Chapter 2

Faunal extinction in Australia

2.1 This chapter provides an overview of the faunal extinction crisis in Australia and outlines the key threats to the survival of Australia's unique fauna.

The status of Australia's biodiversity

2.2 Many submitters noted that Australia has a large, diverse range of unique wildlife. The Wilderness Society commented:

> Australia is one of the world's megadiverse countries: we have around 10% of all the world's species. We have a very high level of endemism compared with other countries. For example, 46% of our birds, 87% of mammals, and 93% of reptiles are only found here.[1]

2.3 However, extensive evidence was received about Australia's very poor record of protecting its unique wildlife, which set out the ongoing decline in biodiversity since white settlement. An article by Professor John Woinarski et al commented:

> Australia's isolation has resulted in its remarkable biodiversity distinctiveness but also the extraordinary vulnerability of its biota to novel threats. With the dwindling abundance, range, and diversity of so many species, we see now only a faint shadow of the richness and abundance of the Australian mammal fauna that existed at the time of European settlement.[2]

2.4 The extent of the decline means that Australia has one of the world's worst records for the extinction and lack of protection for threatened fauna and is ranked second (after Indonesia) in the world for ongoing biodiversity loss.[3] Submitters cited reports indicating that more than 10 per cent of endemic terrestrial land mammal species have become extinct over the last 200 years, which represents 50 per cent of the global mammal extinctions during that period.[4] In comparison, only one native

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1 The Wilderness Society, *Submission 133*, p. 4.

2 J Woinarski, A Burbidge and P Harrison, 'Ongoing unravelling of a continental fauna: Decline and extinction of Australian mammals since European settlement', *Proceedings of the National Academy of Sciences of the United States of America* (April 2015). This is available at: www.pnas.org/content/112/15/4531 (accessed 19 March 2019).

3 See for example: Wide Bay Burnett Environment Council, *Submission 30*, p. 1; The Wilderness Society, *Submission 133*, p. 5; Save the Bilby Fund, *Submission 175*, p. 6.

4 See for example: Centre for Ecosystem Science, UNSW, *Submission 56*, p. 5.

land mammal from continental North America has become extinct since European settlement.[5]

2.5 Mr Paul Sullivan, the Chief Executive of BirdLife Australia, commented on Australia's birds and stated that at least four bird taxa have recently become extinct, and the national threatened bird index shows that relative abundance of threatened birds has decreased by 52 per cent between 1985 and 2015. This includes birds such as the rainbow bee-eater, kookaburra and magpie. This compares very unfavourably with the 624 per cent increase in the population of threatened birds in the United States.[6]

2.6 Dr Graham Edgar, who appeared in a private capacity, provided evidence about the significant loss of biodiversity in the marine environment. Commenting on research on sediment cores from around south-eastern Tasmania, Dr Edgar stated:

> Every single core that we took showed that over the last 100 years there had been a catastrophic decline in the marine community in the system. So from an average of 23 species per slice of the core around 1900, we were down to around seven species today, of which four were introduced species. So basically the whole system has collapsed but with no recognition and nothing other than this study to show for it. This study has not been extended anywhere else but it is clearly important to understand what the scale of these losses are and to try and categorise them properly.[7]

2.7 BirdLife Australia also commented that, while biodiversity is declining globally, in many respects, Australia is a global anomaly. BirdLife Australia went on to explain:

> Australia is renowned worldwide for its unique and diverse flora and fauna. We are a wealthy nation with comparatively good governance and a high degree of political stability. Yet Australia is one of the worst performers for preventing extinction…Most of the continent is remote from urban communities and intensive areas of human development, yet we have high rates of extinction, with many of these having occurred in remote areas.[8]

Overview of the decline in biodiversity

2.8 The ongoing decline in biodiversity has been identified in a range of reports on Australia's environment. Australia's Fifth National Report to the Convention on Biological Diversity (CBD) stated that:

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5 J Woinarski, A Burbidge and P Harrison, 'Ongoing unravelling of a continental fauna: Decline and extinction of Australian mammals since European settlement'.

6 Mr Paul Sullivan, Chief Executive, BirdLife Australia, *Proof Committee Hansard*, 5 February 2019, p. 2.

7 Dr Graham Edgar, Private capacity, *Proof Committee Hansard*, 5 February 2019, p. 2.

8 BirdLife Australia, *Submission 118*, p. 8.

> In general, declines in population size, geographic range and genetic diversity are being seen among a wide range of species across all groups of plants, animals and other forms of life in Australia.[9]

2.9 The CBD report also noted a major decline in mammals in northern Australia, changes in species composition and loss of ecological integrity across a range of threatened ecological communities, and degradation in native vegetation.[10]

2.10 The latest State of the Environment (SoE) Report 2016 commented that 'the status of biodiversity in Australia is generally considered to be poor and deteriorating'. It was noted that mammal declines in northern Australia have continued; and there has been a significant decline in some bird species. The SoE report commented that 'very limited information is available to assess the state and trends of reptiles, amphibians and invertebrates, except for a few high-profile species'.[11] In relation to mammal extinctions, the SoE report commented that the number of mammal extinctions 'is vastly greater than that recorded for any other country'.[12]

2.11 In January 2019, the Organisation for Economic Co-operation and Development (OECD) released its report on Australia's environmental performance. The OECD report commented that 'Australia is one of 17 megadiverse countries. Although gaps in knowledge hamper proper assessment, the overall status of biodiversity is poor and worsening'.[13] The OECD report went on to acknowledge that steps had been taken to improve conservation outcomes, however, it found that:

> …the pace and scale of progress have not been enough to improve the status and trends of ecosystems and species…Small initiatives and limited investment are insufficient to fully address a legacy of land clearing combined with growing pressure from population growth, expanding development, invasive species and climate change.[14]

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9 Department of the Environment and Energy, *Fifth National Report to the Convention on Biological Diversity* (May 2014), p. 10. This report is available at: www.environment.gov.au/system/files/resources/fd293bd1-c8b8-4ef3-9178-315d06a1663d/files/5th-national-report-final_0.pdf (accessed 28 February 2019)

10 Department of the Environment, *Fifth National Report to the Convention on Biological Diversity*, May 2014, p. 2.

11 Department of the Environment and Energy, *Australia State of the Environment 2016, Overview*, p. 27, https://soe.environment.gov.au/theme/overview (accessed 28 February 2019).

12 Department of the Environment and Energy, *Australia State of the Environment 2016, Terrestrial plan and animal species* (2016), https://soe.environment.gov.au/theme/biodiversity/topic/2016/terrestrial-plant-and-animal-species-mammals#biodiversity-figure-BIO19 (accessed 28 February 2019).

13 Organisation for Economic Co-operation and Development, *OECD Environmental Performance Reviews: Australia 2019* (2019), p. 3. This report is available at: https://doi.org/10.1787/9789264310452-en (accessed 28 February 2019)

14 Organisation for Economic Co-operation and Development, *OECD Environmental Performance Reviews: Australia 2019* (2019), p. 170.

