Greater Bilby *Macrotis lagotis*

Key Findings

Greater Bilbies once ranged over three‑quarters of Australia, but declined coincident with the spread of European foxes, along with habitat changes from introduced herbivores (especially rabbits), changed fire regimes and predation by feral cats. Recovery actions have focused on maintaining or restoring traditional Indigenous patchwork fire regimes and controlling introduced predators. Translocations into predator-free exclosures and a predator-free island have allowed for further increases in population and re-establishment into the species' former range.

Photo: Queensland Department of Environment and Science

Significant trajectory change from 2005-15 to 2015-18?

No, generally stable overall.

Priority future actions

- Effective landscape-scale fire management is implemented across all of distribution.
- Targeted cat and rabbit control at key bilby sites.
- Minimise loss of bilby habitat, and maintain connectivity between bilby populations.

Full assessment information

Background information

2018 population trajectory assessment

The primary purpose of this scorecard is to assess progress against the year three targets outlined in the Australian Government's Threatened Species Strategy, including estimating the change in population trajectory of 20 mammal species. It has been prepared by experts from the **National Environmental Science Program's Threatened Species Recovery Hub**, with input from a number of taxon experts, a range of stakeholders and staff from the Office of the Threatened Species Commissioner, for the information of the Australian Government and is non-statutory. Statutory documents relating to this species, such as Recovery Plans or Conservation Advices, are listed at Section 11. The descriptive information in the scorecard is drawn from the summaries of (Woinarski *et al.* 2014; Bradley *et al.* 2015; TSSC 2016; Commonwealth of Australia 2019) and references therein; unless otherwise noted by additional citations.

The background information aims to provide context for estimation of progress in research and management (Section 7) and estimation of population size and trajectories (Section 8).

1. Conservation status and taxonomy

Conservation status	2018
EPBC	Vulnerable
NSW	Extinct
NT	Vulnerable
QLD	Endangered
SA	Vulnerable
WA	Vulnerable

Taxonomy:
Several subspecies have been described: *M. l. lagotis* (South-west WA, Extinct), *M. l. cambrica* (Eastern NSW, Extinct), *M. l. interjecta* (Nullarbor Plain, WA, Extinct), *M. l. nigripes* (SA, Extinct), and *M. l. sagitta* (Central Australia). Genetic research suggests that currently extant subpopulations (including the isolated subpopulation in south-west Qld) show very little genetic variation. As the former distribution was more or less continuous, extinct subspecies are unlikely to be valid. No subspecies are recognised in the Mammal Action Plan (2014).

2. Conservation history and prospects

The Greater Bilby is endemic to Australia. It is the only surviving member of the family Thylacomyidae, following the extinction of the Lesser Bilby in the 1960s. This marsupial is an exceptional digger, using its strong claws to create multiple burrow systems, and to dig for underground invertebrates, fungi, seeds, tubers and bulbs.

The Greater Bilby (hereafter simply 'Bilby') previously occurred continuously over three-quarters of the continent, in the semi-arid and arid zones. However, their distribution since European settlement has contracted to about 20% of this original extent. Ongoing declines were suspected into the late 1990s and early 2000s, but the distribution and occupancy may have stabilised since then. The population is roughly estimated in the Mammal Action Plan at about 10,000 individuals, but could vary substantially from this, and may be much higher. The distributional contraction and population decline have been most marked in the south and east of its previous range. Populations of Bilbies are now restricted to the Tanami, Gibson, Little Sandy, and Great Sandy Deserts, parts of the south and west Kimberley, parts of the Pilbara, with an isolated population in the Diamantina Shire in southwest Queensland. Genetic analysis shows little phylogeographic structure across the extant range, indicating that Bilbies were historically connected across this distribution (Southgate and Adams 1993; Moritz *et al.* 1997).

In addition to the remnant wild populations, Bilbies exist in several translocated populations. Between 2007-09, 128 Bilbies were successfully reintroduced to Matuwa-Lorna Glen (WA), a 250,000 ha unfenced area that is managed intensively to control introduced predators, livestock and fire. Two populations exist in peninsulas with intensive predator management, including fencing to slow the immigration of cats and foxes (Venus Bay, SA; Peron Peninsula, WA).

Translocations have also taken place into several sites from which cats and foxes (a key threat) are excluded. Bilbies have been successfully introduced to Thistle Island in SA. They have also been reintroduced to four mainland fenced areas: Arid Recovery (SA), Yookamurra (SA), Scotia (NSW), and

Mt Gibson (WA), with a reintroduction to a fifth fenced site recently initiated at the Pilliga National Park (NSW). Reintroductions to an additional four new fenced areas are being planned (Newhaven, Mallee Cliffs, Wild Deserts, Currawinya) (Legge *et al.* 2018). The Currawinya site protected a Bilby population for some years, but that population was extirpated when the fence was damaged by floods and introduced predators gained access. The fence has been restored in 2018, with a reintroduction of Bilbies planned for early 2019. Following the completion of these projects, Bilbies will exist in 10 fenced and island sites that are cat-and -fox free, and further investment in new fenced or island populations is a lesser priority compared with managing wild populations of Bilbies in open landscapes, and translocating Bilbies to unfenced areas just outside their current distribution, after appropriate threat management is in place.

