Australian Government

Department of Agriculture, Water and the Environment

Listing Advice for *Perameles nasuta* (southern long-nosed bandicoot)

This document is the approved listing advice for the species. The Minister decided that this species was not eligible for listing as threatened on 2/11/2021.

Perameles nasuta (southern long-nosed bandicoot) © Copyright, Chris Charles (2020)

Conservation status

Perameles nasuta is not currently listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Perameles nasuta was assessed by the Threatened Species Scientific Committee to not be eligible for listing under the EPBC Act. The Committee's assessment is at Attachment A. The Committee assessment of the species' eligibility against each of the listing criteria is:

- Criterion 1: Not eligible
- Criterion 2: Not eligible
- Criterion 3: Not eligible
- Criterion 4: Not eligible
- Criterion 5: Insufficient data

The main factors that make the species ineligible for listing are less than 30 percent past or future population reduction, and wide-ranging distribution and large population size, which both exceed the thresholds for listing.

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 *Perameles nasuta* Geoffroy (1804).

Perameles nasuta was previously comprised of two subspecies: *P. nasuta nasuta* distributed in Victoria (Vic), New South Wales (NSW) and Queensland (Qld; south of Townsville); and *P. nasuta pallescens* in central and northern Qld. *Perameles n. pallescens* is now recognised as a separate species, *Perameles pallescens* (northern long-nosed bandicoot, Thomas 1923), as genetic and morphological studies showed this taxon is distinct from *P. nasuta* (southern long-nosed bandicoot) (Westerman et al. 2012; Travouillon 2016). This taxonomy was used by Woinarski et al. (2014a).

Description

The southern long-nosed bandicoot is a medium-sized, ground-dwelling marsupial. Adults usually weigh approximately 750–1100 g, however, can range from 450–2050 g, with a head-body length of 310–445 mm and a tail length of 120–160 mm (Dickman & Stodart 2008; Dowle 2012). The southern long-nosed bandicoot displays sexual dimorphism, with males approximately 25 percent heavier and 10 percent longer than females (Dickman & Stodart 2008). The fur above is dull grey-brown, while the underbelly, forefeet and upper hindfeet are creamy white. The female southern long-nosed bandicoot has a rear-facing marsupium and eight nipples.

The southern long-nosed bandicoot can be distinguished from *Perameles gunnii* (eastern barred bandicoot) by the absence of distinct dark and light bars on the rump, except in some juveniles and adults which display a faint barred pattern. Similarly, the southern long-nosed bandicoot can be distinguished from *Isoodon* spp. (short-nosed bandicoots) by a longer and more pointed muzzle and ears (Dickman & Stodart 2008). No external features (only dental morphology) can be used to distinguish the southern and northern long-nosed bandicoots; however, their ranges are geographically distinct (Travouillon 2016).

Distribution

Historical distribution

Sub-fossil evidence suggests the southern long-nosed bandicoot's range remained similar throughout the Pleistocene until European occupation and extended from north Qld to the Vic-SA border, potentially reflecting their ability to thrive in a range of climates (Price 2005; Warburton & Travouillon 2016). However, since European occupation, evidence from museum specimens, published records, reliable oral history and sub-fossil evidence, suggest the southern long-nosed bandicoot's range has contracted (Burbidge et al. 2009). The southern long-nosed bandicoot remains extant in 90 percent of the bioregions (IBRA5) in which it occurred in 1750, having gone extinct in the Riverina and Naracoorte Coastal Plain bioregions (Burbidge et al. 2009). However, in 50 percent of the bioregions where it remains extant, its extent of occurrence (EOO) has declined by more than 50 percent since European occupation (Burbidge et al. 2009), suggesting the species and its habitat has contracted and it remains only in suitable habitat fragments within bioregions.

Current distribution

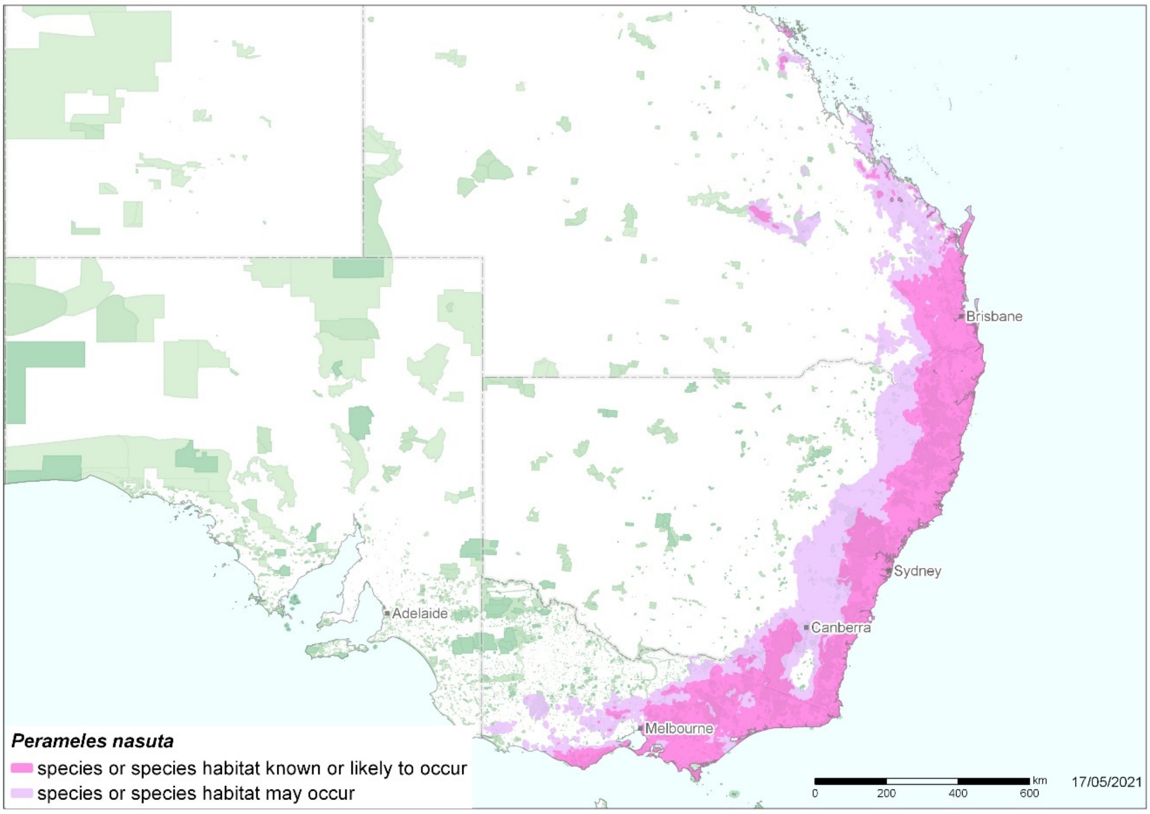
The southern long-nosed bandicoot is endemic to eastern and south-eastern Australia. Its range extends from Townsville in Qld, throughout coastal NSW, to the Otway Ranges in Vic (Map 1). The species occurs in the Central Mackay Coast, Brigalow Belt North, Brigalow Belt South, South Eastern Queensland, Nandewar, New England Tablelands, Sydney Basin, NSW South Western Slopes, South Eastern Highlands, South East Corner, Australian Alps, South East Coastal Plain, Victorian Midlands and Southern Volcanic Plain bioregions (IBRA7).

