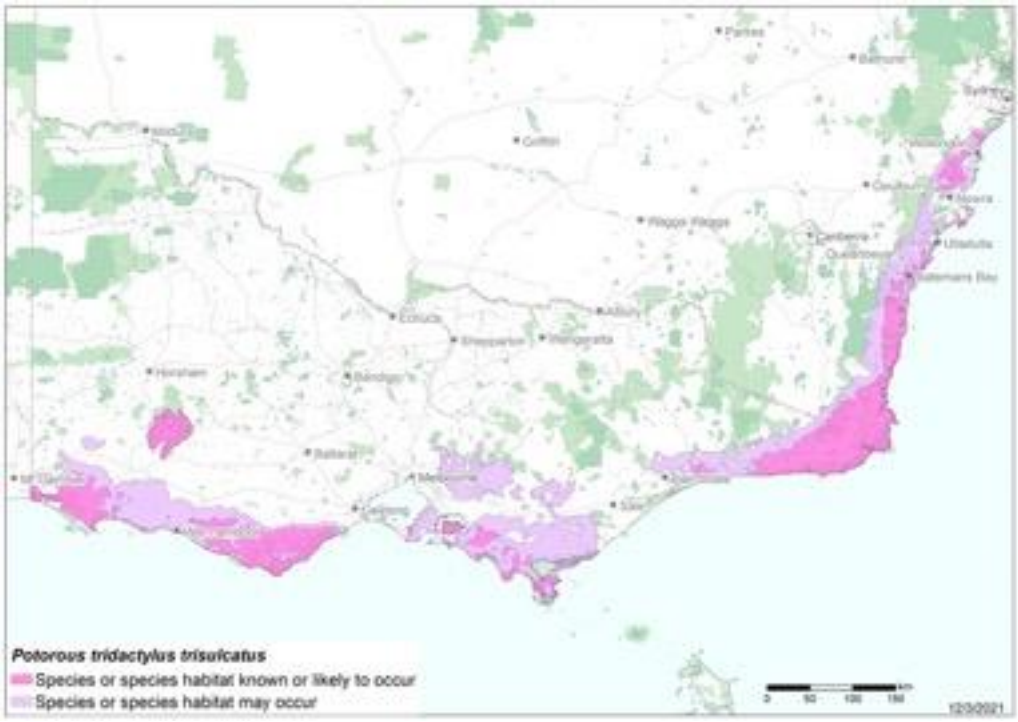
Ten areas were identified via consultation, literature and records available via the Victorian Biodiversity Atlas (VBA) (Victoria State Government 2021) and BioNET (NSW State Government 2021) as areas of importance for Southern Long-nosed Potoroos (Table 1).

Table 1. Southern Long-nosed Potoroo areas where positive sightings have been made in the past 20 years and counts and subpopulation estimates (where available).

Area	Total number reported observations (2000–2020)*	Subpopulation abundance**	Reference for subpopulation estimate
New South Wales			
Southern Highlands	NA	120 adults (2004–2008)	(Norton 2009)
South East Forests (esp. Nadgee Nature Reserve)	NA	Not estimated	
Victoria			
East Gippsland	691	Not estimated	
Grampians Bioregion	10	Not estimated	
Wilson's Promontory	42	Not estimated	
French Island	1	25 (2005–2009)	(Frankham 2011)
Central Highlands		Not estimated	(Department of Environment and Primary Industries 2013)
Otway Ranges	107	181 adults (at Naringal in 1987) 23 adults (at Naringal in 1997) 30 (± 12) individuals (at Mount Rothwell in 2005)	(Bennett 1987; Long 2001; Poole 2005)
Grampians Bioregion	10	Not estimated	
South-west Victoria	1406	Not estimated	

*NB that this data is an indication of effort, the number of times a positive sighting has been recorded from a survey and thus, it is not an indication of population size (Victoria State Government 2021).
**Published studies where effort has been taken to record the population size or the number of individuals caught during the study.

Map 1 Modelled distribution of Southern Long-nosed Potoroo



Source: Base map Geoscience Australia; species distribution data Species of National Environmental Significance database.
Caveat: The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything containing herein.
Species distribution mapping: The species distribution mapping categories are indicative only and aim to capture (a) the specific habitat type or geographic feature that represents to recent observed locations of the species (known to occur) or preferred habitat occurring in close proximity to these locations (likely to occur); and (b) the broad environmental envelope or geographic region that encompasses all areas that could provide habitat for the species (may occur). These presence categories are created using an extensive database of species observations records, national and regional-scale environmental data, environmental modelling techniques and documented scientific research.

Cultural and community significance

The Long-nosed Potoroo has a broad distribution and occurs across many different traditional lands. The species possibly was a form of sustenance and would have had very different spiritual, cultural and dreaming relevance to the many Aboriginal groups who share country with the species. Indigenous rock art communicates stories about how Aboriginal people connect and relate to country, landscapes and ancestors. The Long-nosed Potoroo is featured in rock art in Wollemi National Park (New South Wales) in a way that suggests that it occurred locally and was important to local peoples (Taçon et al. 2010).

Relevant biology and ecology

Reproductive ecology and life history

Long-nosed Potoroos become sexually mature at one year of age, producing a single pouch young that remains with the mother for four months (Johnston 2008). Mature adults will have between two and three offspring per year (Seebeck et al. 1989; Woinarski et al. 2014). They may be reproductive throughout the year but more frequently in the breeding seasons (late winter to early spring and late summer) (Johnston 2008). The species has a promiscuous genetic mating system, though with some repeat paternity (Frankham et al. 2012). Although males are larger

than females (Norton et al. 2010), size of the male does not play a role in successful mating, so direct mating competition is unlikely in this species (Johnston 2008). Long-nosed Potoroo lives up to seven years in the wild and can survive up to 12 years in captivity (Johnston 2008).

Diet

All subspecies of Long-nosed Potoroos are omnivorous, feeding on fruits, seeds, leaves, roots and flowers, and invertebrates (Bennett & Baxter 1989). The most significant food source (contributing between 30–90 percent of the diet) is sporocarps of hypogeal fungi (i.e. fruit bodies of underground fungi) (Claridge et al. 1993; Claridge & Cork 1994). Long-nosed Potoroos are nocturnal feeders, locate the underground fungi by smell and dig them up with their sharp front claws, leaving characteristic diggings in the soil (Martin & Temple-Smith 2012).

Long-nosed Potoroos are intricately linked to forest ecology through the food web, as their physical disturbance of the soil helps to improve aeration (Frankham et al. 2011), and the consumption of the underground fungi helps to disperse the fungal spores (Claridge 1993). Claridge (1993) examined faecal pellets of Southern Long-nosed Potoroos and found the spores of 58 different species of fungus, most of which were mycorrhizal (Claridge et al. 1993). Mycorrhizae are symbiotic fungi that form relationships with plants. The fungi colonise the root system and provide increased water and nutrients from the soil in return for carbohydrates from the plant (Malajczuk et al. 1987; Claridge et al. 1992; Claridge et al. 1993; Johnson 1995).

The complex ecological relationship between Long-nosed Potoroos and forest health is interrelated with fire. In Tasmania, Johnson (1995) found that fire triggered a short term increase in fungal fruiting body production (for four months) which increased feeding by another potoroid, *Bettongia gaimardi* (Tasmanian Bettong). Long-nosed Potoroos (and other fungus-eating species) disperse fungal spores into the post-fire habitats, allowing regenerating and new seedlings to take advantage of the symbiotic benefits of the fungi.

Fire and other environmental variables (season, climate, soil moisture, disturbance history, forest age) shape the diversity and nutrient content of the fungal community (Claridge et al. 1993). Johnson (1995) found that not all ectomycorrhizal fungi fruited in response to a particular fire, and in post-fire habitats, fire-tolerant species dominated. Claridge et al. (1993) found that regrowth forest had lower diversity and abundance of underground fungi.

Food selection by Long-nosed Potoroos has a seasonal aspect. Southern Long-nosed Potoroo feeds on underground fungi less in spring and summer, but this increases in autumn and winter (Claridge et al. 1993), so that fungi contribute as much as 80–90 percent of the Southern Long-nosed Potoroo diet through winter (Tory et al. 1997). These studies suggest underground fungi are an essential dietary item for the subspecies, and the ecological processes surrounding the consumption of fungi are just as crucial for forest health.