Captive populations are housed at a number of facilities in the Zoo and Aquarium Association, and at the Save the Bilby Fund's Captive Breeding facilities in Charleville.

Bilbies declined because of predation by foxes and cats, habitat changes caused by livestock and other introduced herbivores (especially rabbits), and changed fire regimes; these threats still affect the Bilby population, with the relative importance of these threats varying geographically. Bilbies are probably more susceptible to fox predation than cat predation. The decline in Bilby distribution coincided with the spread of the fox across Australia, and the current distribution is in areas where foxes are rare or absent (Radford *et al.* 2018). Wild dogs and dingoes may be a significant predator of Bilbies in the Queensland population, but this is conjectural (Palmer 1999; McRae 2004).

The land tenures of about 70% of the extant Bilby distribution are Indigenous. Bilbies are a culturally significant animal for Indigenous groups across its distribution. There are over 20 different language names for Bilby; the term 'Bilby' is based on the Ullaroi language name, Bilba (Paltridge 2016). The persistence of Bilbies in some local areas is linked to ongoing land management carried out by Indigenous communities. The majority of the remaining distribution of the Bilby overlaps with Indigenous tenures, and the critical role of Indigenous people in ongoing Bilby conservation is recognised in the draft Recovery Plan, which includes a suite of strategies to support Traditional Owners (and other land managers) to improve governance and coordination, surveys, monitoring and research.

There have been two key national initiatives to enhance conservation planning and implementation for the Bilby. In 2015, a 'Greater Bilby Recovery Summit' brought together experts from about 30 organisations, and resulted in an interim conservation management plan (Bradley *et al.* 2015). In 2016 the Kiwirrkurra Community (WA), supported by the Indigenous Desert Alliance, hosted the Ninu (Bilby) Festival, to merge traditional and contemporary knowledge about the Bilby and its threats and produce a framework for effective, collaborative management of wild Bilby populations (Paltridge 2016).

3. Past and current trends

The Bilby previously occurred continuously over three-quarters of the continent (more abundant in preferred habitats), in the semi-arid and arid zones. Between the late 1880s and the 1930s, as rabbits and foxes spread north, Bilbies mostly disappeared from over three-quarters of this distribution, retracting to the northern parts of their WA and NT distribution, and to a smaller area in southwest Queensland (see Woinarski et al. 2014 for details). Bilbies in the NT and WA remain somewhat connected through low density populations, but the Queensland population became isolated sometime between the 1930s and 1970 (Moritz *et al.* 1997).

Translocated populations have been established on one cat- and fox-free island: Thistle Island, SA (c. 500 animals); and within four fenced areas that exclude cats and foxes (Arid Recovery (SA), Mt Gibson (WA), Scotia (NSW), Yookamurra (SA); together totalling about 2000 animals). Reintroductions to a fifth fenced site, in the Pilliga National Park (NSW) have begun this year. Four additional fenced populations are underway or being planned within the next five years (Newhaven (NT), Mallee Cliffs (NSW), Wild Deserts (Sturt NP, NSW), Currawinya (QLD)) (Legge *et al.* 2018). The Currawinya site formerly had a fenced population that persisted for some years but was extirpated when the fence was damaged by flood and introduced predators gained access. This fence has been restored ahead of another Bilby reintroduction in 2019.

Translocations have also occurred to areas where cats and foxes are present, but intensively managed. Matuwa-Lorna Glen (WA) supports a Bilby population within a 250,000 ha where foxes, cats. Livestock and fire and intensively managed. Another two populations exist in peninsulas with partial fencing and intensive management of introduced predators (Venus Bay, SA; Peron Peninsula, WA). The Venus Bay population is very small.

The current population was estimated at 10,000 individuals in the Mammal Action Plan, but it is possible the total population differs substantially from this, and may be much higher. For example, the Bilbies at Matuwa-Lorna Glen alone currently number about 1500 (in a 2500 km^2 area). The cat- and fox-free fenced areas, plus Thistle Island, currently support about 2500 Bilbies (give or take 500, depending on conditions). This number is likely to grow if the recent Mt Gibson and Pilliga reintroductions are successful, and with the additional fenced areas planned in the next few years.

Monitoring (existing programs):

Across WA and the NT, the presence of Bilbies is recorded during tracking surveys on 2 ha plots (or variations on this tracking technique), carried out by a range of Indigenous groups, state government (WA), NGOs and environmental consultants. Although most groups do not collect data that can be used to track population trends within an area, the collective dataset is useful for looking at distributional change. However, until recently these data have not been collated into a single dataset. The Bilby Blitz initiative, coordinated by the Indigenous Desert Alliance, has sought to create a more unified and coordinated sampling regime.