2.12 When considered together, these reports provide clear evidence of the deterioration of Australia's biodiversity. Significantly, it was suggested to the committee that the rate of decline in biodiversity is expected to continue.[15] BirdLife Australia, for example, commented that 'we anticipate the rate of EPBC [Environment Protection and Biodiversity Conservation] listings (new listings and uplistings) will only increase (in volume and pace) over the next 10–50 years'.[16] The Threatened Species Recovery Hub stated:

> Where recent population trajectory information is available, the overwhelming trend for EPBC Act-listed animal species is for ongoing population decline (174 species); in contrast, only three listed species are considered to be increasing. Extinction is a likely end result of ongoing population decline for threatened species.[17]

2.13 WWF-Australia also saw a poor outlook for Australia's fauna and suggested that, given increases from 2011 to 2015 in the number of listed critically endangered animals and plants, 'a further wave of extinctions is imminent'.[18] Mr James Trezise, a Policy Analyst for the Australian Conservation Foundation (ACF), commented:

> This is a crisis that is clearly unfolding in front of our eyes, and it's not like the pressures that are driving these events are abating or diminishing—in fact, they are ramping up. Australia is now a global deforestation hotspot. Let that sink in: we stand next to places like the Amazon and Indonesia for deforestation.[19]

2.14 The reasons for this outcome were clearly articulated by the Centre of Ecosystem Research, which stated:

> Extinction rates are accelerating because the underlying causes are not being addressed effectively by Australian governments, communities and industries, and laws and policies meant to protect against loss of species are not adequately implemented (regulation and compliance) or often subsidiary in decision-making to development legislation (e.g. mining, water resource management).[20]

2.15 The following discussion provides a more detailed analysis of the increase in the number of fauna listed as threatened and the trend rate of extinction in Australia.

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15 See, for example: Environmental Farmers Network, *Submission 27*, p. 2.

16 BirdLife Australia, *Submission 118*, p. 6. See also Centre for Ecosystem Science, *Submission 56*, p. 6.

17 Threatened Species Recovery Hub, *Submission 159*, Attachment 1 (*The ongoing decline in the population and conservation status of threatened fauna*), p. 2.

18 WWF-Australia, *Submission 131*, p. 1.

19 Mr James Trezise, Policy Analyst, Australian Conservation Foundation, *Committee Hansard*, 8 October 2018, p. 1.

20 Centre of Ecosystem Research, *Submission 56*, p. 7.

Rate of faunal extinction in Australia

2.16 At the time of European settlement, much of the fauna now regarded as threatened flourished across the continent. The Northern Territory Government noted extinctions had occurred even in the arid lands of central Australia and stated that this area experienced the worst mammal loss since European settlement.[21] Woinarski et al provided evidence of the rate of mammal extinction in Australia from settlement and stated:

> Although the detail of the patterning is imprecise, the available evidence indicates a broad sequential wave of mammal losses, beginning from the first settled areas in southeastern Australia (coincident with the first arrivals of some associated threats) from the 1840s, reaching central Australia in the 1890s with rapid declines there particularly over the period of 1930–1960 and marked losses continuing from about the 1960s to the present day in much of northern Australia.[22]

2.17 Woinarski et al also pointed to records of the collection of skins of now extinct and threatened species as evidence of this earlier abundance. For example, in one year (1908), a single company marketed 100 000 brush-tailed rock-wallaby skins; and in about 1900, dealers in Adelaide sold a now-extinct subspecies of brush-tailed bettong by the dozen at about ninepence a head for coursing on Sunday afternoons.[23]

2.18 One significant example of the decline of a previously abundant species is the koala. The number of koalas at the time of European settlement has been estimated as being up to 10 million.[24] Following settlement, koala populations came under pressure from clearing of habitat, fire and hunting. Woinarski et al, in their study of mammal extinctions, commented that in the 31 days of the last open season in Queensland in 1927, 500 000 koala skins were collected.[25]

2.19 While hunting of koalas ceased by 1930, continuing pressure from clearing of habitat, disease, fire and drought, saw numbers decline significantly. Koala populations in Queensland, New South Wales and the Australian Capital Territory were listed as vulnerable under the EPBC Act in May 2012. The Species Profile and Threats Database utilised in the listing process assessed koala populations in the

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21 Northern Territory Government, *Submission 2*, p. 2.

22 J Woinarski, A Burbidge and P Harrison, 'Ongoing unravelling of a continental fauna: Decline and extinction of Australian mammals since European settlement'.

23 J Woinarski, A Burbidge and P Harrison, 'Ongoing unravelling of a continental fauna: Decline and extinction of Australian mammals since European settlement'.

24 Bill Phillips, *Koalas: The little Australians we'd all hate to lose*, Australian Government Publishing Service, Canberra, 1990, pp. 20–26.

25 J Woinarski, A Burbidge and P Harrison, 'Ongoing unravelling of a continental fauna: Decline and extinction of Australian mammals since European settlement'.

period 1990 to 2010 as having declined by 43 per cent in Queensland and 33 per cent in New South Wales.[26]

2.20 Despite being listed as vulnerable, submitters argued that koala numbers are still declining, with the Australian Koala Foundation estimating that there are fewer than 100 000 koalas left in the wild, possibly as few as 47 860.[27] Localised extinction is now predicted—Koala Action submitted that the koala is now 'on the brink of extinction in many regions of Queensland'. Koala Action noted that between 1996 and 2014 the estimated mean decline in koala density in the Koala Coast (Redlands) was 80.25 per cent and in the Pine Rivers 54.28 per cent.[28]

2.21 While environmental awareness has grown from the 1960s, with both the Commonwealth and state governments enacting legislation to protect biodiversity, declines in abundance and extinctions have continued to occur. For example, the Commonwealth *Endangered Species Protection Act 1992* responded to 'the widespread view expressed by the Australian public that endangered species are a national problem that requires Commonwealth Government involvement'. The Act established national lists of endangered and vulnerable species and endangered ecological communities. At that time there were 226 species and sub-species of plants and 73 species of animals regarded as endangered, with a further 661 species and sub-species of plants and 66 of animals regarded as vulnerable.[29]

Since the introduction of the EPBC Act

2.22 The EPBC Act replaced the previous ad hoc approach to environmental legislation. In relation to biodiversity, it was the first time that the Commonwealth Government had 'legislated for the holistic concept of biodiversity conservation'.[30] One of the objects of the EPBC Act is to conserve Australian biodiversity.[31] In order to achieve its objects, the EPBC Act enhances Australia's capacity to ensure the conservation of its biodiversity by including provisions to protect native species,

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26 Department of the Environment and Energy, *Species Profile and Threats Database: Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)–Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)* www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=85104 (accessed 28 February 2019).

27 Australian Koala Foundation, *Submission 169*, p. 2.

28 Koala Action, *Submission 92*, p. 3.

29 Senator the Hon Nick Bolkus, Minister for Administrative Services, Second Reading Speech, *Senate Hansard*, 26 November 1992, p. 3587.