Habitat

In general, Long-nosed Potoroos occur in a range of vegetation types from coastal scrub and heathy woodland to wet sclerophyll forest and rainforest (Norton et al. 2010; Andren et al. 2013; Trent 2015). Subpopulations are often separated by large areas of unsuitable habitat (Seebeck 1981; Short 1998; Frankham et al. 2016). Optimum habitat is characterised by a dense canopy or mid-structure and a more open structure at ground level. In Naringal, Victoria, Southern

Long-nosed Potoroos occurred more often in patches with ground covers of either *Pteridium* species of fern or *Lepidosperma or Tetrarrhena* species of grass (Bennett 1990b). This vertical habitat structure facilitates sheltering and foraging behaviours for Long-nosed Potoroos (Norton et al. 2010; Andren et al. 2013). The species has often been recorded in gullies and near creeks, which may provide refuge during fire and drought (Seebeck 1981; Claridge et al. 1993; Martin & Temple-Smith 2012). In higher altitude habitats, such as Barren Grounds Nature Reserve and Budderoo National Park (south of Wollongong, New South Wales), the Southern Long-nosed Potoroo occurred on highland, plateau and escarpment landscapes at over 600 m above sea level in a range of habitats from heath and sedge lands to subtropical rainforest (Norton et al. 2010). At sites with both upland and coastal habitats (such as the Nadgee Nature Reserve in southeast Victoria), Southern Long-nosed Potoroos occurred in open *Eucalyptus sieberi* (Silver-top Ash) forests but were more common in coastal locations (Arthur et al. 2012).

Studies on the Southern Long-nosed Potoroo suggest that vegetation structure, such as canopy cover and habitat mosaic, is more important than vegetative species composition (Catling et al. 2001; Arthur et al. 2012). Suitable habitat was modelled for the Northern Long-nosed Potoroo, and the following key environmental variables were identified (in order of importance): mean annual temperature, nearby (within 1 km) areas of vegetative cover (with more than 2 km^2 of vegetation); dense undergrowth cover (remnant habitat units where more than 25 percent of the undergrowth is densely vegetated); and mean annual precipitation (Trent 2015). Areas, where canopy cover was sparse, were not suitable, regardless of ground cover (Norton et al. 2010; Trent 2015).

Habitat size is essential, as Long-nosed Potoroo rarely occurs in remnant vegetation patches smaller than 0.1 km^2. Martin and Temple-Smith (2012) report that whilst some occurrences are in habitats of 0.16–0.40 km^2, most occurrences are in habitats 0.41–1 km^2. In Victoria, the Southern Long-nosed Potoroo was present in habitat patches 0.1 km^2 in size and occurrence increased in larger patch sizes up to 1 km^2 (Bennett 1990ab).

Home range and density

Long-nosed Potoroos are primarily solitary animals with limited dispersal capabilities and a small home range of between 0.19 km^2 (for females) and 1 km^2 (for males) (Johnson 1987; Frankham et al. 2011; Woinarski et al. 2014; Lewis 2015; Gaborov 2017). Males have more extensive home ranges than females and have overlapping distributions (Johnson 1987; Long 2001; Gaborov 2017) with dispersal capabilities of approximately 6–8 km (Frankham et al. 2014). Southern Long-nosed Potoroos occur at densities between 60 – 100/ km^2 (Frankham et al. 2011; Gaborov 2017). Density can increase by as much as seven-fold over four years in response to predator control (Dexter & Murray 2009; Department of Environment and Primary Industries 2013). Densities of 15 resident adults were caught in a ~1 km^2 managed Eucalypt forest reserve in Naringal, Victoria (an area known for high densities of Southern Long-nosed Potoroos) (Long 2001). Density is likely a function of habitat quality, vegetative structure, patch size and predator abundance, and so will vary from site to site.

Genetic diversity and structure

The Southern Long-nosed Potoroo is restricted to patches of wet sclerophyll forest and heathland, isolated by extensive tracts of modified and unsuitable habitat (Seebeck 1981; Andren et al. 2013; Trent 2015). The species is genetically diverse yet highly structured

(Frankham 2016). The high levels of genetic diversity support the hypothesis that historically large populations persisted across south-eastern Australia during multiple climatic cycles (Frankham 2016). Habitat loss and fragmentation are likely responsible for the recent reductions in gene flow, evidenced in the regional genetic sub-structuring of subpopulations (Frankham 2016). Another contributor to gene flow patterns is the sex bias in dispersal, as Long-Nosed Potoroo males have broader dispersal patterns than females (Johnson 1989; Frankham et al. 2016). There is little evidence of population expansion since the formation of the two mainland subspecies of Long-nosed Potoroo (Frankham 2016).

The more recent taxonomic subdivision of the Long-nosed Potoroo into Northern and Southern subspecies was based on the genetic sampling of animals from South-east Queensland, New South Wales, Victoria and Tasmania (Frankham et al. 2012, 2016).

Population ecology

Long-nosed Potoroos are mainly nocturnal and utilise dense vegetative cover, making them difficult to survey (Norton et al. 2010). There have not been any robust estimates of population size for any of the three subspecies of the Long-nosed Potoroo (Martin & Temple-Smith 2012; Woinarski et al. 2014). Small coastal subpopulations of Northern Long-nosed Potoroo were rarely over 100 individuals (Mason 1998; Andren et al. 2013; Lewis 2015). Similarly, populations of Southern Long-nosed Potoroo populations ranged in abundance from 23 (Long 2001) to 180 individuals (Bennett 1987). The east Gippsland subpopulations of Southern Long-nosed Potoroo have been extensively surveyed. Catch rates indicate that the coastal subpopulations are more abundant than other subpopulations (Table 1).

Although Southern Long-nosed Potoroos live in fire-prone habitats, forest patches with a fire-free period of more than 20 years were found to have the greatest abundance of Long-nosed Potoroos (Claridge et al. 2000; Martin & Templesmith 2012). Southern Long-nosed Potoroo numbers decrease rapidly post-fire (Catling et al. 2001). They tend to recover slowly until the forest canopy recovers, at which point recovery can be positively associated with both tree canopy cover and rainfall (Catling et al. 2001; Arthur et al. 2012), and negatively associated with the post-fire presence of the European red fox (Arthur et al. 2012).

Habitat critical to the survival

The Southern Long-nosed Potoroo inhabits a range of vegetation types, including rainforest, wet and dry woodland, scrubland, coastal heathlands, and often near creeks or gullies (Martin & Temple-Smith 2012; Andren et al. 2013; Trent 2015). The species is matrix-sensitive and requires dense canopy cover and a comparatively open but vegetated understorey, favourable to underground fungi (Bennett 1990ab, 1993). Accordingly, the habitat critical to the survival of the Southern Long-nosed Potoroo includes occupied forested habitats larger than 0.1 km^2 (Bennett 1990a;1990b; Martin & Temple-Smith 2012). Unoccupied forested areas (larger than 0.1 km^2) may also be considered critical if they are adjacent or proximal to extant subpopulations, as they can provide future habitat for Southern Long-nosed Potoroos as either a natural range expansion or as a translocation site for at-risk populations. Areas of habitat that supported Southern Long-nosed Potoroo in the past, but from which they are now absent, for example, because of high predation following a bushfire event, are also habitat critical, as the subspecies could be reintroduced to these sites in the future.

No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat.

Important populations

In this section, the word population refers to subpopulation, in keeping with the terminology used in the EPBC Act and state/territory environmental legislation.

Populations important to the survival of the Southern Long-nosed Potoroo include populations at the limits of the species' range, outlying populations, stronghold populations, island populations, research populations and other populations where recovery actions, such as predator control and reintroductions, are being implemented. The following list of important populations is indicative and not exhaustive. There are likely important populations that have not been identified to date.

In New South Wales (south of the Sydney Basin), the following sites are priority management sites identified for Southern Long-nosed Potoroo under the Saving Our Species program (NSW Office of Environment and Heritage 2016)

- Southern Highlands
    - Barren Grounds Nature Reserve
    - Budderoo
    - Kangaroo Valley in Kiama
    - Shellharbour
    - Shoalhaven
    - Wingecarribee
- Southeast forests – Bega Valley and Nadgee Nature Reserves

In Victoria, the following sites are priority sites for the Southern Long-nosed Potoroo identified in the literature, including the Action Statement for the species (Department of Environment and Primary Industries 2013).

- East Gippsland
    - Coopracambra National Park
    - Croajingolong National Park
    - Cape Conran Coastal Park
    - Ewing Morass Wildlife Reserve
    - Lakes Entrance – Lake Tyers Coastal Reserve
- Wilson's Promontory
    - Wilson's Promontory National Park
- French Island
- Central Highlands
    - Toolangi
    - Marysville
- Otway Ranges
    - Great Otway National Park

- Grampians Bioregion
- South-west Victoria
    - Mount Clay State Forest
    - Cobboboonee National Park
    - Lower Glenelg National Park

Threats

Potoroids, as a group, have the highest percentage (61.9 percent) of extinct and threatened species of any family of mammals in Australia (Woinarski et al. 2014). Southern Long-nosed Potoroos are threatened by habitat loss and fragmentation; predation by invasive species, particularly European red foxes and feral cats; and inappropriate fire regimes and habitat degradation (due to, for example, forestry activities, livestock, feral herbivores, weeds). The preferred food source (underground fungi) is at risk from additional threats, including decreasing annual precipitation, consumption by native and feral species, and forest dieback from either *Phytophthora cinnamomi*, Myrtle Rust (*Austropuccinia psidii*) or other causes of forest dieback.