WA DBCA have developed and been using genetic methods (based on quantitative scat collection) for identifying individuals and monitoring numbers of Bilbies within populations across the state including Matuwa-Lorna Glen (Dziminski and Carpenter 2017).

Populations within the fenced areas are monitored regularly using distance sampling, or trapping, or track surveys. The island population and the Peron Peninsula population are monitored irregularly.

Table 1 summarises monitoring activity; the information in this table was provided by many of the contributors listed at the end of the document.

Table 1. Recent monitoring activity for the Bilby.

Method	Undertaken by	Year/s	Location	Funding source/notes
WA, NT and SA; arranged by monitoring method				
Quarterly track counts	Arid Recovery	2000-2018, ongoing	Roxby Downs (SA)	Arid Recovery
Nocturnal spotlight surveys, density estimated from strip transects	AWC	annually	Scotia (NSW), Yookamurra (SA)	AWC
Track counts	Peron Peninsula; DBCA	Since 2010	DBCA	DBCA
Documenting local expert knowledge of Bilby locations	Kiwirrkurra Rangers	2000, 2012 2014-2018	Kiwirrkurra IPA (WA)	TSN funding IPA funding Bilby population on IPA relatively stable during past two decades: still in same three areas since 2000 (Kiwirrkurra, Jupiter Well, Murruwa); abundance may have declined in the Nyinmi/Jupiter Well area.
Documenting local expert knowledge of Bilby locations	Kanyirninpa Jukurrpa and Martu Rangers; NESP TSR Hub	2017	Martu Determination (WA)	KJ, NESP TSR Hub, TNC, BHP; Suggests local declines over last 50 years. Some areas stable.
Abundance monitoring - technique developed by DBCA using DNA extracted from quantitatively collected scats to genotype individuals coupled with spatially explicit capture-recapture analyses to determine numbers of individuals within populations.	DBCA, FMG	2015-2017	Nullagine, Pardoo, McPhee Creek, Turner River, Hillside, Warralong (all Pilbara, WA)	State offset funding
	DBCA	2013-2016	Two sites at Matuwa (Rangelands, WA)	State offset funding
	DBCA, Kiwirrkurra Rangers and Desert Support Services	2016-2017	Kiwirrkurra (Gibson Desert, WA)	Ranger funding and in-kind DBCA support; IPA funding
	DBCA, Karijarri, Nyangumarta and Yawuru Rangers,	2017	Anna Plains, Thangoo, Nita Downs (La Grange Area, Great	State Government funding

	YMAC and KLC collaboration		Sandy Desert, Kimberley, WA)	
	AWC in collaboration with WA DBCA	2017-2019	Mt Gibson WA)	
Occupancy monitoring using improved and standardised 2 ha Sign Plots with repeated revisits that account for imperfect detection.	DBCA, Karijarri, Nyangumarta and Yawuru Rangers, YMAC and KLC collaboration	2017	La Grange Area (Great Sandy Desert, Kimberley (WA)	State Government funding
	DBCA, Nyul Nyul, Nyikana Mangala, Bardi Jawi and Yawuru Rangers, KLC collaboration	2017 onwards	Dampier Peninsula, Kimberley (WA)	State offset funding
Presence/Absence surveys using standardised 2 ha Sign Plots.	DBCA	2012-2018	Pilbara (WA)	State offset funding
Occupancy monitoring using improved and standardised 2 ha Sign Plots with repeated revisits that account for imperfect detection.	Fortescue Metals Group with DBCA advice and support	2017-2018	FMG rail line, Pilbara (WA)	Mining company
Standardised 2ha plots	Kanyirninpa Jukurrpa and Martu Rangers	2008 - 2016	Martu Determination (WA)	Ranger funding
Occupancy monitoring using Mankarr searches which employ Indigenous knowledge	Kanyirninpa Jukurrpa and Martu Rangers; NESP TSR Hub	2017-ongoing	Martu Determination (WA)	KJ, NESP TSR Hub, TNC, BHP
Track plot monitoring Standardised 2 ha track plots	Birriluburu Rangers	2013-2018	Carnarvon Range, Birriliburu IPA (WA)	Bush Heritage Australia, Indigenous Protected Areas funding,
Track plot monitoring Standardised 2 ha track plots	Birriliburu Rangers	2018	Mungarlu, Birriliburu IPA (WA)	Bush Heritage Australia, Indigenous Protected Areas funding, Threatened Species grant from federal government.
Track plot monitoring Standardised 2 ha track plots	MKK Rangers	2014 onwards	Matuwa, MKK IPA (WA)	IPA funding
Track plot monitoring	Kiwirrkurra Rangers	2012, 2014, 2015, 2016, 2018,	Kiwirrkurra IPA (WA)	IPA funding Rangelands NRM
Track plot monitoring Standardised 2 ha track plots	Central Land Council (CLC) Ranger groups	~2013-2018 on-going	Particularly Tennant Ck region, and North and South Tanami IPAs, Karlantijpa North ALT (NT)	Various funding sources, including Australian Government IPA, Working on Country, Indigenous Land Corporation and in-kind support from the CLC. More recently, also with funding from the Bilby Blitz