30 Senate Environment, Recreation, Communications and the Arts Committee, *Environment Protection and Biodiversity Conservation Bill 1998 and Environmental Reform (Consequential Provisions) Bill 1998*, April 1999, chapter 9.

31 EPBC Act, paragraph 3(1)(c).

including the prevention of extinction and the promotion of the recovery of threatened species, and protection of ecosystems.[32]

2.23 The EPBC Act provides for species identification and listing of species and ecological communities as threatened. Since the commencement of the EPBC Act, new categories have been added for listed threatened species and ecological communities. Critically endangered, conservation dependant and extinct in the wild have been added to the previous categories of endangered, vulnerable and extinct for threatened species and critically endangered and vulnerable have been added to the previous category of endangered for ecological communities.[33]

Trends in listings

2.24 Many submitters noted that since the introduction of the EPBC Act in 1999, the list of nationally threatened species and ecological communities has increased by more than 30 per cent.[34] The Threatened Species Recovery Hub added that, since the EPBC Act's inception, only 13 animal species have been delisted, five animals species have been down-listed (mostly due to review or new information) and 46 species have had their conservation status up-listed, mostly because of ongoing and severe deterioration in their conservation outlook.[35]

2.25 The SoE Report 2016 provides information on the threatened species list as at December 2015:

- 74 ecological communities, of which 31 were listed as critically endangered, 41 as endangered and 2 as vulnerable.
- 480 animal species, including 55 listed as extinct or extinct in the wild, an increase of 44 species since 2011. The number of nationally listed threatened animal species has increased for all taxa except amphibians. This included seven new mammal species listed as endangered and four new species listed as vulnerable. Two species of marsupial mole were delisted. The number of threatened bird species increased by 15 species; the number of critically endangered bird species increased by seven. Four species were uplisted to critically endangered since 2011.[36]

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32 EPBC Act, sub paragraphs 3(2)(e)(i), 3(2)(e)(iii).

33 As set out in chapter 1 of this report.

34 The Wilderness Society, *Submission 133*, p. 5.

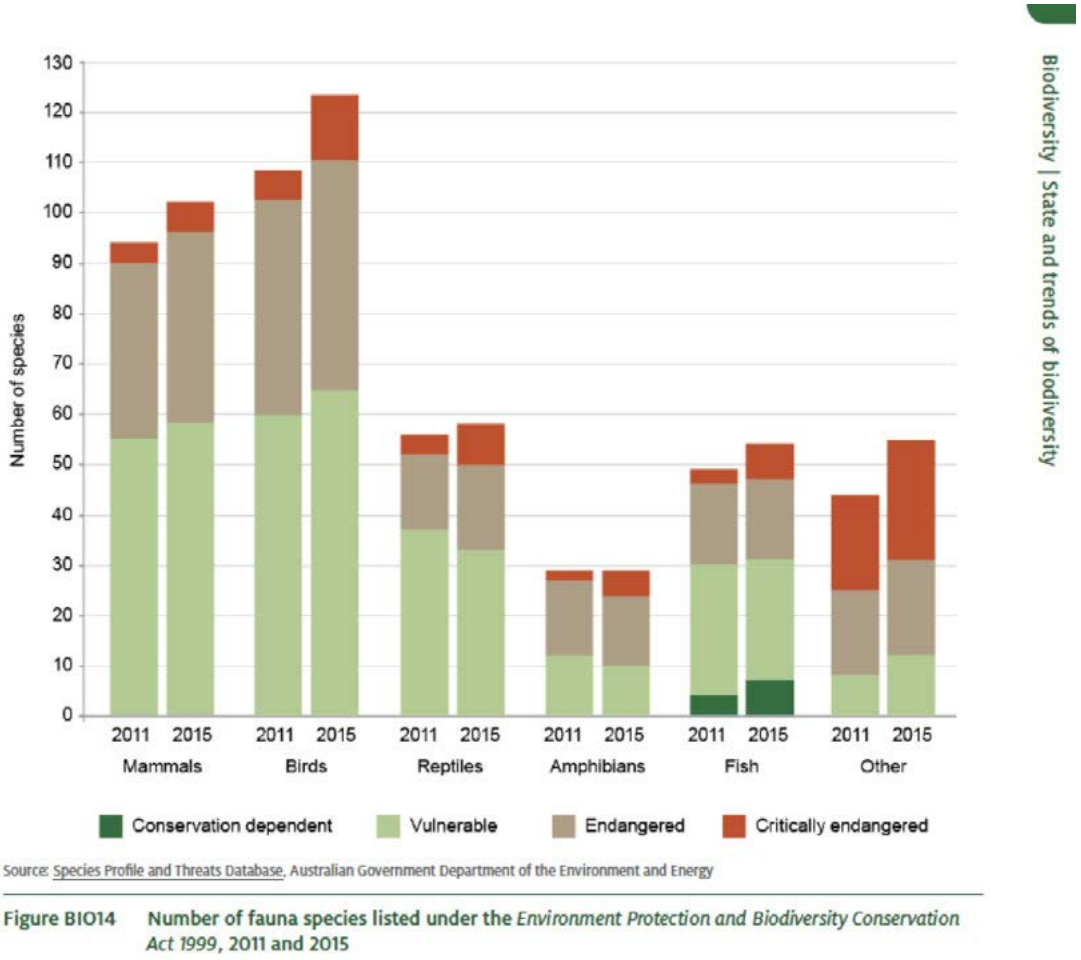
35 Threatened Species Recovery Hub, *Submission 159*, Attachment 1 (*The ongoing decline in the population and conservation status of threatened fauna*), p. 1.

36 Department of the Environment and Energy, *Australia State of the Environment 2016, Terrestrial plan and animal species: Threatened Species Lists* (2016), https://soe.environment.gov.au/theme/biodiversity/topic/2016/terrestrial-plant-and-animal-species-threatened-species-lists#figure-bio14number-of-fauna-species-listed-under-the-environment-protection-and-biodiversity-conservation-act-1999-2011-and-2015--119471 (accessed 28 February 2019).

- 1294 plant species, including 37 species listed as extinct.[37]

2.26 The SoE Report 2016 also provides the change in listings between 2011 and 2015 and noted that in that period, the list of nationally threatened species and ecological communities increased, with the addition of 30 new ecological communities, and 44 animal and 5 plant species.[38] Figure 2.1 provides EPBC Act fauna listings for 2011 and 2015.