Threats can operate synergistically and be cumulative e.g. inappropriate fire management can result in loss of refugial habitats, loss of shallow subsurface food resources, and increased exposure to predation. The sequence of events is also likely to be important, as increased foraging activities into open post-burnt areas by the Long-nosed Potoroo can co-occur with an increase in predator activity, which may increase threats to a point where subpopulations disappear entirely (see Robley et al. 2016).

Table 2 Threats impacting Southern Long-nosed Potoroo

Threat	Status and severity [a]	Evidence
Fire		
Increased frequency and intensity of bushfires	Timing: current Confidence: observed Consequence: major Trend: increasing Extent: across the entire range	Bushfires can cause mortality of medium-sized marsupials directly via high temperatures, toxic effects of smoke and oxygen depletion (Whelan et al. 2002), or indirectly via starvation and predation (McGregor et al. 2014; Hradsky 2020). Following bushfires, the Long-nosed Potoroo is likely to be more vulnerable to introduced predators, such as the European red fox and Feral cat (Robley et al. 2016; Rees et al. 2019; Hradsky 2020). This may be exacerbated by both increased activity and hunting efficiency of introduced predators in burnt areas after a fire (Hradsky 2020; Leahy et al. 2016; McGregor et al. 2014; Robley et al. 2016). Additionally, bushfires can exacerbate the impacts of drought on the abundance of small and medium-sized marsupials (Hale et al. 2016; Crowther et al. 2018). In 2019-20, following years of drought, catastrophic bushfire conditions resulted in extensive bushfires covering an unusually large area of eastern Australia. Such catastrophic bushfires are increasingly likely to occur due to climate change (CSIRO & Bureau of Meteorology 2015). Initial estimates suggest the 2019-20 bushfires overlapped with an estimated 57% of the modelled range of the Southern Long-nosed Potoroo (Legge et al. 2021). An estimated 28% burnt at low to moderate intensity, 29% burnt at high to very high severity Legge et al. 2021). The Southern Long-nosed Potoroo is vulnerable to mortality during and after bushfires due to its limited ability to flee or use understorey vegetation as shelter and high vulnerability to introduced predators in the post-fire environment. Early estimates project

Threat	Status and severity [a]	Evidence
		a Southern Long-nosed Potoroo population decline of approximately 33% over three generations following the 2019–2020 bushfires (with an 80% confidence interval of 14–56% decline) (Legge et al. 2021). Food resources (in particular underground fungi) can substantially decrease post-fire (Claridge & Trappe 2004; Martin & Temple-Smith 2012), and this impact is amplified where fire occurs in combination with a history of other environmental disturbance (e.g. logging) (Claridge et al. 1993). A short term increase in some underground fungi has been observed post-fire (Johnson 1995). However, the abundance of some fungi after fire may be offset by increased predation risk in post-fire habitats (Robley et al. 2016) and decreased abundance of other fungi (Martin & Temple-Smith 2012). Projections of higher temperatures and reduced mean rainfall for eastern Australia due to climate change suggest that the frequency, intensity and scale of bushfires in the region will increase (CSIRO & Bureau of Meteorology 2015).
Inappropriate fire regimes (too frequent and broadscale)	Timing: current Confidence: observed Consequence: major Trend: static Extent: across part of its range	Managed public and private properties vary in their approach to prescribed burns. Fuel-reduction burns, fire suppression and ecological burning to encourage suitable habitat formation for other species may reduce the suitable habitat for the Long-nosed Potoroo. High-frequency, low-intensity burns encourage open forest structures and remove the habitat structure required for refuge and foraging by Southern Long-nosed Potoroos (Johnson 1989; Claridge et al. 2000; Martin & Temple-Smith 2012). Complete loss of understory and groundcover during planned burns increases predation pressure from European red foxes. Post-fire predation by foxes resulted in the loss of all Southern Long-nosed Potoroo from a site in Victoria (Robley et al. 2016). Forest patches with a fire-free period of more than 20 years were found to have the greatest abundance of Long-nosed Potoroo (Claridge et al. 2000; Martin & Temple-Smith 2012). After bushfires, avoidance of predators and access to food are the two most important influences for persistence. In managed forests, post-harvest burns impact soil moisture content and directly destroy underground fungi (Claridge et al. 1992; Claridge et al. 1993). The fire intensity and frequency can permanently alter the diversity and abundance of underground fungi (Johnson 1995), which may reduce the most important food source for Long-nosed Potoroo in those areas. In the Grampians bioregion, the Southern Long-nosed Potoroo did not recover after high-intensity bushfires in 2013 and 2014 resulted in the loss of canopy and complete loss of trees in some instances. At the time of reporting (2019), the subspecies was known from only three long-unburnt sites and considered at risk of local extirpation (Parks Victoria 2019). The occurrence records of Southern Long-nosed Potoroo in the Grampians bioregion did not overlap with the fire scar from the 2019-2020 bushfires (Department of Agriculture Water and the Environment 2020; Victoria State Government 2021).
Invasive and domestic species		
Predation by European red fox	Timing: current Confidence: observed Consequence: major Trend: static* Extent: Across the entire range	Predation by the European red fox is listed as a Key Threatening Process (KTP) under the EPBC Act (Department of the Environment and Water Heritage and the Arts Australian Government 2008) and has been implicated in the decline and extinction of many terrestrial, non-volant mammal species, including Long-nosed Potoroos (Claridge et al. 2010; Martin & Temple-Smith 2012; Robley et al. 2016; Radford et al. 2018). The Long-nosed Potoroo was rated as being highly susceptible

Threat	Status and severity [a]	Evidence
	*The trend represents the presence of foxes; however, other threatening processes (e.g., fire, apex predator control) may alter the impact foxes have on Southern Long-nosed Potoroo.	to introduced predators, with the European red fox identified as the most important predator (Radford et al. 2018) The European red fox has a distribution that completely overlaps all Long-nosed Potoroo populations in Queensland, New South Wales and Victoria (Department of the Environment and Water Heritage and the Arts Australian Government 2008). European red fox control programs are conducted in and around some Southern Long-nosed Potoroo sites, with the majority of control measures operating on conservation reserves (Martin & Temple-Smith 2012; Woinarski et al. 2014). Fox baiting programs have resulted in an increased abundance of Southern Long-nosed Potoroo in forested areas (Dexter & Murray 2009). European red foxes were present in approximately 79 of the 200 surveyed national parks sites in New South Wales (NSW National Parks & Wildlife Service 2016). Between 2012-2016, occupancy and detectability were estimated for European red fox, and there was no significant evidence for expansion or increase in abundance (NSW National Parks & Wildlife Service 2016). Habitats with sufficiently thick understorey vegetation will protect the Southern Long-nosed Potoroo (Short 1998). However, after fires, small mammals are particularly at risk. The European red fox increases predatory activity into recently burnt areas (Robley et al. 2016; Hradsky 2020), except where small scale ecological burns retain a mosaic of refugial vegetation (McHugh et al. 2020). Complete loss of understory during planned burns amplifies predation pressure from European red foxes. It has previously resulted in the loss of all Southern Long-nosed Potoroos from a site in Victoria (Robley et al. 2016).
Predation by cats	Timing: current Confidence: observed Consequence: moderate Trend: static Extent: Across the entire range	Predation by feral cats is listed as a key threatening process under the EPBC Act (Department of the Environment 2015) as cats are implicated in the decline and extinction of many terrestrial mammal species (Woinarski et al. 2014; Radford et al. 2018). Radford et al. (2018) considered Long-nosed Potoroos to be highly susceptible to predation by feral cats. Intense fires and grazing by introduced herbivores create ideal conditions for feral cats, which may rapidly shift their hunting grounds to optimise success in newly burnt areas (McGregor et al. 2014). In Long-nosed Potoroo habitats adjacent to urban, populated areas, domestic cats are also a threat. On French Island, Victoria, the Southern Long-nosed Potoroo coexists with cats (both feral and domestic) and can persist by shifting peak activity times and occupying habitats with denser understory vegetation (Miritis et al. 2020). It's unknown how susceptible Southern Long-nosed Potoroos are to feral cats; some predation pressure has been reported, but the impact on the species is uncertain (Martin & Temple-Smith 2012). In coastal areas, the Southern Long-nosed Potoroo occurs in many areas near urban areas and could very possibly experience predation by feral and domestic cats.
Invasive weeds	Timing: current Confidence: suspected Consequence: unknown Trend: unknown Extent: across part of its range	Weeds can invade, establish and outcompete native vegetation, particularly following disturbance events, such as fire (D'Antonio & Vitousek 1992). In particular, grassy weeds can increase fuel load and alter fire regimes (Setterfield et al. 2013; Milberg et al. 1995). These altered fire regimes can create conditions that are detrimental to the maintenance of native species and favourable to the establishment and spread of weeds (D'Antonio & Vitousek 1992). Accordingly, weed