Track plot monitoring	Traditional owners of Ngururrpa Native Title Determination	2015 And survey planned for Oct 2018	Ngururrpa IPA (WA)	Bilby populations recorded at 8 out of 32 tracking plots. Latitudinal extent of Bilby sign was 130km. Likely to be a connected Bilby population extending all the way from Kiwirrkurra to Balgo.
Monitoring of known burrow systems	Birriliburu Rangers	2015 onwards	Carnarvon Range Birriliburu IPA (WA)	Bush Heritage Australia, Indigenous Protected Areas funding although combined with other monitoring trip to reduce costs.
Method	**Undertaken by**	**Year/s**	**Location**	**Funding source/notes**
Queensland				
Standardised 2 ha track plots	Save the Bilby Fund & Dr Rick Southgate	2018	South west Qld	Taronga Conservation Society, Qld Dept Environment & Science, Save the Bilby Fund (Southgate and Bradley 2018)
Spotlight transect surveys	Queensland Parks and Wildlife Service	2012	Astrebla Downs and Diamantina National Parks (Qld)	State Government funding
Aerial surveys	Queensland Parks and Wildlife Service	2015	Astrebla Downs and Diamantina National Parks (Qld)	State Government funding
3-year trial comparing spotlighting and thermal camera surveys	Queensland Parks and Wildlife Service	2014, 2015, 2016	Astrebla Downs National Park (Qld)	State Government funding
Thermal camera survey	Queensland Parks and Wildlife Service	2014, 2015, 2017, 2018	Astrebla Downs and Diamantina National Parks (Qld)	State Government funding
Bilby burrow activity survey	Queensland Parks and Wildlife Service	2017, 2018	Diamantina National Park (Qld)	State Government funding
Bilby burrow activity survey	Queensland Parks and Wildlife Service	2018	Astrebla Downs National Park (Qld)	State Government funding

Population trends:

Tables 2 and 3 summarise the overall trend and status of the Bilby. The information provided in these tables is derived from the recovery plan and conservation advices with some amendments made by contributing experts based on new information.

Table 2. Summary of the available information on Bilby distribution and population size, and (where possible) trend estimates between 2015 and 2018 for each parameter.

Population parameters	Published baseline	2015 Estimate	2018 Estimate	Confidence in estimates
WILD*				
Extent of Occurrence	3,100,000 km^2	3,100,000 km^2	3,100,000 km^2	Medium (new fenced areas would lead to increases, but estimates of EoO are so approximate that an assessment of change is precluded)
Area of Occupancy	2150 km^2	2150 km^2	2150 km^2	Low (new fenced areas would lead to increases, but estimates of AoO are so approximate that an assessment of change is precluded)
Dates of records and methods used	IUCN guidelines used for records from 1993–2012			
No. mature individuals	10,000	**?**	**?**	Low (given large uncertainty involved)
No. of subpopulations	>10	7	7 (new fenced areas likely to be managed as part of metapopulation)	Medium
No. of locations	>10	>10	>10	Medium
Generation time	4	n/a	n/a	Low (as per MAP)
EXCLOSURES/ISLANDS				
No. mature individuals	n/a	2000	2050	High
No. locations	n/a	3	4 (plus one in 2018)	High
CAPTIVE BREEDING				
No. mature individuals		many	many	High
No. locations		2	2	Medium

*Including translocations

Table 3. Estimated recent (2005-2015) and current (2015-2018) population trends for the Bilby. The estimate for overall population of Bilbies is very uncertain, so % population figures have not been calculated here.

Sub-population	2005-2015 trend	Confidence in 2005-2015 trend	2015-2018 trend	Confidence in 2015-2018 trend	Details
Unfenced population in NT and WA		Low		Low	Mammal Action Plan estimates decline of > 10% over a longer timeframe. This is consistent with accounts by TOs in western deserts, e.g. (Skroblin *et al.* 2017). However, although Bilbies were declining in some areas from 1998-2008, with some key populations disappearing, there has been little change from 2008-2018, and probably none between 2015-2018. Data from Bilby Blitz (in NT, and in the Kiwirrkurra, Warburton and Birriliburru areas of WA) does not provide any evidence of continued decline in last decade (Paltridge, pers. comm.) and data from Matuwa suggests an increase in Bilbies in response to baiting. Anecdotal and trackplot survey evidence suggest populations holding steady or slightly increasing in Tanami and Tennant Ck regions (F. Moyle, CLC; pers. comm). Similarly, recent Bilby surveys in south-west Queensland suggest no decline in wild Bilbies (Southgate and Bradley 2018).
Matuwa-Lorna Glen (re-introduced into large 250 000 ha unfenced area)		High		High	2007-2009 – Founder population = 128 2015-2016 – densities of 1 per 100 ha over an estimated occupancy of 150 000 ha = approx.: 1500 Bilbies
Unfenced population in Qld		Low		Low	Pre 2013, the main Qld population on Astrebla Downs NP was heavily impacted by an irruption of feral cats following a rat plague. Over 2,800 cats were killed in 12-18 months. Since then there has been extensive and ongoing feral cat and dog control. QPWS surveys indicated that the population then increased until 2016. Surveys in 2017 and 2018 suggest that the population within Astrebla has declined once again, most likely due to cat and dog predation (QPWS, pers. comm.). Despite the large population fluctuations recorded by QPWS, a recent survey across pastoral and reserved land in south-west Queensland suggest no decline in the EoO of Bilbies since 1983-84, and that within this EoO, reasonable numbers are still present (Southgate and Bradley 2018).