Figure 2.1: Number of fauna listings under the EPBC Act, 2011 to 2015



Source: Department of the Environment and Energy, *SoE Report 2016.*

2.27 In July 2018, there were a total of 511 faunal species listed under all threatened species categories, an increase in total listings of 31 since 2015.[39] On

37 Department of the Environment and Energy, *Australia State of the Environment 2016, Overview*, p. 27.

38 Department of the Environment and Energy, *Australia State of the Environment 2016, Overview*, p.27.

39 Humane Society International, *Submission 98*, p. 2.

18 February 2019, the reclassification of listed species reduced the total number of threatened species to 506.[40]

2.28 Table 2.1 provides the EPBC Act list of threatened fauna in 2018 and 2015.

Table 2.1: EPBC Act list of threatened fauna

Listing	Species number 2018	Species number 2015
Extinct	Frogs (4) Mammals (27) Birds (22) Other animals (1)	Fauna species extinct or extinct in wild (55)
Extinct in the wild	Fishes (1)	
Critically endangered	Fishes (8) Birds (17) Frogs (5) Mammals (9) Reptiles (10) Other animals (29)	Fishes (7) Birds (13) Frogs (5) Mammals (6) Reptiles (8) Other animals (24)
Endangered	Fishes (17) Birds (54) Frogs (14) Mammals (37) Reptiles (20) Other animals (21)	Fishes (16) Birds (46) Frogs (14) Mammals (38) Reptiles (17) Other animals (19)
Vulnerable	Fishes (24) Birds (62) Frogs (10) Mammals (60) Reptiles (33) Other animals (13)	Fishes (24) Birds (65) Frogs (10) Mammals (58) Reptiles (33) Other animals (12)
Conservation dependent	Fishes (8)	Fishes (7)
TOTAL	Fauna 506	Fauna 480

Sources: Department of the Environment and Energy, *Species Profile and Threats Database*, www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl; and *State of the Environment Report, Terrestrial plant and animal species: Threatened species lists*, https://soe.environment.gov.au/theme/biodiversity/topic/2016/terrestrial-plant-and-animal-species-threatened-species-lists#figure-bio14number-of-fauna-species-listed-under-the-environment-protection-and-biodiversity-conservation-act-1999-2011-and-2015--119471 (both accessed 28 February 2019).

40 The Hon Melissa Price MP, Minister for the Environment, 'Stronger Protections for threatened species', *Media Release*, 18 February 2019.

2.29 The Threatened Species Recovery Hub provided an analysis of population trajectory of EPBC Act listed threatened animal species, based mainly on recent International Union for Conservation of Nature (IUCN) assessments. The trajectory is provided in Table 2.2.

Table 2.2: Population trajectory of EPBC Act listed threatened animal species

Years on EPBC Act list	Current population trajectory				
	Decreasing	Stable	Unknown	Increasing	Not given
18	116	47	21	3	9
15-17	10	1	0	0	2
12-14	10	2	1	0	1
9-11	5	1	0	0	0
6-8	9	1	1	0	0
3-5	16	6	2	0	3
0-2	8	2	2	0	1
Total	174	60	27	3	16

Source: Threatened Species Recovery Hub, *Submission 159*, Attachment 1 (*The ongoing decline in the population and conservation status of threatened fauna*), p. 7. See submission for notes accompanying table.

Faunal species extinctions

2.30 The EPBC Act list includes 55 fauna species either extinct or extinct in the wild. However, evidence suggests that the number of extinctions is much higher.

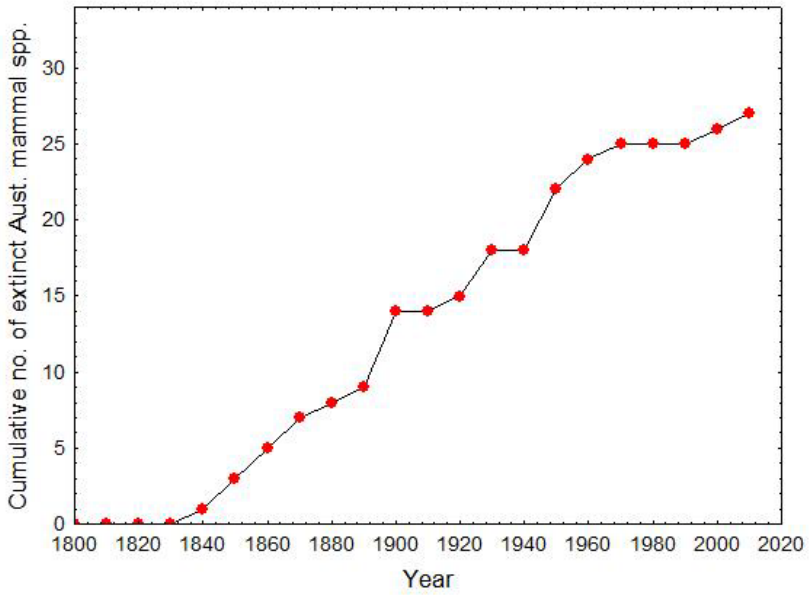
2.31 For example, while the EPBC Act lists 27 extinct mammal species, the Threatened Species Recovery Hub have identified 34 mammal extinctions in Australia since European settlement. It was added that of the 27 listed mammal extinctions include seven subspecies. As a consequence, 'only 59% of the extinctions of Australian mammal species are formally acknowledged under the Act, severely under-playing the extent of loss'.[41]

2.32 The Threatened Species Recovery Hub added that 'the rate of Australian mammal extinctions has continued largely unabated, with an average of 1–2 Australian endemic mammal species being made extinct per decade since about the 1850s'. The Hub also noted that many of the now extinct mammal species had vast ranges and large population sizes.[42] The cumulative number of extinct mammal since 1800 is provided in figure 2.2.

41 Threatened Species Recovery Hub, *Submission 159*, Attachment 1 (*The ongoing decline in the population and conservation status of threatened fauna*), p. 3.

42 Threatened Species Recovery Hub, *Submission 159*, Attachment 1 (*The ongoing decline in the population and conservation status of threatened fauna*), pp. 3–7.

Figure 2.2: Cumulative number of extinctions of Australian endemic mammal species since 1800



Note that, for some species, the dating of extinction is too difficult to assess, so the graph does not include all extinct species

Source: Threated Species Recovery Hub, *Submission 159*, Attachment 1 (*The ongoing decline in the population and conservation status of threatened fauna*), p. 3.

2.33 The Threatened Species Recovery Hub also provided information on the rate of extinction of reptiles and noted that the first known extinction of an Australian endemic reptile species since 1788 occurred in 2014, with the death in captivity of the last known Christmas Island forest skink (*Emoia nativitatis*).[43] It also noted that two other Australian endemic lizards, the blue-tailed skink (*Cryptoblepharus egeriae*) and Lister's gecko (*Lepidodactylus listeria*), became extinct in the wild in 2010 and 2012. The Threatened Species Recovery Hub commented that extinction, or extinction in the wild, of these three Australian endemic lizards represents about 10 per cent of the 31 global reported reptile extinctions since 1500. The Hub stated that, other than the extinction of one tortoise species, these three reptiles are the only known reptile extinctions in the world since the 1970s.[44]

2.34 Submitters also commented that two other species–Bramble Cay melomys (*Melomys rubicola*), the and Christmas Island Pipistrelle (*Pipistrellus murrayi*)—have gone extinct in the last decade.[45] In February 2019, the Minister, based on advice from

43 Threatened Species Recovery Hub, *Submission 159*, Attachment 1 (*The ongoing decline in the population and conservation status of threatened fauna*), p. 3.