Threat	Status and severity [a]	Evidence
		invasion may promote fire regimes that may imperil the Southern Long-nosed Potoroo. Weeds can directly impact food availability for the Long-nosed Potoroo. In rainforest areas, Lantana (*Lantana camara*) shades understory species, alters soil nutrients (Rose 1997) and decreases the abundance of underground fungi (Martin & Temple-Smith 2012). There is little information on the consequence and extent that weeds impact Southern Long-nosed Potoroo habitat and food resources.
Herbivory and trampling by livestock	Timing: current Confidence: suspected Consequence: minor Trend: static Extent: across part of its range	Competition with livestock and other feral herbivores is considered a threat of minor consequence in the Action Plan for Australian Mammals 2012 (Woinarski et al. 2012). Livestock may degrade Southern Long-nosed Potoroo habitats by grazing and trampling understory vegetation, creating conditions that expose them to predation.
Competition with feral pigs (*Sus scrofa*)	Timing: current Confidence: suspected Consequence: minor Trend: unknown Extent: unknown	Competition and habitat degradation by feral pigs is listed as a key threatening process under the EPBC Act (Department of the Environment 2017). Feral pigs are opportunistic omnivores known to ingest underground and above-ground fungi (Corbett 1995; Department of the Environment and Energy 2017) and may be in direct competition with Southern Long-nosed Potoroos in a shared habitat. The Southern Long-nosed Potoroo is also seasonally reliant on underground food resources, and any direct competition with feral pigs will be greater in drier seasons.
Predation by wild dogs (*Canis familiaris*)	Timing: current Confidence: observed Consequence: minor Trend: static Extent: Across the entire range	Predation by wild dogs is a key threatening process under the New South Wales Biodiversity Conservation Act 2016 as dogs are a recognised predator on some threatened species. Some predation pressure from wild dogs occurs, but the impact on the Long-nosed Potoroo population is uncertain (Martin & Temple-Smith 2012). Wild dogs typically target high-abundance and larger prey species (Newsome et al. 1983). In a southern NSW predator scat analysis, Long-nosed Potoroos occurred in scats in comparatively less frequency to other prey items but in equal frequency of both fox and wild dog scats (Claridge et al. 2010). Southern Long-nosed Potoroos occurred more frequently in scats collected from heath or heath with forest habitats when compared with dry coastal forest (Claridge et al. 2010). In the Wildcount program, remote cameras have detected the co-occurrence of both wild dogs and Long-nosed Potoroo at some sites (NSW National Parks & Wildlife Service 2016) though it is not known if there is some temporal aspect to their occurrence that might indicate the species avoids predation. Predator-prey relationships are complex, and the removal of wild dogs is likely to expose Southern Long-nosed Potoroos to greater intensity of predation pressure from mesopredators (e.g. European red foxes and feral cats) (NSW Office of Environment and Heritage 2016).
Changing weather patterns		
Increased temperatures and altered precipitation pattern	Timing: current Confidence: observed Consequence: major Trend: increasing Extent: across the entire range	Decreased rainfall, increased average temperatures, and increased frequency of droughts are increasingly likely to occur due to climate change (CSIRO & Bureau of Meteorology 2015). Drought conditions can act synergistically with bushfires to reduce the abundance of small- and medium-sized marsupials (Hale et al. 2016; Crowther et al. 2018). Southern Long-nosed Potoroos often occur near watercourses and drainage lines, which may provide shelter during bushfires (Martin & Temple-Smith 2012). However, during times of

Threat	Status and severity [a]	Evidence
		drought, watercourses and drainage lines may become dry and fire-prone and hence fail to provide protection. Drier and hotter conditions will decrease the diversity and abundance of underground fungi, which are the most important food source for Long-nosed Potoroo (Claridge et al. 1993; Tory et al. 1997). Drought is thought to be responsible for the observed declines in Northern Long-nosed Potoroo at Cobaki Lakes, New South Wales, as captures decreased from 20 to 4 individuals within one year, coinciding with increasingly dry conditions (Lewis 2015). Similar declines were observed for Southern Long-nosed Potoroos on French Island, where Frankham et al. (2011) attributed catch declines over four years to the reduced carrying capacity of key habitats due to long-term below-average rainfall. Prolonged drought is likely to alter forest structures, food webs and key food availability. However, the extent and intensity of the impact of long-term reductions in rainfall on the Southern Long-nosed Potoroo are not well understood.
Habitat loss, degradation and fragmentation		
Land clearing (from urban, residential and agricultural land development and change) causing habitat fragmentation	Timing: current Confidence: observed Consequence: major Trend: increasing Extent: across part of its range	Throughout New South Wales and Victoria, land clearing for agriculture and urbanisation (especially near the coast) has caused the reduction and fragmentation of suitable habitat resulting in isolated populations of Southern Long-nosed Potoroos (Seebeck 1981; Johnston 2008; Martin & Temple-Smith 2012; Woinarski et al. 2014). The limited dispersal capability of the Long-nosed Potoroo (6–8 km for males) (Frankham et al. 2014, 2016) and the ongoing disappearance of small subpopulations progressively place the survival of the Southern Long-nosed Potoroo subspecies at risk. In protected areas, properties may not change, but fragmentation within the habitat can still impact Southern Long-nosed Potoroo. The creation and maintenance of roads and tracks may also enhance access by predators and result in road deaths (Martin & Temple-Smith 2012). Genetic data demonstrate that Southern Long-nosed Potoroos are genetically diverse and finely structured at a regional scale, suggesting that, post-European settlement, subpopulations have become isolated and differentiated (Frankham et al. 2016). Fragmentation and isolation of the Southern Long-nosed Potoroo subpopulations make them extremely susceptible to extirpation from various inter-related and cumulative threatening processes operating across different locations and spatial scales (Johnson 1989). Each threatening process (within this table) will be intensified by decreasing suitable habitat available to the Southern Long-nosed Potoroo.
Timber harvesting	Timing: current Confidence: observed Consequence: moderate Trend: unknown Extent: across part of its range	Forestry activities overlap with Potoroo distribution Victoria and New South Wales (NSW Office of Environment and Heritage 2016). Forestry is implicated in the decline of the Southern Long-nosed Potoroo (SAC 2002, Lunney 1989). The removal of canopy cover and undergrowth lowered soil moisture and increased susceptibility to fire render forestry-disturbed areas unsuitable for Long-nosed Potoroo (Department of Environment and Primary Industries 2013)(Martin & Temple-Smith 2012). Further, direct mortality resulting from harvesting activity and roadkill, as well as indirect mortality due to increased predation and loss of fungi food sources from soil changes, threaten the Southern Long-nosed Potoroo in state forests (Claridge et al. 1993; Martin & Temple-Smith 2012). The creation and maintenance of roads and tracks through forestry lands promotes access by

Threat	Status and severity [a]	Evidence
		predators, including introduced predators like the feral cat and the European red fox (Martin & Temple-Smith 2012). Lunney et al. (2001) found a 34% increase of Southern Long-nosed Potoroo in the diets of Wild dogs and European red foxes 15 years post logging and bushfire, which may indicate that small mammal numbers increased in abundance as the forest canopy recovered. This highlights that predator control may support the recovery of Southern Long-nosed Potoroo post forestry or fire disturbance.
Forest Dieback caused by *Phytophthora cinnamomi*, *Manorina melanophrys* (Bell Miner) or Myrtle Rust (*Austropuccinia psidii*)	Timing: current Confidence: suspected Consequence: unknown Trend: increasing Extent: across part of its range	In New South Wales, *Manorina melanophrys* (Bell miner) associated dieback extends from southern Queensland to Victoria in wet and dry sclerophyll forests. A complex of causative factors (including "farming" of psyllids by the Bell miner) increase the load of sap-sucking psyllid pests to the point that the eucalypts die (Silver & Carnegie 2017). This threatening process is currently managed in northern New South Wales habitats under the regional biodiversity management plan (Department of Environment Climate Change and Water NSW 2010). *Phytophthora cinnamomi* is an introduced soil-borne pathogenic oomycete, which results in plant death through the destruction of root systems. *Phytophthora cinnamomi* is listed as a Key Threatening Process under the EPBC Act (Department of Energy and Environment 2018). Vegetative communities along the south-eastern Australian coastal fringe are at risk of the *P. cinnamomi.* The impact on Southern Long-nosed Potoroo is not known, though, in Western Australia, *Potorous gilberti* (Gilbert's Potoroo) occurs only in patches free of the disease (Martin & Temple-Smith 2012). It's not known if dieback impacts Southern Long-nosed Potoroo, though presumably any major alterations in habitat mosaic, soil moisture, understory vegetation density and underground fungi availability will have negative consequences for the Southern Long-nosed Potoroo.
Competition from native species		
Competition with overabundant native species for fungal food resources	Timing: current Confidence: suspected Consequence: minor Trend: unknown Extent: Across part of its range	Other mycophagous species may compete for underground fungal food resources in areas where the species overlap (Elliot & Vernes 2020). Many forest-dwelling mammals consume *Mesophellia*, a genus of truffle-like fungi which are also targeted by Long-nosed Potoroos (Malajczuk et al. 1987; Claridge & Cork 1994). An over-abundance of competitive species or a decline in shared resources may result in decreased resources for Long-nosed Potoroos. The increasing likelihood of more frequent fire and drier habitats under climate change scenarios may reduce available food resources and place significant indirect pressure and increased competition between mycophagous species. *Alectura lathami* (Brush Turkey) are mycophagous (Elliot & Vernes 2020) and remove a large amount of ground cover and seedlings whilst foraging and nest building (Warnken et al. 2004). Brush Turkey numbers have noticeably increased in urban areas and also areas of National Park in Queensland (Jones et al. 2004) and Northern New South Wales, whereby direct competition for food resources and extensive habitat disturbance is thought to have contributed to the decline of a Northern Long-nosed Potoroo subpopulation at Tyagarah Nature Reserve (Milledge et al. in review). It is unclear if there has been a similar impact on habitat and food resources from the Brush Turkey in southern New South Wales and Victoria.