In Qld, the southern long-nosed bandicoot is distributed patchily along the east coast and is only common in the D'Aguilar Range and its lower slopes near Brisbane (DES 2016). In NSW, the species is considered a Regionally Significant Species (a priority taxon identified as having conservation significance) in the Sydney Basin bioregion (IBRA7), as it is uncommon, patchily distributed and possibly declining in southern Sydney (DECC 2007). In the Blue Mountains, it likely occurs in low density and may be declining (DEC 2005; DECC 2007, 2008a; OEH 2012). In northern Sydney the species occurs and is reliably recorded in camera trap surveys (at 32–57 percent of sites, DPIE unpublished data) in Garigal and Ku-ring-gai Chase National Parks (and adjoining suburbs), which are actively managed to reduce fox predation on co-occurring *Isoodon obesulus* (southern brown bandicoot) (Dowle 2012). Additionally, it is considered rare and patchily distributed in Werakata National Park and the Sugarloaf State Conservation Area near the Hunter Valley (DECC 2008b, c). In Booderee National Park, near Jervis Bay, the species is considered to be rare (Lindenmayer et al. 2018). In the South East Corner bioregion (IBRA7), the species occurs in Nadgee Nature Reserve and Ben Boyd National Park near Eden (Claridge et al. 2019). In the Australian Capital Territory (ACT), the southern long-nosed bandicoot was presumed extinct, until it was rediscovered near Corin Dam in Namadgi National Park in 2015 (EPD 2015). More recent sightings suggest a breeding population exists in this area but population size is unknown (CNM 2020). In Vic, the species is considered to be a rare Regionally Significant Species in the Gippsland Plain region (Ehmke et al. 2008; Parks Victoria 2016).

Distribution in urban areas

Although the southern long-nosed bandicoot was historically widespread across the major east coast cities of Brisbane, Sydney and Melbourne, it has contracted to isolated populations in urban bushland fragments (Marlow 1962; Van der Ree & McCarthy 2005; Garden et al. 2007; Dickman & Stodart 2008; Rowland 2015). Two small subpopulations in Sydney at North Head and Inner Western Sydney are listed as Endangered Populations under the *NSW Threatened Species Conservation Act 1995* (TSC Act) (NPWS 2000). The southern long-nosed bandicoot is likely to be locally extinct in inner Melbourne (<10 km from CBD), as it was found to have less than one percent probability of being extant in this region in 2000 (Van der Ree & McCarthy 2005). The species is likely to persist in isolated subpopulations in urban bushland fragments in outer Melbourne (>10 km from CBD), as it had greater than 50 percent probability of being extant in this region in 2000 (Van der Ree & McCarthy 2005) and has been observed in this area as recently as 2015 (ALA 2020).

Map 1 Modelled distribution of the southern long-nosed bandicoot



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

Bandicoots feature in Dreaming Stories across Australia. Bandicoots were an important food source for First Nations Australians and incorporated into the social and ceremonial fabric of local Indigenous culture and tradition (McArthur et al. 2000; Balme & O'Connor 2016). The southern long-nosed bandicoot may occur on country traditionally owned by Giya, Yuwi, Biri, Guwinmal, Darumbal, Bayali, Gureng Gureng, Badtjala, Gubbi Gubbi, Waka Waka, Yuggera, Bundjalung, Ngarabal, Gumbainggir, Nganyaywana, Dainggatti, Biripi, Geawegal, Worimi, Wonnarua, Awabakal, Darkinung, Kuring-gai, Dharug, Eora, Tharawal, Wiradjuri, Gundungurra, Ngunawal, Ngarigo, Yuin, Bidwell, Jaitmatang, Kurnai, Boonwurrung, Woiworung, Waveroo, Tungurong, Wathaurong, Gulidjan, Gadubanud, Giraiwuruang and Gunditjmara language groups.

Relevant biology and ecology

Habitat ecology

The southern long-nosed bandicoot is associated with several habitats, including rainforest, wet and dry woodland, scrubland, heathland, sedgeland, swamp and urban settings (Harrison 1962; Gordon & Hulbert 1989; Opie et al. 1990; Chambers & Dickman 2002; MacGregor et al. 2020). The southern long-nosed bandicoot nests diurnally in one of several cryptic nests, made with dry grass, twigs and leaves in a shallow depression, usually located in dense scrub vegetation (Stodart 1977; Scott et al. 1999; Hope 2012). It forages nocturnally in open grass areas, in moist, soft and/or sandy soils (Chambers & Dickman 2002; Hughes & Banks 2011). At the urban interface, the species is matrix-sensitive and requires both dense bushland for sheltering and open grass areas for foraging (Hughes & Banks 2011).

In Booderee National Park, probability of occupancy is greatest in areas with high variation in fine-scale vegetation cover and low amounts of small tree cover (Stirnemann et al. 2015). Following intensive control of the European red fox *(Vulpes vulpes)* the Booderee subpopulation experienced irruptive growth which peaked in 2006. The subpopulation subsequently declined in abundance, possibly due to it exceeding the available resources (Dexter et al. 2011; Lindenmayer et al. 2016). This resulted in density-dependent habitat selection, with forest and woodland habitat being preferred to heath, likely reflecting a higher abundance of foraging resources (Dexter et al. 2011). More broadly, bandicoot subpopulations are known to fluctuate dramatically across time (Short et al. 1997; Winnard & Coulson 2008; Short 2016).

Bandicoots are generalists and opportunists, allowing them to persist in urban remnant bushland (Quin 1985; Gordon & Hulbert 1989; Mallick et al. 1998; Garden et al. 2006). However, given their propensity to dig, the southern long-nosed bandicoot may be considered a pest by residents in urban areas (FitzGibbon & Jones 2006; Dowle & Deane 2008). The southern long-nosed bandicoot may be more abundant at lowland altitudes (Claridge & Barry 2000; Westerman et al. 2012) and in areas with high rainfall (Strahan 1995). Indeed, precipitation and temperature were identified as important variables for explaining the species' occupancy in eastern NSW (DPIE 2020b).