44 Threatened Species Recovery Hub, *Submission 159*, Attachment 1 (*The ongoing decline in the population and conservation status of threatened fauna*), p. 4.

45 Green Fire Science, University of Queensland, *Submission 88*, p. 5; Victorian National Parks Association, *Submission 110*, p. 2.

the Threatened Species Scientific Committee (TSSC), determined to move the Bramble Cay melomys to the extinct category. At that time, the Tammar wallaby was removed from the extinct list to not listed.[46]

2.35 The committee also received evidence that 'many more Australian animal and plant species have not been sighted for decades, which warrants full scientific assessment for extinct listing'.[47]. For example, three subspecies and one species of Australian bird are thought to have gone extinct in the last two decades: Spotted Quail-thrush (Mt Lofty Ranges), Hooded Robin (Tiwi Islands), Star Finch (southern) and White-chested White-eye. All were seen in the 1980s or early 1990s but have not been sighted since.[48]

2.36 Given the concern that the EPBC Act listings do not accurately reflect the current outlook for many species, the Centre for Ecosystem Science, UNSW, concluded:

> Many more Australian animal and plant species have not been sighted for decades, warranting full scientific assessment for extinct listing.[49]

Species that are threatened with extinction

2.37 The committee also received evidence that pointed to a range of species which are threatened with extinction in the coming decades.[50] For example, Green Fire Science highlighted that, according to the *Action Plan for Australian Mammals*, 56 mammal species and 33 mammal subspecies are threatened with extinction.[51]

2.38 BirdLife Australia noted recent research which has identified a group of threatened birds at high risk of extinction in the next 20 years. It stated that 'these are taxa that have not attracted significant recovery effort, funding and/or lack recovery plans, representing the failure of successive Australian Governments to meet our international obligation to protect and conserve biodiversity'.[52]

2.39 In addition, submitters stated that, for many species, there is too little information about them to have them listed. The TSSC stated that:

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46 Minister for the Environment, the Hon Melissa Price MP, 'Stronger protection for threatened species', *Media release*, 18 February 2019.

47 Centre for Ecosystem Science, *Submission 56*, p. 7.

48 Green Fire Science, University of Queensland, *Submission 88*, p. 9; BirdLife Australia, *Submission 118*, p. 4.

49 Centre for Ecosystem Science, UNSW, *Submission 56*, p. 7.

50 Nature Conservation Society of South Australia, *Submission 104*, p. 3.

51 Green Fire Science, University of Queensland, *Submission 88*, p. 9, citing Woinarski JCZ, Burbidge AA, Harrison PL 'The Action Plan for Australian Mammals 2012', CSIRO Publishing (2014).

52 BirdLife Australia, *Submission 118*, p. 6.

> There are large numbers of other poorly known but imperilled species at risk from extinction but they are not protected because we know so little about them. Sufficient data are available for other species that have not been assessed. Scientists suspect that many hundreds of thousands of Australian species remain undiscovered or poorly known, and that many of these species are at as great a risk of extinction as those formally listed as threatened.[53]

2.40 Green Fire Science commented that research suggested that 'the number of EPBC Act listed threatened fauna species in Australia is possibly just 1/20th of the number that may actually be threatened'. Further, numerous species may have been lost before they were known to science. Green Fire Science concluded that 'we are constantly under-stating the severity of the crisis facing us'.[54]

Issues raised in relation to the threatened species list

2.41 As the EPBC Act list is at the heart of the legislative framework for threatened species recovery and protection, it was argued that the list must be rigorous and reflect the current situation of listed species. The Threatened Species Recovery Hub stated:

> The list of Australia's threatened species provides a robust foundation for recovery efforts and the application of regulatory protections. The list should therefore be justified, up-to-date and appropriately include all Australian species that are threatened with extinction. If the list is not comprehensive, so must our approach to conserving species be inadequate. An accurate, scientifically robust list thus provides a strong foundation for the prevention of extinction, and the recovery, of Australia's threatened species.[55]

2.42 However, the committee received a range of evidence commenting on aspects on the process for listing threatened species and ecological communities including:

- lengthy delays between nomination and listing of species and communities;
- the lists are incomplete, inaccurate and are not reviewed;
- heavy reliance on public nominations;
- problems with listing where there is insufficient data;
- taxonomic bias in the lists; and
- lack of emergency listing provisions.

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53 Threatened Species Scientific Committee, *Submission 151*, p. 4.

54 Green Fire Science, University of Queensland, *Submission 88*, p. 9.

55 Threatened Species Recovery Hub, *Submission 159*, Attachment 10 (*The adequacy of existing assessment procedures for identifying the conservation status of threatened fauna*), p. 3.

2.43 The following discussion provides an overview of the evidence received in relation to these issues. The committee's final report will consider these issues in greater detail.

Delays in nomination

2.44 Submitters stated that the process for listing is slow—at best taking up to a year, but generally taking two years.[56] While the EPBC Act includes timeframes for the TSSC to complete its assessment of nominations, the Act allows the TSSC to seek an extension of time to do so. The Department of the Environment and Energy (the department) has informed the committee that, at the time of writing, there are currently 13 species for which the assessment completion time has been extended by the Minister, at the TSSC's request. The department also commented that the requests and justification for extensions are available on the departmental website.[57]

2.45 One example of a delay in the assessment of a change in listing is the Australian sea lion. In 2005, the sea lion was EPBC Act listed as vulnerable. However, in 2008, the IUCN listed it as endangered. The TCCS is currently assessing the listing of the Australian sea lion and has been doing so for a number of years.[58]

2.46 As a consequence of the time taken to complete a nomination, a species may continue to decline and their conservation status can become more threatened. In addition, the failure to list a species may result in a lack of adequate consideration being given when a development proposal is being assessed. To address these concerns, submitters called for a simpler and faster nomination and listing process with statutory timeframes for the assessment of nominations.[59]

Lack of accuracy

2.47 In addition to concerns about the accuracy of listed species that have gone extinct, submitters also questioned the accuracy of the threatened species list for other classifications. For example, Associate Professor Mark Lintermans stated that the listings of freshwater fish grossly underestimate the actual number of threatened taxa. Professor Lintermans added:

> It is estimated that approximately 1/3rd of Australia's freshwater fish are yet to be formally described, and it is this cryptic freshwater fish biodiversity

56 Green Fire Science, University of Queensland, *Submission 88*, p. 19; Australian Institute for Marine Science, *Submission 158*, p. 4.

57 Department of the Environment and Energy, Answer to questions on notice from Additional Estimates 2018-19, 18 February 2019, Question no. 37 (received 20 March 2019). The list of extensions for assessment and decision can be found at www.environment.gov.au/biodiversity/threatened/nominations/extensions (accessed 20 March 2019).

58 Environment and Communications Legislation Committee, Mr G. Richardson, Department of the Environment and Energy, *Proof Estimates Hansard*, 18 February 2019, p. 114.