Each threat has been described in Table 2 in terms of the extent that it is operating on the species. A risk matrix (Table 33) provides a visual way to capture the level of risk being imposed by a threat and supports the prioritisation of subsequent management and conservation actions. In using a risk matrix, several factors have been taken into consideration; they are: the life stage they affect, the duration of the impact, and the efficacy of current management regimes, assuming that management will continue to be applied appropriately.

The risks posed by a threat can vary depending on where the species is in its life cycle, the season or duration of the threat. The prioritisation of the risk posed by these threats has been determined in the risk matrix (Table 33). The risk assessment process is used to determine the priority for conservation and/or management actions. The risk matrix in Table 33 and ranking of threats has been developed in consultation with species experts and in-house expertise using available literature.

Table 3 Southern Long-nosed Potoroo risk matrix

Likelihood	Consequences				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	Low risk	Moderate risk	Very high risk **Timber harvesting** **Predation by cats**	Very high risk **Inappropriate fire regimes** **Increased frequency and intensity of bushfires** **Increasing temperatures and altered precipitation pattern** **Land clearing causing habitat fragmentation** **Predation by European red fox**	Very high risk
Likely	Low risk	Moderate risk **Predation by wild dogs**	High risk	Very high risk	Very high risk
Possible	Low risk	Moderate risk **Herbivory and trampling by livestock** **Competition with overabundant native species for fungal food resources**	High risk	Very high risk	Very high risk
Unlikely	Low risk	Low risk	Moderate risk	High risk	Very high risk
Unknown	Low risk	Low risk **Forest dieback** **Invasive weeds** **Competition with Feral pigs**	Moderate risk	High risk	Very high risk

The outcome of the risk matrix

Priority actions have then been developed to manage the threat, particularly where the risk was deemed to be 'very high' or 'high'. For those threats with an unknown or low-risk outcome, it may be more appropriate to identify further research or maintain a watching brief.

Conservation and recovery actions

Primary conservation outcome

Populations across the range of the species, including coastal as well as inland populations, are stable or increasing in suitable habitats managed appropriately for the species.

Habitat is protected to prevent further loss or fragmentation of the species.

Conservation and management priorities

Habitat loss, degradation, disturbance and modifications

- Avoid further loss and fragmentation of habitat, including loss of vegetation connecting areas of habitat for the species or the creation or increase of barriers to movement between subpopulations.
- Where feasible, promote the restoration and enhancement of habitat connectivity between fragmented habitat patches to allow safe movement of individuals.
- Outside of National Parks and other managed conservation areas, promote the conservation and management of the species' habitat through the establishment of voluntary conservation agreements, Council open space habitat areas and covenanted areas.
- Ensure that adequate protection measures are in place to protect the viability of populations in areas subjected to forestry and associated management activities (this includes logging, road construction, coupe burning).
- Assess the effectiveness of current forestry management practices in ameliorating disturbance to the habitat of the species, and revise management practices if necessary. Given the suspected impacts of logging on the species, stringent protection measures should be adopted.
- At sites where road mortality of the species is highly likely, consider the implementation of measures to reduce road mortality, such as underpasses (with appropriate substrate and shelter within, see Lewis 2015), road escape ramps and slowing vehicle movement. Ensure underpasses have appropriate vegetation cover for the species on either side of the road.
- Where *P. cinnamomi* occurs within or proximal to Southern Long-nosed Potoroo subpopulations, implement an appropriate disease management plan to protect forest health and structure. Ensure appropriate hygiene protocols are adhered to when entering or exiting areas infected with *P. cinnamomi*, such as those outlined in Podger et al. (2001) and O'Gara (2005).

Climate Change and fire

- Ensure that a high proportion of the Long-nosed Potoroo habitat is maintained in a long unburnt condition (>20 years).
- Ensure immediate and ongoing post-fire predator control within the habitat of the species following fires.
- If fire is essential and long unburnt patches are not possible, then develop and implement a fire management strategy that optimises the survival of the species during planned and unplanned fires. These regimes should include buffers that prevent bushfire or planned burns from impacting habitat and food sources; a post-fire introduced predator control program, a post-fire population monitoring program, and sufficient funding to facilitate these projects.
- Provide maps of known Long-nosed Potoroo sites to local and state Rural Fire Services and seek inclusion of actions to mitigate impact to the Southern Long-Nosed Potoroo. Where the prescribed fire is necessary for reducing the risk of wildfire, maintain and document habitat structure and fire frequency, ensuring some patches are fire-free for at least 20 years.

- Maintain and protect areas identified as climate change refuges; establish corridors to allow movement to modelled suitable habitat under climate change projections.

Invasive species (including threats from predation, competition)

- Develop and implement strategies to control predation by the European red fox and feral cats and where relevant, competition from feral pigs, as detailed in the relevant Threat Abatement Plans (TAPs) or management strategies.
- Implement grazing management actions in consultation with land managers and community groups; prevent further introduction of pest animals and control those that are already present, as detailed in the relevant threat abatement plan (DOEE 2016). Develop and implement strategies to control introduced herbivores consistent with the relevant TAP.
- Develop and implement strategies to manage weeds where they are impacting the species, consistent with the Australian Weeds Strategy 2017-2027 (Invasive Plants and Animals Committee 2016) and other relevant management strategies. Develop appropriate prioritisation of which weed species to control based on those which specifically affect the Southern Long-nosed Potoroo.
- Promote the registration and responsible management of domestic cats and dogs, targeting urban areas adjacent to known Southern Long-nosed Potoroo populations. Consider cat containment and prohibition options for suburbs next to important populations of LNP.

Captive breeding and other ex situ recovery actions

- Identify population thresholds that may initiate a captive breeding program for the species.
- Identify key subpopulations and suitable habitats for a future release of captively bred animals and/or wild-to-wild translocations, and ensure habitats are managed for future suitability.
- Assess the need for, and feasibility of, one or more large fenced areas to create insurance populations that are protected from feral predators and habitat degradation from livestock. For example, this approach may be a viable management option to protect small populations in coastal habitat fragments.
- Identify high-risk subpopulations under climate change and catastrophic depletion scenarios and plan for emergency responses to translocate at-risk animals where needed.

Stakeholder engagement/community engagement

- Engage and involve Traditional Owners in conservation actions, including the implementation of Indigenous fire management and other surveys, monitoring and management actions.
- Identify and engage partners including the Local Councils, NRM regions, state agencies, Indigenous communities, landholders, community-based organisations and conservation management organisations that can assist with conservation actions.
- Contribute to impact assessment and planning processes on measures to protect the species and its habitat.

- Ensure information and data on Long-nosed Potoroos and their habitat is shared between land managers, environmental managers and landholders.
- Where research identifies potential habitat for the species in areas that are privately-owned, liaise with landholders to provide information on the species and its habitat requirements and encourage reporting of any sightings.
- Increase the recognition and support for the species' recovery by disseminating information on the species and its conservation status to the public.

Survey and monitoring priorities

- Monitor the subspecies at representative sites across its range to track changes in the overall population size, the effects of varying levels of threats, and the effectiveness of management of those threats.
- Continue to gather information on the impact of the 2019–2020 bushfires on the species.
- Survey the spatial and temporal behavioural, occurrence, abundance and predation patterns of European red foxes, feral cats and wild dogs in important Southern Long-nosed Potoroo habitats.
- Monitor abundance and responses of Southern Long-nosed Potoroos before and after a fire and invasive species control measures.
- Assess the efficacy of existing threat management actions.