Arid Recovery, SA (fenced area)		High		High	From 2000. Population varies 500-1000 individuals, depending on conditions.
AWC sanctuaries (fenced areas)		High		High	Scotia Sanctuary, NSW, from 2004 Yookamurra Sanctuary, SA, from 2007 Mt Gibson Sanctuary, WA, from 2016 Pilliga NP, from 2018 Overall, 1150 individuals in 2018; small increase in 2016-2018 due to new site being established at Mt Gibson, but increase is too small and recent to contribute to overall change.
Thistle Island, SA		Medium		Medium	From 1998; (c. 500 animals)
Whole population		**Low**		**Low**	**Estimate for overall population is very uncertain, so % population figures have not been calculated here**

Note – very small populations at Venus Bay and Peron Peninsula not counted separately.

KEY:

Improving	Stable	Deteriorating	Unknown
			?

Confidence	Description
High	Trend documented
Medium	Trend considered likely based on documentation
Low	Trend suspected but evidence indirect or equivocal

4. Key threats

The threats listed here are derived from the latest Conservation Advice (TSSC 2016) and the draft Recovery Plan (Commonwealth of Australia 2019), with some amendments made by contributing experts based on new information. Note that this is not a list of all plausible threats, but a subset of the threats that are likely to have the largest impact on populations.

Given the large extent of occurrence of the extant Bilbies, the relative severity of threats varies geographically, with fire a greater threat in the northern part of the Bilby distribution, and foxes and rabbits a greater threat in the south.

Inappropriate fire regimes

The relationship between Bilbies and fire is complex. Bilbies sometimes prefer to feed in freshly-burnt areas, and Bilby populations often persist in areas surrounding Indigenous communities where fires are frequent but very fine-scale. Some food plants used by Bilbies are promoted by disturbance including fire. Intense fires in the summer followed by rain may provide the most favourable conditions for seed production in a number of grass species, such as *Yakirra australiensis* (Southgate and Carthew 2006). However, extensive and large fires remove vegetation (cover) from large areas, potentially causing increased vulnerability to predators. Extensive and intense fires may also affect the availability of food resources, for example by reducing the occurrence of fire sensitive shrub species that support root-dwelling larvae used by the Bilby as food. Given this complexity, areas with a patchwork of differently-aged post-fire vegetation probably increases habitat quality for Bilbies (Southgate et al. 2007). Fire frequency is inevitably higher in the northern parts of the Bilby distribution where rainfall is monsoonal. In desert areas, extensive fires tend to be concentrated after widespread rainfall events, which happen approximately every five years in the northern deserts and every ten years in the southern deserts.

Predation by foxes

Fox (*Vulpes vulpes*) presence is negatively correlated with the presence of Bilbies. Foxes are more abundant and therefore are a more significant threat in the southern part of the Bilby's range, but there are some anecdotal reports of fox expansion associated with increases in water points in the Pilbara, and foxes move north into areas such as the Tanami when good conditions prevail. Foxes also do occur along the Pilbara and Kimberley coastline, where the largest known naturally occurring wild Bilby population has been documented in Western Australia (Dziminski *et al.* 2018).

Predation by cats

Predation by feral cats (*Felis catus*) has been observed during attempted reintroductions at Dryandra Woodland, Arid Recovery, Matuwa-Lorna Glen, Venus Bay and the Tanami Desert. Predation by cats is particularly severe in Queensland; it was likely to have been the cause of the population collapse at Currawinya, and increases in cat density following rain are known to exert pressure on Bilby populations at Astrebla (Rich *et al.* 2014). However, wherever Bilbies exist, feral cats are always present, which indicates Bilby populations can tolerate some level of cat presence. It is possible that cats have larger negative impacts in situations where when cat predation pressure increases (temporally or spatially) – this likely has larger negative impacts.