59 EDOs of Australia, *Submission 52*, p. 7.

> that is providing the bulk of recently identified taxa that urgently needs conservation action.[60]

2.48 The department commented that 'many of the species listed under the EPBC Act do not regularly have their status reviewed'. The department added that 'comprehensive reviews of all listed species is challenging due to the large number that are threatened'.[61]

Reliance on public nominations

2.49 Submitters argued that the threatened species list relies heavily on ad hoc nominations from 'under-resourced community groups rather than any program of systematic review'.[62]

Impact of insufficient data

2.50 Many species are either unassessed or classified as data deficient, meaning they do not receive environmental protection or management even if they are at threat and declining.[63]

Lack of emergency listing

2.51 As listing of a threatened species can take up to two years, submitters supported the inclusion of an emergency listing mechanism. For example, the Humane Society International stated that there should be a means by which 'more urgent nominations can be prioritised and emergency listings made where there are demonstrated immediate or significant threats'.[64] The Threatened Species Recovery Hub commented that:

> [Emergency listing] may be particularly critical where species experience sudden, catastrophic declines, or where a new species discovered during an environmental impact assessment could be at risk from the proposed development.[65]

2.52 The Threatened Species Recovery Hub provided the case of the Bellinger River Snapping Turtle, *Myuchelys georgesi*, to illustrate the need for emergency listing. In 2015, the turtle experienced an up to 90 per cent loss of population in under

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60 Associate Professor Mark Lintermans, *Submission 228*, p. 1.

61 Department of the Environment and Energy, *Submission 57*, p.12.

62 Nature Conservation Society of South Australia, *Submission 104*, p. 8.

63 EDOs of Australia, *Submission 52*, p. 8; Green Fire Science, University of Queensland, *Submission 88*, p. 19.

64 Humane Society International, *Submission 98*, p. 18. See also, Tasmanian Land Conservancy, *Submission 44*, p. 4; Green Fire Science, University of Queensland, *Submission 88*, p. 19; Australian Conservation Foundation, *Submission 137*, p. 9.

65 Threatened Species Recovery Hub, *Submission 159*, p. 18.

one year due to disease. While a recovery program has been established, the change in the formal conservation status under the EPBC Act took from February 2015 to December 2016 to be completed. The Hub noted that 'during which time the Commonwealth would have been unable to legally use the turtle's proposed Critically Endangered status in considering applications for developments that would impact them'.[66]

Key drivers of faunal extinction

2.53 According to the state of the environment report, the key pressures of habitat clearing and fragmentation, invasive species and climate change remain high on the list of pressures that threaten listed species and ecological communities, and biodiversity in general.[67] Evidence received by the committee also pointed to a range of threatening processes, both singly and in combination, driving biodiversity loss in Australian including:

- habitat loss, degradation and fragmentation;
- invasive species including cats and foxes;
- changes to fire management;
- climate change; and
- disease.

Habitat loss, degradation and fragmentation

2.54 The Commonwealth Endangered Species Scientific Sub-committee (the predecessor to the TSSC) commented that it was 'strongly of view that land clearance has been the most significant threatening process in Australia since European settlement' and should land clearing continue, additional species will become endangered.[68] Many submitters supported this view.[69] Dr Prowse for example, commented:

> The extinction of species and the loss of biodiversity is clearly a crisis of our own making. The reasons for this crisis are really quite clear: the loss of habitat is driving a loss of biodiversity and leading to extinction of species.[70]

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66 Threatened Species Recovery Hub, *Submission 159*, p. 18; Attachment 10 (*The adequacy of existing assessment procedures for identifying the conservation status of threatened fauna*), p. 4.

67 Department of the Environment and Energy, *Australia State of the Environment 2016, Overview*, p. vii.

68 Department of the Environment and Energy, 'Land Clearance', www.environment.gov.au/biodiversity/threatened/key-threatening-processes/land-clearance (accessed 19 March 2019).

69 Australian Veterinary Association, *Submission 54*, p. 3.

70 Dr Stephen Prowse, Chair, Protect the Bush Alliance, *Proof Committee Hansard*, 1 February 2019, p. 28.

2.55 The Centre for Ecosystem Science, UNSW, provided the following overview of deforestation:

- between 1972 and 2014, more than 7.2 million ha of primary forest was cleared across Australia, about 7 per cent of the available forest;
- in 2015, Eastern Australia, including NSW, was identified as one of only 11 regions of the world undergoing high deforestation and the only one in a developed country;
- deforestation has contributed to serious declines in woodland birds and reptiles. For example, it was estimated that about 100 million native birds, reptiles and mammals were killed because of destruction of their habitat in NSW between 1998 and 2005; and
- the loss of such habitat threatens the continent's biodiversity, affecting 60 per cent of Australia's nearly 1700 threatened species.[71]

2.56 Professor David Lindenmayer, appearing in a private capacity, provided evidence on the impact of logging on forest biodiversity. He stated:

> What we have seen, particularly in the last 20 years, is a significant decline in what we call site occupancy—that's the occupancy of these long-term sites by various elements of biodiversity. We have seen site occupancy for Leadbeater's possum decline by half, 50 per cent, in the last 20 years. Greater gliders have declined by 64 per cent. We've seen significant declines in virtually all of the species of possums and greater gliders on which we have worked. We have seen declines in 24 of the 49 species of birds on which we work.[72]

2.57 The rate of land clearing is contentious. The Australian Veterinary Association pointed to work by Evans which indicated that a lack of consistency between Queensland's SLATS (Statewide Landcover and Tree Study) and the Australian Government's NCAS (National Carbon Accounting System). The study concluded that 'in the absence of a robust quantitative evaluation, it is not yet clear whether deforestation rates have significantly changed following other recent policy changes in New South Wales, Victoria and Western Australia'.[73] This issue will be explored further in the committee's final report.

2.58 Dr Reside provided evidence on the threat of extinction facing the black-throated finch from habitat loss. The black-throated finch has been EPBC Act listed as endangered for nearly 14 years. As a result of habitat loss it has now disappeared from

71 Centre for Ecosystem Science, UNSW, *Submission 56*, p. 6 (citations not included).

72 Professor David Lindenmayer, Private capacity, *Committee Hansard*, 22 November 2018, p. 2.

73 Australian Veterinary Association, *Submission 54*, p. 5.

over 80 per cent of its original range and is now confined to two major areas around Townsville and the Galilee Basin in Central Queensland.[74]

Invasive species including cats, foxes and cane toads

2.59 Invasive species have contributed significantly to species extinctions in Australia. The Invasive Species Council stated that 'invasive species have been overwhelmingly the main cause of animal extinctions in Australia, primarily responsible for at least three-quarters of the mammal losses, about half the bird losses and all frog and lizard losses'. The Council went on to note that the recent extinctions and extinctions on Christmas Island (of the Christmas Island pipistrelle, Christmas Island forest skink, Blue-tailed skink and the Lister's gecko), were all due to invasive species such as the Asian wolf snake, cats, black rates and Asian giant centipedes. The Council concluded that 'Christmas Island offers a sobering case study of the destruction that can be wrought by invasive species'.[75]

2.60 Submitters commented on the benefits of eradicating invasive species for faunal populations. Many pointed to the example of Macquarie Island where feral cats, rabbits, ship rates and house mice had destroyed important seabird populations and sub-Antarctic ecosystems. An eradication program was completed in 2014 and since that time, populations of eight threatened bird species had either stabilised or recovered.[76] A further example was provided by Professor Moritz who noted that the baiting of foxes in Western Australia 'was demonstratively effecting in recovering threatened species there'.[77]

2.61 Some evidence pointed to the need for a more stringent environmental biosecurity regime, which would prevent the arrival into Australia of potentially harmful new invasive species. For example, the Invasive Species Council supported a stronger regime, particularly for islands, where native animal populations were more vulnerable to the effects of invasive species. The Invasive Species Council also noted that island habitats also offered substantial opportunities for the recovery of threatened fauna, as feral animals could be eradicated to protect endemic species.[78]

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74 Dr April Reside, Research fellow, Green Fire Science Lab, University of Queensland, *Proof Committee Hansard*, 1 February 2019, p. 40.