Home range

The size of the southern long-nosed bandicoot's home range depends on location. In Booderee National Park, the species' home range is reported as 3.9 ± 1.7 ha and 1.8 ± 0.2 ha for males and females respectively (MacGregor et al. 2013). Similarly, in urban remnant forest in Sydney Harbour National Park, the species' home range is reported as 4.4 ± 0.8 ha and 1.7 ± 0.8 ha for males and females respectively (Scott et al. 1999). In contrast, in a peri-urban setting in Ku-ring-gai Chase National Park, the species' home range is reported as 4.2 ± 0.6 ha for females (Hope 2012). This discrepancy may result from sparser foraging resources in peri-urban settings (Hughes & Banks 2011; Hope 2012). Female home ranges overlap year-round, while male home ranges only overlap during breeding periods (Scott et al. 1999).

Diet

The southern long-nosed bandicoot predominately consumes invertebrates, however, a broad range of food items including plants, fungi, skinks, birds and human-derived material (such as bird seed, vegetable scraps and plastic) are also consumed (Claridge 1993; McGee & Baczocha 1994; Scott et al. 1999; Thums et al. 2005; Vernes 2014; Guppy & Guppy 2018). Surface-active invertebrates, such as spiders, orthopterans, lepidopteran larvae, ants, leaves and seeds, are consumed in greater abundance during summer, while subterranean foods, such as cicada larvae, roots and fungi, are consumed in greater abundance during winter (Thums et al. 2005; Vernes 2014). Additionally, cicada larvae and fungi are more abundant in the diet of males than females, suggesting males may spend more time digging for subterranean foods (Thums et al. 2005).

Reproductive ecology

The southern long-nosed bandicoot is a solitary species, so individuals only interact during breeding periods (Stodart 1966, 1977). Females are panmictic and polyandrous, mating randomly with multiple males per breeding period (Rose et al. 1997; Piggott et al. 2018) which peaks from late spring to early summer (Scott et al. 1999; Dickman & Stodart 2008). Gestation lasts 12.5 days and weaning occurs at 60 days (Stodart 1966, 1977; Dickman & Stodart 2008). Females can produce up to four litters per year, with litter size ranging from one to five offspring, but typically being two to three (Lyne 1964; Stodart 1977; Thompson 1987; Scott et al. 1999). However, juvenile mortality can exceed 80 percent, suggesting a high reproductive rate with low recruitment success (Thompson 1987; Scott et al. 1999). The reproductive ecology of bandicoots can contribute to fluctuations in population size over time (Short et al. 1997; Winnard & Coulson 2008; Short 2016).

Both males and females disperse short distances from their mother's home range before they reach three to five months of age, at which point, dispersal ceases (Thompson 1987; Dickman & Stodart 2008). Females begin reproducing at five months of age (Dickman & Stodart 2008). In northern Sydney, minimum longevity was estimated to be approximately two years (Dowle 2012), while at North Head, average longevity was estimated to be approximately 10 months for males and 16 months for females (noting these estimates are based on only 30 percent of the subpopulation; Price & Banks 2015). Accordingly, the southern long-nosed bandicoot is likely to have a generation time of approximately one year. This is consistent with other bandicoot species, such as the eastern barred bandicoot and southern brown bandicoot, which live for two to three and three to four years respectively (Paull 2008; Jones et al. 2009) and have generation times of one to two years (Woinarski et al. 2014a).

Threats

The southern long-nosed bandicoot is threatened or may become threatened by habitat loss, disturbance or modification, invasive species, disease and climate change (Table 1).

Table 1 Threats impacting the southern long-nosed bandicoot

Threat	Status and severity [a]	Evidence
Habitat loss, disturbance and modifications		
Inappropriate fire regimes	• Status: current • Confidence: known • 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, linked to loss of suitable habitat, increased predator abundance and activity (McGregor et al. 2014; Leahy et al. 2016; Hradsky et al. 2017). Additionally, bushfires can exacerbate the declining abundance of small- and medium-sized marsupials caused by drought conditions (Letnic & Dickman 2006; Hale et al. 2016; Crowther et al. 2018). The southern long-nosed bandicoot is vulnerable to mortality during and after bushfires, due to its distribution in eucalypt forest and woodland, limited ability to flee, use of understorey vegetation as shelter and high vulnerability to introduced predators (Legge et al. 2020). Following bushfires, the species is likely to be more vulnerable to introduced predators, such as the European red fox (*Vulpes vulpes*) and feral cat (*Felis catus*) (Van der Ree & McCarthy 2005; MacGregor et al. 2015). This may be exacerbated by the increased activity of such introduced predators in burnt areas following both low- and high-intensity fires (Arthur et al. 2012; Hradsky et al. 2017). European red foxes can also alter their diet following low-intensity fires, to increase selection of the southern long-nosed bandicoot as prey (Hradsky et al. 2017). The destruction of large areas of suitable habitat may also lead to habitat fragmentation and the loss of gene flow among southern long-nosed bandicoot subpopulations (Bennett 1990; Dowle 2012). However, the fire response of the southern long-nosed bandicoot is likely to be complex and may vary across its range. Many studies suggest that southern long-nosed bandicoot population size increases with time following fires (Claridge & Barry 2000; Arthur et al. 2012; Lindenmayer et al. 2016), while others suggest the species is insensitive to fire history (Catling et al. 2001; Lindenmayer et al. 2008; MacGregor et al. 2020). Additionally, as an omnivorous generalist, the southern long-nosed bandicoot is unlikely to lack foraging resources following the fires (Legge et al. 2020).