Predation by dogs/dingoes

In Queensland, dingoes (*Canis familiaris dingo*), wild dogs (*Canis familiaris*) and their hybrids may be a threat to the Bilby population. Recent analysis of 150 canid scats in south-western Queensland has

shown around 70% of the diet is Bilby (Queensland Parks and Wildlife Service, unpublished data 2018). Whether this means dogs exert significant pressure on Bilbies, or that Bilbies are simply quite common where the dogs are active, is unclear. The significance of predation by dingos/dogs, relative to cats, may depend on the relative densities, the availability of alternative prey, and hunting preferences, all of which may vary through time: cat predation appears to be much more significant after extended periods of rain, when native rat populations have irrupted and led to large increases in the cat population (see above). However, Palmer (1999) considered that Bilbies were more frequently preyed upon by dingoes/dogs than cats in dry years when native rats are rare, because very few cats travelled through the Mitchell Grass Downs during those periods. Anecdotal reports suggest that the wild dog population started to increase in the 1960s when sheep grazing properties converted from sheep to cattle and the number of dog trappers in the district declined (J. Augusteyn, unpublished data).

Introduced herbivores

Bilby distribution is associated with an absence or low density of rabbits (*Oryctolagus cuniculus*) and low stocking rates of livestock. Rabbits compete with Bilbies for food and possibly also for burrows. Rabbits support higher densities of cats and foxes. Pastoralism leads to increases in watering points, which may also cause elevated densities of introduced predators. Introduced herbivores also threaten Bilbies by removing key food plants, reducing the amount of vegetation cover available and compacting soil, especially around watering points. In the Pilbara and Tanami Desert, herbivores congregate along drainage lines which are prime Bilby habitat.

Habitat loss and fragmentation

Land clearing leads to loss of habitat, degradation of surrounding habitat, increased predation and fragmentation effects. Infrastructure associated with mining (for example, roads and rail lines), and developing mineral sand and lithium mines, and agricultural developments may threaten the Bilby through vegetation clearance, increased risk of road kill, causing barriers to dispersal and gene flow, and elevating predator densities as a result of increases in food and water resources. Currently, these threats may be greatest in the north-western part of the Bilby range. The cumulative effect of many smaller clearing approvals, especially for centre pivot agriculture in the north of WA (Kimberley and Pilbara) could lead to large areas of Bilby habitat being cleared and fragmented over time.

Lack of acknowledgement of cultural importance of species

A large proportion of the remaining distribution of the Bilby overlaps with Indigenous land, and Bilbies tend to persist near Indigenous communities where traditional land management is practiced. The loss of this resource management expertise, and the cultural context the expertise is embedded within, will affect the prospects for the Bilby.

Weeds

Buffel grass *Cenchrus ciliaris* changes the fire regime by increasing the frequency of fire, and affecting the abundance of food plants such as the grass *Yakirra australiensis* and bush onions *Cyperus bulbosus*, and *Acacias*. Couch grass invades drainage lines and may have similar effects. Although it seems likely that weeds reduce habitat quality for Bilbies, but this has not been clearly demonstrated.

The impacts of the major threats are summarised in Table 4.

Table 4. The major threats facing the Bilby and their associated impact scores.

CURRENT THREAT IMPACT			
Threat	**Timing**	**Extent**	**Severity**
1. Increase in fire frequency/intensity	Continuing/ongoing	>90% of range	20-29%
2. Red foxes	Continuing/ongoing	50-90% of range	50-100%
3. Feral cats	Continuing/ongoing	>90% of range	Not negligible but <20%
4. Wild dogs/dingoes (Qld)	Continuing/ongoing	1-50% of range	Not negligible but <20%
5. European rabbits	Continuing/ongoing	1-50% of range	Not negligible but <20%
6. Habitat loss and fragmentation (agriculture and mining)	Continuing/ongoing	1-50% of range	Not negligible but <20%
7. Lack of acknowledgement of cultural importance of species	Continuing/ongoing	50-90% of range	Not negligible but <20%
8. Weeds	Continuing/ongoing	1-50% of range	Negligible declines (<1%)

Timing: continuing/ongoing; near future: any occurrence probable within one generation (includes former threat no longer causing impact but could readily recur); distant future: any occurrence likely to be further than one generation into the future (includes former threat no longer causing impact and unlikely to recur).
Extent: <1% of range; 1-50%; 50-90%; >90%.
Severity: (over three generations or 10 years, whichever is longer) Causing no decline; Negligible declines (<1%); Not negligible but <20%; 20-29%; 30-49%; 50-100%; Causing/could cause order of magnitude fluctuations.

5. Past and current management

There is an approved Conservation Advice (2015) and Recovery Plan (2006) guiding recovery action for this specie. A revised recovery plan is in the late draft form, which has much greater recognition of the importance of Aboriginal-owned Land, Aboriginal agency and Aboriginal involvement in the recovery of the species.

Recent and current management actions thought to be contributing to the conservation of Bilbies are summarised in Table 5. The information is a collation of material provided by contributors.

Table 5. Management actions thought to be contributing to the conservation of the Bilby. The estimate for overall population of Bilbies is very uncertain, so % population figures have not been calculated here.