75 Invasive Species Council, *Submission 27*, p. 2. See also, Ms Rachel Lowry, Director of Wildlife Conservation and Science, Zoos Victoria., *Committee Hansard*, 22 November 2018, p. 51.

76 Invasive Species Council, *Submission 27*, p. 9; Australian Veterinary Association, Queensland Branch, *Submission 54*, p. 2.

77 Professor Craig Moritz, Chair, National Committee for Ecology, Evolution and Conservation, Australian Academy of Science, *Committee Hansard*, 8 October 2018, p. 25.

78 Invasive Species Council, *Submission 27*, p. 9.

Changed fire management

2.62 Changed fire regimes is considered a major threat that has contributed to the extinction of six mammal species, and is a significant pressure on 35 threatened mammal species.[79]

2.63 Professor Bowman provided evidence on the impact of the change from Aboriginal fire management:

> …the fire regimes that were applied to that national park were completely at odds with the fire regimes under Aboriginal practice. I wanted to know about Aboriginal practice. I've worked in central Arnhem Land for 20 years. I've seen traditional Aboriginal fire management. I've worked on an estate that was very rich in biodiversity. Again, that system where we worked has now also deteriorated.[80]

Disease

2.64 Disease is now affecting a number of Australia's native animals, including: Tasmanian devils and facial tumour disease; *chytrid* fungus with global impacts on wild frog populations; Bellingen River turtle virus; Koala chlamydia; and sarcoptic mange in wombats.[81]

2.65 The department noted that in 2014, seven frog species were identified as being at high risk of extinction from the disease *chytridiomycosis*, resulting from infection by the *chytrid* fungus, with a further 22 species assessed as being at moderate to lower risk of extinction.[82]

Climate change

2.66 Climate change is recognised as having a severe impact on the survival of species across the globe and in Australia it is seen as one of the major factors in biodiversity decline and species loss in both the terrestrial and marine environments. Professor Brendan Wintle, a Director of the Threatened Species Recovery Hub, commented that 'of the 450 listed animals in the EPBC Act, almost all of them are actually still declining, so there is a real risk also that these declines will be accelerated and exacerbated by climate change'.[83]

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79 Department of the Environment and Energy, *Submission 57*, p. 4.

80 Professor David Bowman, Private capacity, *Proof Committee Hansard*, 14 February 2019, p. 9

81 Zoo and Aquarium Association of Australia, *Submission 51*, p. 2.

82 Department of the Environment and Energy, *Submission 57*, p. 4.

83 Professor Brendan Wintle, Director, Threatened Species Recovery Hub, *Proof Committee Hansard*, 4 February 2019, p. 61.

2.67 Australia has already lost one known species due to the effects of climate change. In 2016 a report found that the Bramble Cay melomys was found to have become extinct due to sea level rise, which was attributed to climate change.[84]

2.68 The committee was also provided with evidence of the impact of extreme weather arising from climate change. In the case of the white lemuroid ringtail possum which lives on Mount Lewis in Far North Queensland, a severe heatwave in 2005 had a catastrophic impact on population numbers.[85]

Impacts of faunal extinction and decline

2.69 The impacts of faunal extinction and decline are multifaceted and pervasive; it is not only the environment that suffers but also Australian society and our economic wellbeing.

2.70 The committee received extensive evidence on the ecological impact of faunal loss and decline and the need to maintain health and diverse ecosystems. For example, the Tasmanian Land Conservancy, citing a study by Fonesca, stated:

> …the stability in natural ecosystems modulates depending on their richness and the functional role played by its composite species. In some cases extinction will have no effect at all if the role of the species lost is assumed by others, but extinction can have devastating ecosystem effects if the species lost performs a unique function or if services are compromised.[86]

2.71 The Wilderness Society submitted that emerging research shows the impacts of diversity loss might be sufficiently large to rival the impacts of other global drivers of environmental change such as climate change—that is, diversity loss may have fundamental impacts on global life systems such as water exchange, nutrient cycling and climate.[87] The Threated Species Recovery Hub added:

> Ecological research worldwide has documented the beneficial interactions of species in food webs and has shown that simplification of food webs due to the extinction (or functional disappearance) of some species can have cascading and complex effects on biodiversity, ecosystem processes and ecosystem services…[88]

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84 Gynther, I., Waller, N. & Leung, L.K.-P, *Confirmation of the extinction of the Bramble Cay melomys Melomys rubicola on Bramble Cay, Torres Strait: results and conclusions from a comprehensive survey in August–September 2014* (2016), Unpublished report to the Department of Environment and Heritage Protection, Queensland Government, p. i.

85 Mr Lyndon Schneiders, National Director, The Wilderness Society Ltd, *Proof Committee Hansard*, 1 February 2019, p. 9.

86 Tasmanian Land Conservancy, *Submission 44*, p. 3.

87 The Wilderness Society, *Submission 133*, p. 4.

88 Threatened Species Recovery Hub, *Submission 159*, Attachment 2 (*Ecological impacts of faunal extinction and decline*), p. 3.