Threat	Status and severity [a]	Evidence
Land clearing	• Status: historical/current • Confidence: known • Consequence: major • Trend: increasing • Extent: across part of its range	Habitat loss and fragmentation, via land clearing, road and urban development, and historical plantation establishment is implicated in the decline of many small- and medium-sized mammals, including southern long-nosed bandicoots (Bennett 1990; Law & Dickman 1998; Lindenmayer et al. 2000; NPWS 2004; Ramalho et al. 2018). Loss of understorey refuge habitat, via land clearing, can cause dramatic declines in abundance of the southern long-nosed bandicoot (Lunney & Leary 1988; Van der Ree & McCarthy 2005) by making the species more vulnerable to introduced predators (Claridge 1998; Arthur et al. 2012; McGregor et al. 2014; MacGregor et al. 2015; Leahy et al. 2016). Since European occupation, in 50% of the bioregions (IBRA5) where the species remains extant, the species' EOO has declined by more than 50%, suggesting the species has contracted to suitable habitat fragments within bioregions (Burbidge et al. 2009). Broad-scale land clearing ceased throughout Australia in the late 20th century. However, urban development continues to threaten the species, particularly in major cities (Van der Ree & McCarthy 2005; OEH 2017b, a). Indeed, land clearing in NSW has increased by approximately 60% since the *Native Vegetation Act 2003* was repealed in 2017 (DPI 2020a). Additionally, habitat fragmentation may restrict connectivity and gene flow among southern long-nosed bandicoot subpopulations (Dowle 2012). Forest remnants and roadside vegetation may facilitate connectivity and gene flow, by allowing sub-adults to disperse among habitat patches (Bennett 1990). However, loss of suitable vegetation cover at roadsides may restrict dispersal (Taylor & Goldingay 2014).
Road mortality	• Status: current • Confidence: known • Consequence: moderate • Trend: unknown • Extent: across part of its range	Bandicoots are some of the most frequently observed victims of road mortality along eastern Australian highways (Taylor & Goldingay 2004; Hayes & Goldingay 2009). Road mortality can prevent the species' dispersal and gene flow across landscapes (Taylor & Goldingay 2014) and has been identified as a major threat to the persistence of the Endangered subpopulation at North Head (Scott et al. 1999; Banks 2004). The southern long-nosed bandicoot regularly uses underpasses and road escape ramps, which may reduce road mortality (Taylor & Goldingay 2003; Bond & Jones 2008; Hayes & Goldingay 2009; Goldingay et al. 2018). However, underpass use may decline if there is loss of suitable vegetation cover at underpass entrances (Taylor & Goldingay 2014).

Threat	Status and severity [a]	Evidence
Native timber harvesting	• Status: historical/current • Confidence: inferred • Consequence: unknown • Trend: unknown • Extent: across part of its range	The southern long-nosed bandicoot is found in areas where native timber harvesting occurs, however, there are coupe and landscape-scale protections in place to maintain landscape connectivity and habitat (VicForests 2019). Native timber harvesting can affect bandicoots through the removal of overstorey and understorey (Brown & Main 2010). The immediate loss of ground cover and subsequent increased predation may threaten bandicoots in recently harvested areas (Richards et al. 1990). However, other observations indicate that bandicoots can successfully recolonise previously harvested areas (Fanning & Rice 1989; Recher et al. 1980).
Invasive species		
Predation by the European red fox	• Status: current • Confidence: known • Consequence: major • Trend: increasing • Extent: across the entire range	Predation by the European red fox is listed as a Key Threatening Process under the EPBC Act (DEWHA 2008) and has been implicated in the decline and extinction of many terrestrial, non-volant mammal species, including bandicoots (Ashby et al. 1990; Menkhorst & Seebeek 1990; Dickman 1996; Scott et al. 1999; Woinarski et al. 2014b; Radford et al. 2018). The southern long-nosed bandicoot is highly susceptible to predation by the European red fox (Radford et al. 2018). The species does not respond to odour cues from the European red fox and lacks an effective anti-predator response (Russell & Banks 2005; Sih et al. 2010). In contrast, the European red fox is rapidly attracted to odour cues from the southern long-nosed bandicoot, suggesting it has a novelty predation advantage (Bytheway et al. 2016). Indeed, the southern long-nosed bandicoot is commonly found in European red fox scats throughout their range (Reynolds & Aebischer 1991; Scott et al. 1999; Glen et al. 2006; Roberts et al. 2006; Hradsky et al. 2017). Predation by introduced predators has been implicated as a primary cause of mortality in the Endangered North Head subpopulation (Scott et al. 1999; NPWS 2004) and population viability analysis suggests that predation by the European red fox is likely to reduce the probability of persistence for this subpopulation (Price & Banks 2015). Sustained suppression of the European red fox is difficult to achieve (Marlow et al. 2016). Moreover, although subpopulations can irrupt following control of the European red fox (Dexter et al. 2007; Dexter et al. 2011; Lindenmayer et al. 2016; MacGregor et al. 2020), control efforts may also lead to an increase in feral cats (Risbey et al. 2000), which can cause further declines in bandicoot abundance (Arthur et al. 2012; Robley et al. 2014). Predation pressure by the European red fox is likely to have increased following the 2019-20 bushfires, as dense vegetation refugia has been reduced (Claridge 1998; Claridge & Barry 2000; Van der Ree & McCarthy 2005; Hradsky et al. 2017).

Threat	Status and severity [a]	Evidence
Predation by feral and domestic cats (*Felis catus*)	• Status: current • Confidence: known • Consequence: moderate • Trend: increasing • Extent: across the entire range	Predation by feral cats is listed as a Key Threatening Process under the EPBC Act (DOE 2015) and is implicated in the decline and extinction of many terrestrial, non-volant mammal species (Ashby et al. 1990; Menkhorst & Seebeek 1990; Dickman 1996; Woinarski et al. 2014b; Short 2016; Radford et al. 2018). The southern long-nosed bandicoot is highly susceptible to predation by feral and domestic cats (Radford et al. 2018), as it is within the at-risk weight range (<4 kg) (DOE 2015; Fancourt 2015). Indeed, the southern long-nosed bandicoot is commonly found in stomach and scat contents of feral cats throughout their range (Reynolds & Aebischer 1991; Hradsky et al. 2017; McComb et al. 2019). Predation by introduced predators has been implicated as a primary cause of mortality in the Endangered North Head subpopulation (Scott et al. 1999; NPWS 2004). The impact of feral and domestic cats is thought to be less significant than that of European red foxes (Radford et al. 2018). However, control of European red foxes may inadvertently lead to an increase in feral cats (Risbey et al. 2000), which can cause declines in bandicoot abundance (Arthur et al. 2012; Robley et al. 2014). Predation pressure by feral and domestic cats is likely to have increased following the 2019-20 bushfires, as dense vegetation refugia has been reduced (Claridge 1998; Van der Ree & McCarthy 2005; Arthur et al. 2012; McGregor et al. 2014; MacGregor et al. 2015; Leahy et al. 2016).
Predation by wild and domestic dogs (*Canis familiaris*)	• Status: current • Confidence: known • Consequence: moderate • Trend: increasing • Extent: across the entire range	Predation by wild dogs (*Canis familiaris*) is listed as a Key Threatening Process under the TSC Act and can have negative impacts on some threatened species (DPI 2017). Recent anecdotal and monitoring evidence suggests that the distribution and impacts of wild dogs are increasing in some parts of NSW (DPI 2017). The southern long-nosed bandicoot has been found in scat contents of wild dogs (Lunney et al. 1990) and predation by introduced predators has been implicated in the decline of the Endangered subpopulation at North Head (OEH 2017b). However, the threat posed by wild and domestic dogs is thought to be less significant than that of other introduced predators, as the southern long-nosed bandicoot possesses an effective anti-predator response to dogs, following thousands of years of living alongside dingoes (*Canis familiaris*) (Carthey & Banks 2012; Frank et al. 2016).