Action	Location	Timing	Est. % population	Contributors and partners
Creation of insurance populations on predator-free islands and in mainland fenced reserves.		1998-2015		SA DEWNR
One island population	Thistle Island, SA	From 1997		Arid Recovery ($1million over 18 years from Corporate Sponsorship, community donations, state/federal/philanthropic grants, state government funding, BHP funding).
	Arid Recovery Reserve SA, 123 km^2;	From 2001		
Construction and maintenance of the current fenced reserves, totalling 225 km2.	Scotia Sanctuary NSW, 80 km^2;	2001; then 2004 after fence reconstruction		Australian Wildlife Conservancy (donations and philanthropic grants)
	Yookamurra Santuary SA, 11 km^2	1999; then 2007 after fence reconstruction		Australian Wildlife Conservancy (donations and philanthropic grants)
	Mt Gibson Wildlife Sanctuary, WA (78 km^2)	2016-18		Australian Wildlife Conservancy (donations and philanthropic grants)
	Pilliga NP, NSW (58 km^2)	2018		Australian Wildlife Conservancy, in partnership with NSW government
Construction and maintenance of Currawinya, then repairs in 2018.	Currawinya, 25 km^2	2005, then 2019 after fence reconstruction		Save the Bilby Fund (Donations and philanthropic grants)
				QLD DEHP and QPWS

Future translocation to fenced areas:	Newhaven Wildlife Sanctuary, NT (94 km^2)	2019-21	0% (translocation planned)	Australian Wildlife Conservancy
	Mallee Cliffs, NSW	2018	0% (translocation planned)	Australian Wildlife Conservancy, in partnership with NSW government
	Wild Deserts, Stuart NP, NSW (40 km^2)	2019-21	0% (translocation planned)	UNSW in partnership with NSW government
	Currawinya NP QLD (25 km2)	2019-20	0% (translocation planned early 2019)	Save the Bilby Fund, Qld Dept Env & Science, QPWS
Translocations to areas with foxes and cats that are intensively managed, including partly-fenced peninsulas	Venus Bay, 14.6 km^2	From 2001		SA DEWNR
	Peron Peninsula, 1000 km^2	From 2000		WA DBCA
	Matuwa-Lorna Glen WA, 2500 km^2	2007		WA DBCA
Translocation of Bilbies outside the Arid Recovery reserve to establish wild population. Failure due to cat predation despite intensive control through baiting, shooting and trapping. High rabbit numbers thought to support high cat density.	Roxby Downs Station SA	2007-2009	0	Arid Recovery (funded by Australian Govt. Natural Heritage Trust through SA Arid Lands NRM, Arid Recovery Core funding)
Bilbies exposed to cats in controlled situation to promote predator-awareness behaviours. Initial results suggest that exposure of naïve Bilbies to cats for prolonged periods leads to greater survival after release.	Arid Recovery Reserve, Roxby Downs SA	2015-2018		Arid Recovery, UNSW (funded by AR and ARC).
Bilby Recovery Summit: Reviewed progress since 2006 Recovery plan, identified priority actions for next plan (Recovery Summit Report and Interim Conservation Plan)	Queensland	2015	100%	Save the Bilby Fund, IUCN CPSG SSC. Involved c. 30 organisations, Identified need for appropriate and significant Indigenous involvement in recovery planning and implementation.
Formation of Recovery Team, following the Summit. Drafting of national Recovery Plan, and of metapopulation Management Plan		2015	100%	Save the Bilby Fund and many others (Andrew *et al.* 2018)
Ninu Festival – to assemble traditional and contemporary knowledge about the Bilby and threats to its survival, and produce a framework for effective, collaborative management of wild Bilby populations	Kiwirrkurra	2016		Kiwirrkurra Community, Indigenous Desert Alliance, many Indigenous groups, and many funding partners (Paltridge 2016)