Information and research priorities

- Determine the key environmental variables and thresholds for habitat critical in both coastal and mountain areas where are extant Potoroo subpopulations. Assess the risk of extinction and causes in coastal versus mountain populations.
- Determine variability in food availability between different habitat types for important populations, and determine which environmental drivers are responsible for changes in food abundance and nutrient levels.
- Determine natural and anthropogenic fluctuations in the key ecological attributes responsible for species survival (e.g., food resources, predator abundance, environmental parameters and responses to fire and drought). Use the information to prioritise management responses at a location/subpopulation level.
- Undertake research into the ecology of hypogeous fungi, particularly the impacts of timber harvesting, bushfire, drought, and prescribed burning. Determine the spatial variability in mycophagous species and where the most intense competition for this food source with other species occurs.
- Model habitat loss and projected habitat loss and fragmentation under different climate scenarios.
- Determine thresholds for viable subpopulations and viability under future climate change scenarios.
- Determine the prevalence and impact of both *Phytophthora cinnamomi* and Bell Miner related dieback on important habitats for Southern Long-nosed Potoroo.

- Determine the current distribution and abundance of the species.
- Identify individual risks for each subpopulation.
- Develop standard protocols for the detection of Southern Long-nosed Potoroo in the field using remote camera and trap survey methods.
- Determine the need for captive breeding or reintroduction programs in key areas where isolated populations have declined or severe impacts on the subpopulations have occurred due to stochastic events such as fire.
- Undertake connectivity analysis to prioritise important areas for conservation and restoration and the location of critical habitat linkages and barriers to the movement of individuals and gene flow (McRae et al. 2008).
- Determine the efficacy of predator control programs (especially for European red fox) in reducing predator caused mortality of the Southern Long-nosed Potoroo. Include scale, intensity and interacting factors in the control programs in the experimental design.

Recovery plan decision

No recovery plan is in place for the Southern Long-nosed Potoroo. A Saving Our Species Strategy is in place in New South Wales for subpopulations at Barren Grounds and surrounding reserves and southeast forests in the Bega Valley. This consultation document will elicit the additional information needed to inform the requirement of a Recovery Plan for the Southern Long-nosed Potoroo.

Links to relevant implementation documents

Action statement No. 254 Long-nosed Potoroo *Potorous tridactylus*. Flora and Fauna Guarantee Act 1988

Conservation Advice *Potorous tridactylus tridactylus* Long-nosed Potoroo (SE Mainland)

Threat abatement plan for predation by Feral cats (2015)

Threat abatement plan for predation by the European red fox (2008)

New South Wales Saving our species strategy: Long-nosed Potoroo (2016)

New South Wales Saving our species strategy: Endangered populations of Long-nosed Potoroo (in prep)

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The Threatened Species Scientific Committee finalised this assessment on DD Month Year.

Attachment A: Listing Assessment for *Potorous tridactylus trisulcatus*

Reason for assessment

This assessment follows prioritisation of a nomination from the TSSC and provision of new information; molecular data has identified two separate subspecies of Long-nosed Potoroo on the Australian mainland: The Northern Long-nosed Potoroo (*Potorous tridactylus tridactylus*) and the Southern Long-nosed Potoroo (*Potorous tridactylus trisulcatus*) which are recognised subspecies in the Australian Biological Resources Study – Australian Faunal Directory. The EPBC Act currently groups both subspecies under *Potorous tridactylus tridactylus* (Long-nosed Potoroo, SE Mainland).

Assessment of eligibility for listing

This assessment uses the criteria set out in the EPBC Regulations. The thresholds correspond with those in the IUCN Red List criteria except where noted in criterion 4, sub-criterion D2. The IUCN criteria are used by Australian jurisdictions to achieve consistent listing assessments through the Common Assessment Method (CAM).

Key assessment parameters

Table 4 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria.

Table 4 Key assessment parameters

Metric	The estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	20 000	18 000	254 000	Density ranges between 20–255 individuals per km^2 (though the majority of reported densities are <100 per km^2 (Seebeck et al. 1989; Mason 1998; Frankham et al. 2011; Andren et al. 2013). Confidence in this estimate is low to medium as Southern Long-nosed Potoroo subpopulations are patchy and fragmented, with large areas of unsuitable habitat between them. The species may be absent from "highly suitable" habitats close to existing subpopulations. Using the AOO and a median density value of 137 individuals per km^2, there are an estimated 254 000 individuals. The Action Plan for Australian Mammals 2012 used expert opinion to estimate the number of mature individuals to be 20 000 (Woinarski et al. 2014). At the time, there was insufficient data to estimate the population size reliably, and projections estimated a 10% decline over 12 years (since 2012). A 10% decline is 2000 individuals per year, leaving an estimate of 18 000 individuals in 2021, which is used for the minimum plausible value. At the time of assessment (2021), there were no comprehensive population estimates to confirm or rebut the estimate of 20 000 made by Woinarski et al. (2014). If it was an overestimate at the time, it might be closer to accurate now (nine years later). Due to the uncertainty and lack of new data, 20 000 was used as the estimate for the assessment.

Metric	The estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Contracting			In 2012, Woinarski et al. (2014) suspected that the population size of the Southern Long-nosed Potoroo was declining at a rate approaching but not greater than 10% over 12 years (three generations) (Woinarski et al. 2014). The key threats causing this decline are habitat loss and fragmentation, predation (European red fox) and inappropriate fire regimes. Given that there is no evidence the key threats have abated, it can be assumed that this trajectory of decline will continue into the future. In addition, preliminary data suggest that the recent 2019-2020 bushfires have impacted the population and resulted in a 36% decline in the first year, and including some small recovery from the bushfires, a longer-term 33% decline(or up to 56% for the lower 80% confidence bound) predicted over 3 generations (12 years) (Legge et al. 2021). Future large-scale bushfires were not factored into population declines projected by the NESP Threatened Species Recovery (TSR) Hub (Legge et al. 2021). The expert elicitation carried out by the TSR Hub indicated that the 2019-2020 bushfire is responsible for an additional 20% decline by 3 generations in addition to pre-existing declines (13%). The projected declines stated above do not include the possibility of future broad-scale bushfire events. Climate change projections indicate that environmental conditions will facilitate more frequent and intense bushfires in the future (CSIRO 2015). The likelihood of another fire event in the next three generations is high (CSIRO 2009) and so the 33% decline projected by Legge et al. (2021) may be considered conservative.
Generation time (years)	4 years	3 years	5 years	Long-nosed Potoroos can live up to 7 years in the wild (Guiler & Kitchener 1967) but more often for 4–5 years (Martin & Temple-Smith 2012). The species is reproductive in its second year and produces an average of 2–3 pouch young per year (Johnston 2008). For generation length calculations, fecundity was set to 2.5 pouch young per year. No direct estimates of survival have been made for the species. All generation length calculations were estimated using the IUCN generation length calculator (IUCN). Minimum generation length was obtained by setting an annual survival rate between 40–70% and a life span of 5 years. The maximum value was by setting survival rate at 90% or above and lifespan of 7 years. The Action Plan for Australian Mammals 2012 estimated generation time at between 3–4 years (Woinarski et al. 2014).

Metric	The estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Extent of occurrence	216 962 km^2	168 197 km^2	216 962 km^2	The estimate used in the assessment was the maximum value, as it applies the most recent data. The minimum estimated EOO was that estimated in the Action plan for Australian Mammals 2012 (Woinarski et al. 2014). The maximum plausible is based on the mapping of point records from a 20-year period (2000–2020) obtained from state governments, museums and CSIRO. The EOO was calculated using a minimum convex hull based on the IUCN Red List Guidelines (IUCN 2019). This is considered to be the maximum plausible value because the species range is thought to be contracting.
Trend	Contracting			Contracting EOO is evidenced in the literature (Woinarski et al. 2014). The entire population was historically widespread and now exists in a comparatively small area. EOO is likely to continue contracting due to loss of suitable habitat resulting from further land clearing, exacerbated by events such as the 2019-20 bushfires. A total estimated 57% of the modelled distribution was impacted by fire in the 2019–2020 bushfire season resulting in a population decline of 33% over three generations but as high as 56% decline (Legge et al. 2021). It's not known how much the observed contraction in the number of subpopulations and population numbers will affect the estimated EOO, though presumably, as isolated edge populations disappear, EOO estimates will contract.
Area of Occupancy	1856 km^2	748 km^2	1856 km^2	The minimum estimated AOO was that estimated in the Action plan for Australian Mammals 2012 (Woinarski et al. 2014), which, at the time, was considered to be an underestimate due to limited sampling. The maximum plausible value is based on the mapping of point records from a 20-year period (2000–2020) obtained from state governments, museums and CSIRO. The AOO was calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines (IUCN 2019). This is considered to be the maximum plausible value because the species range is thought to be contracting. This estimate applies the most recent data and is, therefore the value used in the assessment.