Threat	Status and severity [a]	Evidence
Habitat degradation caused by feral deer	• Status: current • Confidence: inferred • Consequence: moderate • Trend: increasing • Extent: across the entire range	Feral deer are considered a major emerging pest problem in Australia (DSEWPC 2011; Davis et al. 2016). Feral deer can destroy and degrade native vegetation, by trampling and grazing plants, ring-barking young trees, preventing plant regeneration, altering ecological communities, promoting weed invasion and spreading *P. cinnamomi* (DSEWPC 2011; Crowther et al. 2016; Davis et al. 2016). Accordingly, feral deer could reduce the quality of nesting and foraging habitat for the southern long-nosed bandicoot. Additionally, at recently burned sites, the abundance of small, ground-dwelling marsupials is negatively related to the occurrence of feral deer (Pedersen et al. 2013). So feral deer may be an important determinant of the abundance of small mammals in post-fire landscapes (Pedersen et al. 2014). Further information about this threat is required.
Habitat degradation caused by rabbits (*Oryctolagus cuniculus*)	• Status: current • Confidence: known • Consequence: minor • Trend: increasing • Extent: across the entire range	Rabbits are found in all states and territories of Australia and have been listed as a Key Threatening Process under the EPBC Act (DOEE 2016). Grazing by rabbits can damage habitat by preventing plant regeneration, reverse the normal processes of plant succession, alter ecological communities and promote weed invasion (DOEE 2016). Accordingly, rabbits could reduce foraging habitat quality for the southern long-nosed bandicoot. However, the species is a generalist and often forages in suburban backyards (Quin 1985; Gordon & Hulbert 1989; Mallick et al. 1998; Garden et al. 2006). Accordingly, rabbits likely pose a low risk to foraging resources for this species. The impact of rabbits often increases following droughts and bushfires, as food resources are scarce (DSEWPC 2011), so the impact of this threat may be greater following the 2019-20 bushfires.
Weed invasion	• Status: current • Confidence: inferred • Consequence: minor • Trend: increasing • Extent: across the entire range	Weeds can invade, establish in and outcompete native vegetation, particularly following disturbance events, such as bushfires (Hobbs 1991; Hobbs 2002; Brown et al. 2016). In particular, grassy weeds can increase fuel load and alter fire regimes (Milberg & Lamont 1995; Setterfield et al. 2013). 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; Grigulis et al. 2005). Accordingly, weed invasion may promote fire regimes that may imperil the southern long-nosed bandicoot across its range. Weed invasion may also degrade foraging habitat for the southern long-nosed bandicoot. However, the species is a generalist and often forages in suburban backyards (Quin 1985; Gordon & Hulbert 1989; Mallick et al. 1998; Garden et al. 2006). Accordingly, weed invasion likely poses a low risk to foraging resources for this species.

Threat	Status and severity [a]	Evidence
Disease		
Toxoplasmosis caused by *Toxoplasma gondii*	• Status: current • Confidence: suspected • Consequence: moderate • Trend: unknown • Extent: across the entire range	Toxoplasmosis is an infectious disease caused by the protozoan parasite, *T. gondii,* and is spread by cats. Toxoplasmosis was recognised as a cause of disease and mortality in Australian marsupials, including bandicoots (Obendorf & Munday 1990; Hollings et al. 2013). Toxoplasmosis has been reported in the southern long-nosed bandicoot (Pope et al. 1957) and was identified as a threat to the Endangered subpopulation at North Head (NPWS 2004). However, there is a lack of scientifically robust data to determine the level of susceptibility of the southern long-nosed bandicoot to *T. gondii* infection (Hillman et al. 2015).
Climate change		
Increased temperature and change to precipitation patterns	• Status: current • Confidence: inferred • Consequence: major • Trend: increasing • Extent: across the entire range	The CSIRO & Bureau of Meteorology (2015) predict eastern Australia will experience decreased rainfall, increased average temperatures and frequency of droughts. Drought conditions can act synergistically with bushfires to reduce the abundance of small- and medium-sized marsupials (Letnic & Dickman 2006; Hale et al. 2016; Crowther et al. 2018). The response of southern long-nosed bandicoots to drought conditions is unknown. However, eastern barred bandicoots are known to decline in abundance during drought conditions (Winnard & Coulson 2008). This is thought to be linked to reduced vegetation cover impacting the availability of nesting and shelter sites and making the species more susceptible to predation (Hill et al. 2010). Breeding in southern brown bandicoots and western barred bandicoots is known to cease during drought conditions (Driessen & Rose 2015; Short 2016). Accordingly, southern long-nosed bandicoots are likely to be similarly threatened by drought conditions. Additionally, following years of drought (DPI 2020b), catastrophic bushfire conditions resulted in extensive bushfires covering an unusually large area of eastern Australia in 2019-20. Estimates suggest the 2019-20 bushfires overlapped with approximately 43% of the southern long-nosed bandicoot's modelled distribution, including 18% at high or very high severity (Legge et al. 2021). Such catastrophic bushfires are increasingly likely to occur due to climate change (CSIRO & Bureau of Meteorology 2015). Warmer temperatures and changes to precipitation patterns may also favour the spread of *T. gondii* (Yan et al. 2019) and weeds (Scott et al. 2014).

Status—identify the temporal nature of the threat;

Confidence—identify the extent to which we have confidence about the impact of the threat on the species;

Consequence—identify the severity of the threat;

Trend—identify the extent to which it will continue to operate on the species;

Extent—identify its spatial content in terms of the range of the species.

Each threat has been described in Table 1 in terms of the extent that it is operating on the species. The risk matrix (Table 2) provides a visual depiction of the level of risk being imposed by a threat. In preparing 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 risk matrix and ranking of threats has been developed in consultation with in-house expertise using available literature.

Table 2 southern long-nosed bandicoot risk matrix

Likelihood	**Consequences**				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	Low risk	Moderate risk	Very high risk **Predation by feral and domestic cats**	Very high risk **Inappropriate fire regimes** **Increased temperature and change to precipitation patterns** **Predation by the European red fox**	Very high risk
Likely	Low risk	Moderate risk **Habitat degradation caused by rabbits** **Weed invasion**	High risk **Predation by wild and domestic dogs** **Habitat degradation caused by feral deer** **Road mortality** **Toxoplasmosis caused by *T. gondii***	Very high risk **Land clearing**	Very high risk
Possible	Low risk	Moderate risk	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	Moderate risk	High risk	Very high risk

Note: Native timber harvesting has not been included in the table as the consequences are unknown.