2.72 Disturbance of ecosystems through loss and decline can cause substantial change and the recovery of threatened species will have environmental benefits. Many threatened species have roles in the dispersal of seeds of native plants and spores of beneficial fungi. They play a role as ecosystem engineers and in balancing populations through predation as well as moderation of fire regimes, control of vegetation composition, and prevention of erosion.[89]

2.73 In this regard, the Tasmanian Land Conservancy pointed to ecosystem de-stabilisation in Tasmania due to the functional loss of two apex predators, the extinct Thylacine and now reduced Tasmanian devil populations due to Devil Facial Tumour Disease. As a consequence, 'over the past two decades significant shifts in predatory species especially feral cats now impacting critical weight range species such as bandicoot and bettong mean that Tasmania's status as a safe haven is perilously at risk'.[90] Bush Heritage Australia also added that quoll populations are at risk in Tasmania from increased numbers of feral cats.[91]

2.74 The Northern Territory Government noted declining biodiversity of complex ecosystems and stated that the 'loss and decline of threatened species, along with the wider declines of species that they are indicative of, have potential ecological domino effects on other species and communities'. These effects include: reduced prey availability for native predators, changes in community composition and competition, reduction in species for pollination and seed/fruit dispersal, and loss of environmental engineers, for example mammals that burrow and dig.[92]

2.75 Further evidence of the ecological contribution of threatened species was provided by the Western Australian Government, which provided the following examples:

- the endangered Carnaby's Cockatoo contributes to the health of the Endangered Banksia woodlands of the Swan Coastal Plain ecological community through its role in removing wood boring grubs and pruning trees and shrubs to increase flowering and fruiting;
- the burrows of the vulnerable bilby provide shelter and refuge for at least 20 species of arid zone mammals, reptiles and birds. Bilby burrows also accumulate nitrogen and other nutrients and hold moisture for longer periods in arid environments, which support improved plant regeneration; and

89 Threatened Species Recovery Hub, *Submission 159*, Attachment 2(*Ecological impacts of faunal extinction and decline*), p. 6.

90 Tasmanian Land Conservancy, *Submission 44*, p. 3. See also, Threatened Species Recovery Hub, *Submission 159*, Attachment 2 (*Ecological impacts of faunal extinction and decline*), pp. 5–6.

91 Bush Heritage Australia, *Submission 37*, p. 3.

92 Northern Territory Government, *Submission 2*, p. 4. See also, Australian Wildlife Conservancy, *Submission 55*, p. 2.

- the Critically Endangered woylie turns over large volumes of soil, dispersing seeds and fungi, improving water infiltration, nutrient cycling, plant regeneration and reducing fire risk by lowering leaf litter fuel loads.[93]

2.76 The Ecological Society of Australia pointed to the part played by Australian marsupials such as bettongs and potoroos in dispersing spores of fungi which are of benefit to trees. The loss of these marsupials has a cascading effect on the health of the entire ecosystem.[94] Many mammals such as bandicoots and rat-kangaroos dig for food and in the process turn over large volumes of soil, keeping soil in a loose and friable state, accelerating recycling of nutrients, and enhancing penetration of moisture.[95]

2.77 Other submitters cited the loss of dingoes from the environment in order to protect livestock as contributing to the rise in numbers of kangaroo and feral pigs.[96]

2.78 In further evidence to the committee, submitters commented on the importance Australia's unique biodiversity on our character, our economic wellbeing and for Indigenous Australians.

2.79 Mr Trezise of the ACF drew to the committee's attention the place of Australia's biodiversity at the core of our national identity; that we are taught from a young age the wonders of our native fauna.[97] Professor Wintle, Threatened Species Recovery Hub, added that the loss of species degrades our society and that:

> Species have a right to exist, and the loss of species degrades our society. We have a responsibility to pass on to future generations the wondrous natural heritage that we've been so fortunate to inherit, and we need to pass it on in a state that's equal to or better than when we inherited it. The current faunal extinction crisis represents a major threat to the legacy of our generation.[98]

2.80 Australians depend on thriving ecosystems for their well-being and prosperity. Extinction and species population loss reduces overall biodiversity in any ecosystem, reducing the stability of ecosystems and affecting the efficiency of ecosystem function. The Australian Veterinary Association, Queensland Branch submitted:

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93 Western Australian Government, *Submission 9*, p. 2.

94 Ecological Society of Australia, *Submission 86*, p. 2.

95 Threatened Species Recovery Hub, *Submission 159*, Attachment 2 (*Ecological impacts of faunal extinction and decline*), p. 5.

96 Bush Heritage Australia, *Submission 37*, p. 3; Wildlife Preservation Society of Queensland Fraser Coast, *Submission 41*, p. 6

97 Mr James Trezise, Policy Analyst, Australian Conservation Foundation, *Committee Hansard*, 8 October 2018, p. 1.

98 Professor Brendan Wintle, Threatened Species Recovery Hub, 14 February 2019, p. 8.

> Biodiversity in all its complexity is essential for the maintenance of ecosystem services, clean and adequate water supplies, clean air, soil fertility and stability, carbon sequestration and to address climate change. Human health and prosperity as well as that of the natural world is ultimately dependent upon addressing faunal extinctions. A healthy fauna can only exist in conjunction with a healthy flora and microbiota.[99]

2.81 The Centre for Ecosystem Science similarly emphasised the importance of maintaining healthy ecosystems and argued that 'prolonged over-exploitation of [Australia's] landscapes has eroded their capacity to deliver economic prosperity and security'. The Centre added:

> Ecosystems deliver services such as clean water and air, soil stability and fertility, climate regulation, carbon storage, recreational and tourism opportunities, as well as production goods such as food, fibre and timber. Although many of these services are often regarded as economic externalities, they cannot be taken for granted and their maintenance costs cannot be ignored without eroding Australian incomes and business profitability.[100]

2.82 Other submitters pointed to impacts on particular industries, should the extinction crisis not be addressed. This included losses to the tourist industry when iconic wildlife such as the koala no longer exist or when ecological systems such as the Great Barrier Reef are so degraded that their appeal to tourists diminishes. The continued loss of fauna risks crop and stock production and therefore loss of food supplies.[101] The Environmental Farmers Network commented that

> Ecological networks, like all complex systems, behave in unpredictable ways when components are removed (become extinct). Ecological processes are critical to sustainable farming, eg pollination, water filtration, breakdown of crop residues and the recycling of nutrients. Fauna play roles in these things.[102]

2.83 A further matter raised in evidence was the fundamental importance of Australia's unique flora and fauna to Aboriginal and Torres Strait Islander people who have strong connections and obligations to country. The Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) submitted that:

> Retaining connection to country is critical to the identity and cultural continuity of Aboriginal and Torres Strait Islander societies and as a consequence, for the wellbeing and freedom of individual Aboriginal and Torres Strait Islander people. Indigenous peoples' laws and philosophical

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99 Australian Veterinary Association, Queensland Branch, *Submission 54*, p. 2.

100 Centre for Ecosystem Science, *Submission 56*, p. 10.

101 Name withheld, *Submission 391*, p. 8.

102 Environmental Farmers Network, *Submission 29*, p. 2.

> traditions, kinship, language and art are all connected through their relationship with lands and waters.[103]

2.84 AIATSIS went on to state that 'Indigenous owners prioritise caring for country as part of their overarching obligations and spiritual relationships with their lands and waters because of their interconnectedness with all aspects of the natural environment'.[104] Any extinction affects that interconnectedness. The ACF commented:

> Extinction events can have profound cultural implications. There are deep connections between Indigenous culture and custom and Australia's wildlife. Extinction events break these connections. They can and have significant impacts on communities and can further perpetuate social inequality.[105]

103 Australian Institute of Aboriginal and Torres Strait Islander Studies, *Submission 168*, p. 2.

104 Australian Institute of Aboriginal and Torres Strait Islander Studies, *Submission 168*, p. 3.

105 Australian Conservation Foundation, *Submission 137*, p. 2.