Metric	The estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Contracting			Initial estimates suggest the 2019-20 bushfires overlapped with an estimated 57% of the 'known and likely to occur' modelled range of the Southern Long-nosed Potoroo Legge et al. 2020). An estimated 28% burnt at low to moderate intensity, 29% burnt at high to very high severity (Legge et al. 2021). The Action Plan for Australian Mammals 2012 (Woinarski et al. 2014) inferred a (now past) population decline of 10% over three generations. The 2019–2020 fire season is judged by experts as likely to cause a future decline of 33% but as high as 56% decline within three generations (Legge et al. 2021). This species often occurs in low numbers at a given location (often <100), particularly in coastal populations. The projected population decline for the species will undoubtedly influence future AOO for the species as unviable subpopulations are lost.
Number of subpopulations	>10	9	>10	The number of subpopulations is not known with certainty but is estimated to be >10. The Action plan for Australian Mammals (Woinarski et al. 2014) stated with medium confidence that there were >10. However, using the geographic distribution, reported estimates of numbers of subpopulations (Seebeck 1981) and considering the genetic sub-structuring in the population (Frankham 2016), a preliminary assignment of nine subpopulations is estimated though comprehensive distribution mapping and gene flow analysis is required to confirm this. An estimate of >10 subpopulations has been used in the assessment.
Trend	Contracting			In 2012, the population was predicted to decline by 10% over three generations (Woinarski et al. 2014). Recent estimates of population decline project a decline of 33% (and up to 56%) over three generations as a result of the 2019–2020 bushfires (Legge et al. 2021). Entire subpopulations of Southern Long-nosed Potoroo have been lost in less than one generation as a result of the combination of inappropriate fire regimes and predation (see Robley 2016). The subpopulations which are small (<100) are likely to become non-viable and may be lost, and so the number of subpopulations will decrease as a function of that overall population decline.

Metric	The estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Basis of assessment of subpopulation number	The number of subpopulations is not known with certainty but is estimated to be > 10. Southern Long-nosed Potoroos require specific habitat mosaics (Norton et al. 2010) in habitats that are long unburnt (>20 years; Claridge & Barry 2000). The species exhibits small home ranges (0.19 km^2 for females and 1 km^2 for males; Johnson 1987; Frankham et al. 2011; Woinarski et al. 2014; Lewis 2015; Gaborov 2017) and short dispersal capabilities (6-8km; Frankham et al. 2011; Gaborov 2017). These characteristics make it reasonable to assume that even small areas of urbanised or unvegetated patches of land are barriers to connectivity between locations where Southern Long-nosed Potoroos persist. The low levels of genetic isolation between these patches may be evidence of historical connectivity and current isolation (Frankham 2016). There are ten areas identified for Southern Long-nosed Potoroos; however, there is little evidence to suggest that these are true subpopulations. A complete sampling of the distribution with comprehensive genetic sampling may reveal a greater number of subpopulations. The estimate of >10 subpopulations is provided with low confidence.			
No. locations	<10	5	<10	Bushfires can impact multiple subpopulations at one time and may result in the immediate loss of Southern Long-nosed Potoroos and ongoing declines as a result of post-fire predation and loss of food and habitat resources. The minimum plausible value for the number of locations is five based on the most recent impacts of the 2019-2020 bushfires, which burnt 57% of the plausible distribution (Legge et al. 2021) projected to have caused an immediate loss of 36% of the population within a year (Legge et al. 2021). The intensity, frequency and scale of catastrophic bushfires will likely increase due to climate change and future broadscale bushfire events may have an even greater impact on the surviving population than the 2019-2020 bushfires.
Trend	Contracting			Southern Long-nosed Potoroos require long unburnt habitat (of >20 years). With the increasing frequency of bushfires, the remaining suitable habitat will decline, and so the number of locations in which a single bushfire can rapidly affect all individuals may be lower.
Basis of assessment of location number	Although the distribution of Southern Long-nosed Potoroo is broad, the species is restricted to specific habitat mosaics. The unprecedented impact of broadscale bushfires similar in scale to the 2019-2020 bushfires may impact as much as 36% (but as high as 46%) of the population in a single year (Legge et al. 2021). Post-fire recovery in the Long-nosed Potoroo is slow and is unlikely to meet pre-fire levels before the next catastrophic scale bushfire.			

Metric	The estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Fragmentation	Not determined to be severely fragmented. Woinarski et al. (2014) state that the species has a "highly fragmented distribution" between Sydney Basin and southwest Victoria. Within this range, the species is restricted to the coastal areas and up to ~800 m above sea level. Suitable habitats are those that receive an annual rainfall >760 mm and are long unburnt (>20 years). Historical habitat loss and fragmentation has resulted in highly fragmented subpopulations, isolated by large areas of uninhabitable remnant vegetation. There is little migration as adults have a very small dispersal capacity (6-8 km) (Frankham et al. 2014, 2016). Only a few areas have been surveyed for species abundance, and of those, most are small (<100 individuals) and isolated by areas of unsuitable habitat. For many vertebrates, subpopulations of fewer than 100 individuals may be considered too small to be viable (IUCN Standards and Petitions Committee 2019). However, there is no evidence to suspect that more than 50% of the subpopulations are small and isolated without further sampling, particularly within the larger areas of suitable habitat where there is an abundance of occurrence records (e.g. South East New South Wales and Gippsland, Victoria).			
Fluctuations	Not subject to extreme fluctuations in EOO, AOO, number of subpopulations, locations or mature individuals – no parameter was changed by an order of magnitude by the 2019/20 fire.			

Criterion 1 Population size reduction

Reduction in total numbers (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.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [*(a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

Based on any of the following

(a) direct observation [except A3]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Eligible under Criterion 1 A4ce **for listing as** Vulnerable

Generation length

The Southern Long-nosed Potoroo is likely to have a generation time of four years (Table 4). Three generations give a 12-year timeframe, which was used for the assessment under this criterion.

Population decline due to catastrophic bushfires and predation by introduced apex predators

The Southern Long-nosed Potoroo is vulnerable to mortality during high intensity and broadscale fires. A further risk to the species occurs post-fire as the dense understory vegetation is typically lost, and refuge habitats are not available to protect the species from predation by introduced taxa, predominantly from European red fox, feral and domestic cats and wild and domestic dogs (Hradsky 2020; McHugh et al. 2020; Miritis et al. 2020).

In 2019-20, following years of drought (Bureau of Meteorology 2021; CSIRO 2021), catastrophic bushfire conditions resulted in extensive bushfires covering an unusually large area of eastern Australia (Department of Agriculture Water and the Environment 2020). Fire intensity and severity varied across the bushfire extent, with many patches burning at extreme intensity and severity while others remained unburnt (Department of Agriculture Water and the Environment 2020). Initial estimates from early 2020 suggested the 2019-20 bushfires overlapped with approximately 57 percent of the Southern Long-nosed Potoroo's modelled range (Table 5).

Table 5. Percent of Southern Long-nosed Potoroo modelled range of "known and likely to occur" distribution that was impacted by different fire intensities during the 2019–2020 bushfire season (Legge et al. 2021).

	Unburnt	Low to Moderate fire intensity	High to very high fire intensity	Total modelled distribution
Percent of distribution impacted	43%	28%	29%	57%

The Long-nosed Potoroo (SE Mainland) was prioritised as a species requiring urgent post-fire management following the 2019–2020 bushfires (Legge et al. 2020). In a project run by the Threatened Species Recovery Hub, expert elicitation was used to estimate the extent of population decline after fires of varying severity and the predicted population trajectories out to three generations after the fires. Experts judged that populations at burnt sites declined by 46 percent in the first year after mild fire and by 76 percent after a severe fire, with little recovery over three generations (populations still reduced by 33% and 65% after a mild and severe fire, respectively). The information on population response to fires of varying severity was combined with spatial estimates of the overlaps between the species distribution and fire severity mapping. This analysis suggests that the *overall* population of Southern Long-nosed Potoroos declined by 26 percent immediately after the bushfires and 36 percent in the year following bushfires (by the year 2021) but may have declined by as much as 46 percent (80 percent confidence bound). Three generations post-fire (by the year 2031), the overall population is predicted to be 33 percent lower than its pre-2019 level but may be as much as 56 percent lower (80 percent confidence bound). By comparing this trajectory to that predicted for populations that were not exposed to fires, the elicitation concluded that after three generations, Southern Long-nosed Potoroos would be 20 percent lower than they would have been had the fires not occurred. The elicitations assumed there were no further extensive fire events in the

range of the Long-nosed Potoroo over the three-generation period; repeated large-scale fire would progressively worsen the extent of the decline. (Legge et al. 2021).