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The Threatened Species Scientific Committee finalised this assessment on 11 August 2021.

Attachment A: Listing Assessment for *Perameles nasuta*

Reason for assessment

This assessment follows prioritisation of a nomination from the TSSC.

Assessment of eligibility for listing

This assessment uses the criteria set out in the EPBC Regulations. The thresholds used 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 3 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria.

Table 3 Key assessment parameters

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	>30,000	>30,000	Unknown	There is no robust estimate of population size for the southern long-nosed bandicoot, however, it is very likely to exceed 10,000 mature individuals. The southern long-nosed bandicoot is described as common throughout its range (Dickman & Stodart 2008). The northern long-nosed bandicoot has very similar habitat requirements and threats to the southern long-nosed bandicoot, but a smaller EOO and AOO (Woinarski et al. 2014a). The northern long-nosed bandicoot's population is estimated to be 30 000 mature individuals (Woinarski et al. 2014a), suggesting the population size of the southern long-nosed bandicoot may be greater than 30,000 individuals.
Trend	Contracting			The number of mature individuals is likely to be contracting, due to mortality associated with loss of suitable habitat and increased predation following the 2019-20 bushfires. Preliminary estimates suggest population size will decline by 19% (80% confidence limits: 0–38%) 10 years after the bushfires (Legge et al. 2021).
Generation time (years)	1-2 years	1 year	2 years	The southern long-nosed bandicoot is likely to have a generation time of approximately one year (see Criterion 1).

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Extent of occurrence	1,286,404 km^2	Unknown	1,286,404 km^2	The maximum plausible value has been calculated using record data for the past 20 years (1999–2019) and applying the shortest continuous imaginary boundary which can be drawn to encompass these records, as outlined in the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2019). This is considered to be the maximum plausible value because the species range is thought to be contracting. The minimum plausible value is unknown. Accordingly, the maximum plausible value has been used in this assessment.
Trend	Contracting			Since European occupation, the species is known to have gone extinct in the Riverina and Naracoorte Coastal Plain bioregions (IBRA5) (Burbidge et al. 2009). Additionally, the species is declining in urban areas (Van der Ree & McCarthy 2005; OEH 2017a, b). EOO is likely to continue contracting due to loss of suitable habitat resulting from further fires and land clearing. See Table 1 for further information.
Area of Occupancy	13,608 km^2	Unknown	13,608 km^2	The maximum plausible value has been calculated using record data for the past 20 years (1999–2019) and applying 2 x 2 km grid cells, as outlined in the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2019). This is considered to be the maximum plausible value because the species range is thought to be contracting. The minimum plausible value has not been calculated. Accordingly, the maximum plausible value has been used in this assessment.
Trend	Contracting			Since European occupation, the species is known to have gone extinct in the Riverina and Naracoorte Coastal Plain bioregions (IBRA5) (Burbidge et al. 2009). Additionally, the species is declining in urban areas (Van der Ree & McCarthy 2005; OEH 2017a, b). AOO is likely to continue contracting due to loss of suitable habitat resulting from further fires and land clearing. See Table 1 for further information.
Number of subpopulations	Unknown	Unknown	Unknown	This wide-ranging species is cryptic and difficult to sample (Mills et al. 2002; Dexter & Murray 2009; Claridge et al. 2019). The species is known from many sites through Qld, NSW, ACT and Vic and the number of subpopulations is suspected to be large. Accordingly, the number of subpopulations cannot be estimated.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Contracting			Since European occupation, the species is known to have gone extinct in the Riverina and Naracoorte Coastal Plain bioregions (IBRA5) (Burbidge et al. 2009). Additionally, the species is declining in urban areas (Van der Ree & McCarthy 2005; OEH 2017a, b). The number of subpopulations is likely to continue contracting due to loss of suitable habitat resulting from further fires and land clearing. See Table 1 for further information.
Basis of assessment of subpopulation number	The number of subpopulations is unknown.			
No. locations	>10	>10	Unknown	The exact number of locations is not known; however, it is thought to exceed 10. The spatial nature of threats, although stochastic in space and time, is such that there are >10 geographically or ecologically distinct areas where a single bushfire could rapidly affect all individuals of the species. The geographic position of unburnt locations will vary between bushfires, but there are always likely to be >10.
Trend	Contracting			The severity, frequency and scale of catastrophic bushfires will likely increase due to climate change. Accordingly, the number of locations in which a single bushfire can rapidly affect all individuals will likely decrease.
Basis of assessment of location number	The species is wide-ranging and occurs across four states and territories. A large number of bushfire events (or other threat) are likely to be required to impact all individuals.			
Fragmentation	Although certain subpopulations, such as the North Head subpopulation, are considered to be isolated, there is no evidence of severe fragmentation across the species' range. Piggott et al. (2018) found the subpopulation at Booderee National Park is not genetically impoverished and has higher genetic diversity than other bandicoot species, suggesting connectively among subpopulations in this region.			
Fluctuations	Bandicoot population sizes are known to undergo extreme fluctuations across time (Short et al. 1997; Winnard & Coulson 2008; Short 2016). The subpopulation of southern long-nosed bandicoots in Booderee National Park experienced irruptive growth and subsequent decline in the number of individuals, peaking in 2006, following intensive control of the European red fox and subsequent overshooting of resources (Dexter et al. 2011; Lindenmayer et al. 2016). There are no known extreme fluctuations in EOO, AOO, number of subpopulations or locations.			

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

Criterion 1 evidence

Insufficient data to determine eligibility

Generation time

Female southern long-nosed bandicoots begin reproducing at five months of age (Dickman & Stodart 2008). In northern Sydney, minimum longevity was estimated to be approximately two years (Dowle 2012), while at North Head, average longevity was estimated to be approximately 10 months for males and 16 months for females (noting these estimates are based on only 30 percent of the subpopulation; Price & Banks 2015). Accordingly, the southern long-nosed bandicoot is likely to have a generation time of approximately one year. This is consistent with other bandicoot species, such as the eastern barred bandicoot and southern brown bandicoot, which live for two to three and three to four years respectively (Paull 2008; Jones et al. 2009) and have generation times of one to two years (Woinarski et al. 2014a). As three generations gives just a 3-year timeframe, the default 10-year timeframe was used for this criterion.

Population trends based on monitoring data

The southern long-nosed bandicoot is monitored across approximately 200 sites in eastern NSW National Parks using camera trapping, as part of the WildCount long-term monitoring program (DPIE 2020b). Using WildCount data, model-averaged occupancy of the species declined by approximately 22 percent (from 41 to 32 percent) between 2012–2016, with a trend model favoured (DPIE 2020b). However, the decline in occupancy did not exceed the detectable change threshold (approximately 40 percent) (DPIE 2020b). This suggests that the data are too variable to reliably infer occupancy is undergoing continuing decline rather than natural fluctuation (DPIE 2020b) and longer-term data (collected over 10–20 years) are required to make inferences.

Additionally, prior to the 2019-20 bushfires, population size was increasing or stable in other areas of NSW, which are actively managed to reduce fox predation (DPIE unpublished data; Claridge et al. 2019; Price & Banks 2019). Annual camera trapping in Garigal and Ku-ring-gai Chase National Parks in northern Sydney (and adjoining suburbs) suggested that naïve occupancy fluctuated among years but showed no upward or downward trend from 2010–2018 (DPIE unpublished data). Biennial cage trapping at North Head in northern Sydney suggested that population size increased from 2010–2016 and remained stable from 2016–2018 (Price & Banks 2019). Similarly, annual camera trapping in Ben Boyd National Park and Nadgee Nature Reserve in southern NSW suggested that probability of occupancy increased from 2015–2018 (Claridge et al. 2019). Immediately following the 2019-20 bushfires, the species underwent a slight decline in occupancy at these sites but is otherwise being reported at a rate broadly consistent with previous estimates (A. Claridge 2021. pers comm 25 June 2021). Ongoing monitoring over the next few years will allow better assessment of post-fire trends (A. Claridge 2021. pers comm 25 June 2021).

Given the variability in population trends among subpopulations within NSW, the information presented above cannot be scaled up to the species level with any confidence.

Extent of 2019-20 bushfires and distribution of the southern long-nosed bandicoot

Between 2017 and 2019, much of eastern Australia, including parts of Qld, NSW and Vic, experienced severe drought (Bureau of Meteorology 2020; DPI 2020b). Following this drought, catastrophic bushfire conditions resulted in extensive bushfires covering an unusually large area of eastern Australia in 2019-20. Fire severity varied across the bushfire extent, with many patches burning at extreme severity while others remained unburnt (DPIEa 2020). Initial estimates from early 2020 suggested the 2019-20 bushfires overlapped with approximately 35 percent (plausible range: 34–37 percent) of the southern long-nosed bandicoot's distribution (Legge et al. 2020; Ward et al. 2020). Recent preliminary estimates suggest the 2019-20 bushfires overlapped with approximately 43 percent of the species modelled distribution (Legge et al. 2021). Approximately, 18 percent of the species modelled distribution was burnt at high-very high severity (Legge et al. 2021).

Population reduction associated with 2019-20 bushfires and other threats

The southern long-nosed bandicoot is vulnerable to mortality during and after bushfires, due to its distribution in eucalypt forest and woodland, limited ability to flee, use of understorey vegetation as shelter and high vulnerability to introduced predators (Legge et al. 2020). Bushfires can also act synergistically with drought conditions to reduce the abundance of small and medium-sized marsupials (Letnic & Dickman 2006; Hale et al. 2016; Crowther et al. 2018) and other bandicoots are known to decline in abundance and cease breeding during drought conditions (Winnard & Coulson 2008; Driessen & Rose 2015; Short 2016).

Legge et al. (2021) produced preliminary estimates of population change following the 2019-20 bushfires, using the proportion of the species' modelled distribution in unburnt, mildly (low-moderate severity) and severely (high-very high severity) burnt areas, intersected with expert estimates of population change following bushfires. These estimates suggest that the overall population declined by 22 percent one year after the 2019-20 bushfires, but may have declined by as much as 33 percent (80 percent confidence limits: 11–33 percent decline) (Legge et al. 2021). By ten years after the 2019-20 bushfires, the overall population is predicted to have declined by approximately 19 percent, but may have declined by as much as 38 percent (80 percent confidence limits: 0–38 percent decline) assuming no further extensive fire events (Legge et al. 2021). This estimate includes 13 percent decline due to the 2019-20 bushfires and six percent decline due to ongoing processes, such as drought (Legge et al. 2021). This suggests that the species has, and is experiencing decline, which may approach 30 percent, but is more likely to be less than 30 percent.

The high level of uncertainty in population decline estimates (reflected by wide confidence intervals) is also reflected in the conflicting findings on the fire response of this species in the literature. A number of studies suggest that southern long-nosed bandicoot population size increases with time following fires. Claridge & Barry (2000) found that southern long-nosed bandicoot abundance increased with time since last fire in East Gippsland, Vic. Lindenmayer et al. (2016) also found a marginal increase in the probability of presence of southern long-nosed bandicoots with time since last fire at Booderee National Park in south-eastern NSW. Arthur et al. (2012) found that the density of southern long-nosed bandicoots increased immediately following a fire in 1980, peaked in the mid-1990s and declined again to low densities by 2008 in Nadgee Nature Reserve in south-eastern NSW.

In contrast, other studies find that southern long-nosed bandicoots are relatively insensitive to fire history. Catling et al. (2001) demonstrated that southern long-nosed bandicoot abundance was not affected by time since fire and instead depended on vegetation complexity in Nadgee Nature Reserve. MacGregor et al. (2020) found that neither fire frequency nor time since fire affected the persistence of the southern long-nosed bandicoot at Booderee National Park following the 2003 bushfires. Similarly, Lindenmayer et al. (2008) found that rates of capture of the southern long-nosed bandicoot increased over time at all survey sites in Booderee National Park, irrespective of fire history, suggesting that the 2003 bushfires had limited direct short–medium term impacts on the species. Price & Banks (2015) only found transitory reduction in population size, which was within normal variation, following hazard reduction burns at North Head in Sydney. Moreover, Hradsky et al. (2017) could not determine if fire history affected the occurrence of the southern long-nosed bandicoot in the Otway Ranges, Vic, although they did find that bandicoots would be more vulnerable to predation following fire. All in all, the fire response of the southern long-nosed bandicoot is most likely complex and may vary across its range, and existing data may not reflect the population response to fires of the scale experienced in 2019-20.

Australia is predicted to continue to experience decreased rainfall, increased frequency of droughts and average temperatures, leading to bushfires of increased frequency, severity and scale (CSIRO & Bureau of Meteorology 2015). Accordingly, catastrophic bushfires are increasingly likely to occur due to climate change. Predicted fire regimes may reduce the ability of small and medium-sized marsupials to recover from bushfire events, as declines in species richness, abundance and survival of such species are associated with frequent, large, severe and homogenous fires (Pardon et al. 2003; Chia et al. 2015; Hradsky 2020). Although the evidence presented above suggests the southern long-nosed bandicoot may recover from bushfire events, increased frequency, severity and scale of bushfires may result in an ongoing and non-reversible decline in population size of the species in the coming decades.