Long-nosed Potoroos prefer habitats that are long unburnt (more than 20 years), and after a severe fire, population recovery times can exceed 15 years (Claridge & Barry 2000). Thus, habitat quality specific to the Southern Long-nosed Potoroo has markedly declined post-2019-2020 bushfires and will continue to decline if fire frequency is more than once every 20 years. Some habitats may already be experiencing an inter-fire interval of fewer than 15 years, and this is expected to increase in the future. Australia is predicted to experience weather conditions conducive to catastrophic bushfire events. CSIRO predicted return periods of 15 years or less for catastrophic fire weather, and by 2050 such weather events may be as frequent as every three to eight years for fire-prone areas (CSIRO 2009). The increased frequency, intensity and scale of bushfires (CSIRO & Bureau of Meteorology 2015; CSIRO 2021) will likely cause the continued decline for the Southern Long-nosed Potoroo well above 30 percent with little opportunity for recovery without major management interventions. Assuming an ongoing decline rate, in the absence of largescale fire, of 10 percent (Mammal Action Plan) or 13 percent (Legge et al. 2021), and assuming a bushfire season of similar scale to the 2019-2020 bushfire occurs at least once every 15 years (CSIRO 2009), the Southern Long-nosed Potoroo is predicted to experience ongoing declines with little opportunity to recover without major management intervention.

Conclusion

Southern Long-nosed Potoroo populations are predicted to have declined 36 percent (and as much as 46 percent) in the year following the 2019-2020 bushfires. In the three generations following the bushfires, populations are predicted to decline by 33 percent, but potentially by as much as 56 percent. This estimate does not include the potential for future catastrophic bushfire, as may be expected under climate change (CSIRO & Bureau of Meteorology 2015). Thus, the Committee considers that the Southern Long-nosed Potoroo meets the criteria for listing as Vulnerable under A4 for past and future declines exceeding 30 percent due to bushfires and other post-fire threatening processes (mostly predation by European red fox). The quality of habitat is predicted to decline and predicted population declines would likely also result in contracting EOO and AOO for the species.

The purpose of this consultation document is to elicit additional information to better understand the subspecies' status. The conclusion of Vulnerable is based on modelled data, and inferred declines and so should be considered 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:				
(a)	Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b)	Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c)	Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Eligible under Criterion 2 B2ab(ii,iii,iv,v) **for listing as** Vulnerable

The extent of occurrence and area of occupancy

The extent of occurrence (EEO) in this assessment is estimated at 216 962 km², and the area of occupancy (AOO) is estimated at 1856 km². Both are inferred to be contracting (see Table 4).

Severely fragmented

Woinarski et al. (2014) state that the species has a "highly fragmented distribution" between Sydney Basin and southwest Victoria. The small dispersal capabilities of the species, as well as the suitable habitat requirements, result in subpopulations being isolated from each other (see Table 4 under fragmentation). For many vertebrates, subpopulations of fewer than 100 individuals may be considered too small to be viable (IUCN Standards and Petitions Committee 2019). Three sampled areas have very small populations sizes, though there is no data to suggest that these are representative of total or other subpopulations. Further research on population abundance and gene flow is required to determine the number of subpopulations and if they are truly fragmented (with little to no gene flow between them). Therefore, the committee considers that the Southern Long-nosed Potoroo does not meet the criteria of Severely Fragmented with the available evidence.

Number of locations and declining extent and quality of habitats

The Action Plan for Australian Mammals 2012 estimated that there were more than ten locations (Woinarski et al. 2014) based on the key threatening processes (habitat loss, degradation and fragmentation, predation and inappropriate fire regime). Between 2019–2020 catastrophic bushfires impacted approximately 57 percent of the modelled distribution of the

Southern Long-nosed Potoroo, and the impact is predicted to cause a population decline of 33 (and up to 56 percent) for the Southern Long-nosed Potoroo over the next three generations (Threatened Species Recovery Hub 2020, 2021). Here, the number of locations is based on the threatening process of catastrophic bushfire and the compounding co-occurring threats of post-fire food loss and increased predation by European red fox and feral cats. The 2019–2020 bushfires demonstrated that one fire season could impact over half of the range and cause a loss of one-third of the population at disparate, geographically separate subpopulations. Given that bushfires are predicted to increase in frequency and intensity under climate change scenarios (CSIRO & Bureau of Meteorology 2015), it is reasonable to predict that the available habitats offering optimum habitat (including those which are 20+ years unburnt) will decrease in number and that the scale of future fires may cause similar declines. Thus, here the number of locations is considered to be less than ten.

Climate change intensifies the impacts of decreased rainfall, increased average temperatures and increased frequency of droughts (discussed above in Table 2 and 4). Drought conditions can act synergistically with bushfires to reduce the abundance of small- and medium-sized marsupials (Hale et al. 2016; Crowther et al. 2018). Drought degrades habitat suitability via loss of the primary food source of the species, underground fungi. Drier and hotter conditions will decrease both the diversity and abundance of underground fungi available to the species (Claridge et al. 1993; Tory et al. 1997). Recorded declines of Southern and Southern Long-nosed Potoroo have been attributed to the increasingly dry conditions (Frankham et al. 2011; Lewis 2015) though it's not known how this drier period influenced the availability of primary food sources in this location. Prolonged drought is likely to alter habitat, forest structures, food webs and key food availability, though how this will impact Southern Long-nosed Potoroo population size, distribution and viability are not well understood.

The decline in the number of adult individuals and the number of subpopulations is discussed above in Criterion 1 and Table 4. The decline is likely attributable to a suite of threatening processes acting together in a site-specific manner. The loss of subpopulations is assumed to have reduced and continue to reduce the area of occupancy, though a comprehensive survey and analysis is required to confirm this.

Conclusion

The data presented above appear to demonstrate that the subspecies is **eligible for listing as Vulnerable (B2ab (ii, iii, iv,v))** under this criterion.

However, the purpose of this consultation document is to elicit additional information to better understand the subspecies' status. This conclusion is based on the acceptance that this species has less than 10 locations (due to the threat of catastrophic bushfires and post-fire predation and habitat loss) and ongoing declines in population and habitat parameters and should be considered 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:

Not Eligible under Criterion 3

Population size

No robust estimates of population size exist for Southern Long-nosed Potoroo. Previous estimates in the Action Plan for Australian Mammals 2012 suspected that there were 20 000 individuals in the total population, though declining (Woinarski et al. 2014), which does not meet the threshold for listing under this criterion. Using the median of published density estimates and an AOO of 1856km^2 gave an estimated population of 254 000 individuals. The estimates of suspected population size vary greatly, though it is likely that the population is larger than 10 000 mature individuals, making it ineligible for Vulnerable under this Criterion.

Population decline

Recent declines of 36 percent (and up to 46 percent) were thought to have occurred in the year following the 2019-2020 bushfire season (Legge et al. 2021). Ongoing population declines of 33 percent (and up to 56 percent) over three generations (12 years) are anticipated following the 2019-2020 bushfire season (Legge et al. 2021).

Number of mature individuals in a subpopulation

The largest subpopulation has been reported to be 1000 individuals (Woinarski et al. 2014); however, published estimates are often significantly less. Long-nosed Potoroo subpopulations were rarely larger than 100 animals for both northern (Andren et al. 2013; Lewis 2015; Mason 1998) and southern subspecies (Long 2001; Poole 2005; Frankham et al. 2011). Subpopulations larger than 100 animals may exist in the larger forested habitats, though no published data are available.

Conclusion

With an estimated population size greater than 10 000, this species is not eligible under Criterion 3, even though it does meet sub-criterion thresholds. However, the purpose of this consultation document is to elicit additional information to better understand the subspecies' status. This conclusion should therefore 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**
D. Number of mature individuals	< 50	< 250	< 1,000
D2.[1] *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 km² or number of locations ≤ 5

[1] 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:

Not Eligible under Criterion 4

The total number of mature individuals is estimated to be 20 000, which is not considered low. Therefore, the species has not met this required element of this criterion.

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 three generations, whichever is longer (100 years max.)	≥ 20% in 20 years or five generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Evidence:

Insufficient data to determine eligibility

Population viability analysis has not been undertaken. Therefore, there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

Adequacy of survey

The survey effort has been considered adequate, and there is sufficient scientific evidence to support the assessment.

Listing and Recovery Plan Recommendations

No recovery plan is in place for the Southern Long-nosed Potoroo. A decision about whether this subspecies meets the criterion for Vulnerable and listing in the EPBC Act and 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.

Cataloguing data

This publication (and any material sourced from it) should be attributed as: Department of Agriculture, Water and the Environment 2021, *Conservation advice for Potorous tridactylus trisulcatus* (Southern Long-nosed Potoroo), Canberra.

This publication is available at the SPRAT profile for *Potorous tridactylus trisulcatus* (Southern Long-nosed Potoroo).

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