Conclusion

The Committee considers that the species is ineligible for listing in any category under this criterion.

Criterion 2 Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy

		Critically Endangered **Very restricted**	**Endangered** **Restricted**	**Vulnerable** **Limited**
B1.	Extent of occurrence (EOO)	**< 100 km^2**	**< 5000 km^2**	**< 20,000 km^2**
B2.	Area of occupancy (AOO)	**< 10 km^2**	**< 500 km^2**	**< 2000 km^2**
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			

Criterion 2 evidence

Not eligible

Extent of occurrence (EOO) and area of occupancy (AOO)

The extent of occurrence (EOO) is estimated at 1,286,404 km^2 and the area of occupancy (AOO) is estimated at 13,608 km^2. These figures are based on the mapping of point records from 1999 to 2019, obtained from state governments, museums and CSIRO. The EOO was calculated using a minimum convex hull, and the AOO calculated using a 2 x 2 km grid cell method, as outlined in the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2019).

Severe fragmentation, number of locations, continuing decline and extreme fluctuations

There is no evidence of severe fragmentation across the southern long-nosed bandicoot's range. The species is likely to occur in more than 10 locations in which a single threatening process could rapidly affect all individuals (Table 3). The increased frequency, severity and scale of bushfires, predicted under climate change scenarios (CSIRO & Bureau of Meteorology 2015), may result in an ongoing and non-reversible decline in the population size of the southern long-nosed bandicoot. There is evidence of extreme fluctuations in the population size of southern long-nosed bandicoot subpopulations (Table 3) (Dexter et al. 2011; Lindenmayer et al. 2016). However, the EOO, AOO, number of subpopulations and locations are not known to fluctuate for this species (Table 3).

Conclusion

The Committee considers that the species is ineligible for listing in any category under this criterion.

Criterion 3 Population size and decline

	Critically Endangered **Very low**	**Endangered** **Low**	**Vulnerable** **Limited**
Estimated number of mature individuals	**< 250**	**< 2500**	**< 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			

Criterion 3 evidence

Not eligible

Population size

There is no robust estimate of population size for the southern long-nosed bandicoot, however, it likely exceeds 10,000 mature individuals. The southern long-nosed bandicoot is described as common throughout its range (Dickman & Stodart 2008). In 2018, a minimum of 114 individuals were trapped at North Head in Sydney, suggesting a population size of 185 ± 15 on this headland alone (excluding individuals in adjacent urban areas) (Price & Banks 2019). Additionally, the northern long-nosed bandicoot has very similar habitat requirements and threats to the southern long-nosed bandicoot, but a smaller EOO and AOO (Woinarski et al. 2014a). The northern long-nosed bandicoot's population is estimated to be 30,000 mature individuals (Woinarski et al. 2014a), suggesting the population size of the southern long-nosed bandicoot may be greater than 30,000 individuals.

Conclusion

The Committee considers that the species is ineligible for listing in any category under this criterion.

Criterion 4 Number of mature individuals

	Critically Endangered **Extremely low**	**Endangered** **Very Low**	**Vulnerable** **Low**
D. Number of mature individuals	< 50	< 250	< 1000
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 km^2 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*.

Criterion 4 evidence

Not eligible

Number of mature individuals

There is no robust estimate of population size or number of mature individuals for the southern long-nosed bandicoot. However, as per the reasoning above for Criterion 3, it is highly unlikely that the number of mature individuals is less than 1000. Additionally, the southern long-nosed bandicoot does not meet the quantitative threshold for Vulnerable under sub-criterion D2. The area of occupancy (AOO) is estimated to be 13,608 km^2 and the species occurs at more than five locations.

Conclusion

The Committee considers that the species is ineligible for listing in any category under 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 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Criterion 5 evidence

Insufficient data to determine eligibility

Population viability analysis of southern long-nosed bandicoot subpopulation at North Head, Sydney

Population viability analysis (PVA) was conducted in 2004, 2011 and 2015 for an urban subpopulation of the southern long-nosed bandicoot at North Head in Sydney (Banks 2004; Lothian & Banks 2011; Price & Banks 2015). These models estimated this subpopulation's risk of extinction under various scenarios for carrying capacity, environmental variation and adult mortality (Banks 2004; Lothian & Banks 2011; Price & Banks 2015). The most recent PVA in 2015 found that the subpopulation had a 38 percent probability of extinction after 50 years, due to high rates of adult mortality caused by European red fox predation and road accidents (Price & Banks 2015). This represents an increase in the probability of extinction after 50 years for this subpopulation (20 percent probability in 2011) (Lothian & Banks 2011), which can be attributed to the slightly higher sex-specific adult mortality rates in 2015 (Price & Banks 2015). Given the variability in susceptibility to local extinction between urban and non-urban areas, and that many populations are distant from the urban interface (Dickman & Stodart 2008; Burbidge et al. 2009), the PVAs conducted for the North Head subpopulation cannot be scaled up to the species level with any confidence.

Population model for southern long-nosed bandicoot subpopulations in Melbourne Local Government Areas

Urban subpopulations of the southern long-nosed bandicoot in Melbourne are also at risk of extinction due to urbanisation, habitat fragmentation and loss of vegetation cover (Van der Ree & McCarthy 2005). Van der Ree & McCarthy (2005) estimated that by 2000, the southern long-nosed bandicoot had a probability of extinction greater than 99 percent in inner (<10 km from CBD) Local Government Areas (LGAs), and 6–50 percent in outer Melbourne (>10 km from CBD) LGAs, calculated using Bayesian formulation of Solow's equation (Solow 1993). However, as explained above, this population model also cannot be scaled up to the species level with any confidence.

Conclusion

The Committee considers that 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.

Public consultation

Notice of a consultation document was made available for public comment for 34 business days between 6 May 2021 and 24 June 2021.

Listing and Recovery Plan Recommendations

No recovery plan is in place for the southern long-nosed bandicoot. A Saving Our Species Strategy is in place in NSW for the Endangered subpopulation at North Head, Sydney (OEH 2017c).

The Threatened Species Scientific Committee recommends:

(i) that *Perameles nasuta* is not eligible for inclusion in the list referred to in section 178 of the EPBC Act.

Cataloguing data

This publication (and any material sourced from it) should be attributed as: Department of Agriculture, Water and the Environment 2021, *Listing Assessment for* Perameles nasuta *(southern long-nosed bandicoot),* Canberra.

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