Regional training and 2 –way knowledge sharing between scientists and Rangers, many of whom had not previously worked with Bilbies. Rangers all use standardised 2ha plot method, and are all engaged and empowered to monitor and manage country for Bilbies	Kimberley region	2015-ongoing	Environs Kimberley, WWF Australia, WA DBCA, KLC and the Karajarri, Yawuru, Nyul Nyul, Bardi Jawi, Nyikina Mangala, Gooniyandi, Ngurrara and Paruku Rangers. In-kind support (Ranger WOC and IPA$), DBCA offsets, WA State NRM
Bilby Blitz: to coordinate actions to support Bilby recovery and promote participation by Indigenous groups	Across range	2017-18	Indigenous Desert Alliance, CLC and many Indigenous groups. Many funding partners, including the OTSC, who have supported development of the Tracks App
Monitoring Mankarr populations, along with design of survey method that integrates Martu knowledge and western science.	Martu	2015-2018	Martu, Kanyirninpa Jukurrpa, NESP TSR Hub, BHP, TNC. Project to design monitoring program to track management effectiveness. (Skroblin *et al.* 2017)
Record of Martu traditional knowledge of Mankarr, including how to manage populations. IEK integrated into survey to maintain use.	Martu	2016-2017	Martu, Kanyirninpa Jukurrpa, NESP TSR Hub, BHP, TNC. Project to design monitoring program to track management effectiveness. (Skroblin *et al.* 2017)
Initiation of Ten Deserts Project, which will enhance regional fire management across deserts, and much of the Bilby distribution, except Kimberley and Qld	Deserts	2018	Indigenous Desert Alliance/Central Deserts Services, with multiple Indigenous and government partners
Direct and indirect cat management for Bilbies. Some cats killed but relatively un-strategically with no monitoring of population changes	Kimberley region	2015-ongoing	Gooniyandi and Nyul Nyul Rangers, possibly other groups. Environs Kimberley. WOC and IPA funding
Feral predator management (cat and fox). Aerial Eradicat baiting and some targeted trapping/shooting. Reduced occupancy and activity of feral predators, inferred decrease in abundance of feral predators	Matuwa (Rangelands)	2004-2017	DBCA (offset funding)
Feral predator control baiting. DBCA were undertaking baiting prior to 2018, but are now working together with MKK rangers as part of new five year two-way science plan.	Matuwa	2018-onwards	MKK Rangers, DBCA
Feral predator management (cat and fox). Aerial Eradicat baiting and some targeted trapping/shooting. Reduced occupancy and activity of feral predators, inferred decrease in abundance of feral predators	Fortescue Marsh (Pilbara)	2012-2018	DBCA (offset funding)

Feral predator management – Eradicat baiting	Waralong (Pilbara)	2019-2021	DBCA and Roy Hill
Targeted cat hunting (and monitoring) around Bilby sites. 100 cats removed from area around Kiwirrkurra since 2014. Camera monitoring indicates low cat visitation to Bilby burrows compared with the Tanami Desert sites, but insufficient data (yet) to confirm cat hunting is having a significant impact on cat abundance.	Kiwirrkurra IPA (Gibson Desert)	2014-2018	Kiwirrkurra Community and Kiwirrkurrra Rangers, Desert Support Services
Trials of different baits and bait delivery for introduced predators, to maintain Bilbies	Sangster's Bore (Tanami)	2000-13	CLC, DWS
Feral predator eradication	Currawinya Queensland	2015-18	Save the Bilby Fund/ QLD DEHP/ QPWS
Direct and indirect fire management for Bilbies. Rangers are all conducting early season burning to reduce late season fires with ranging success. Some targeting mosaic burning around known Bilby locations	Kimberley region	2015-ongoing	Environs Kimberley, WWF Australia, WA DBCA, KLC and the Karajarri, Yawuru, Nyul Nyul, Bardi Jawi, Nyikina Mangala, Gooniyandi, Ngurrara and Paruku Rangers. A large amount of in-kind support given (eg Ranger WOC and IPA$), otherwise DBCA offsets, WA State NRM
Fire management, including on ground and helicopter-based patch mosaic burning to aim to reinstate Martu Indigenous burning patterns. Some targeted mosaic burning around known Bilby locations to maintain cover from predators and promote Bilby (and Martu) food resources.	Martu and Kanyirninpa Jukurrpa	2008 – ongoing	Martu, Kanyirninpa Jukurrpa,
Fire management (Regular patch mosaic burning reducing large size and high intensity wildfires and promoting smaller sized and different aged burnt patches with a diversity of regrowth and food resources)	Matuwa rangelands	2004-2018	DBCA; and with Matuwa Kurrara Kurrara Rangers, Desert Support Services since 2015
Fire management (as above)	Fortescue Marsh (Pilbara)	2012-2018	DBCA
Fire management (as above)	Nullagine (Pilbara)	2017	DBCA and Millennium Minerals
Fire management (as above)	Waralong (Pilbara)	2019-2021	DBCA and Roy Hill
Fire management (as above)	La Grange area, Dampier Peninsula (Kimberley),	? - 2018	Karijarri, Nyangumarta, Yawuru, Nyul Nyul, Nyinkana Mangala, Bardi Jawi, Kiwirrkurra Rangers, KLC, Desert Support Services.

	Kiwirrkurra (Gibson Desert)		Likely also occurs across other Native Title/IPA areas that intersect current Bilby distribution.
Landscape-scale fire management, directly and indirectly for Bilbies	South and North Tanami IPAs and Tennant Ck region (CLC)	2015 - ongoing	Central Land Council, NTG. Also see Ten Deserts work above
Fencing off Bilby areas from cattle. A Bilby colony on a cattle station was fenced off to stop cattle damage, afterwards Bilbies moved locations which could be for a range of reasons.	Ngurrara country	2015-ongoing	Ngurrara Rangers and pastoral station. WOC and IPA funding
Fire management to reduce the average size of fires, reduce the total area burnt each year, increase seral diversity, protect sensitive areas from fire	Carnarvon Range (Birriliburu IPA)	2015-ongoing	Birriliburu Rangers, Desert Support Services, Bush Heritage Australia; Australian Government Threatened Species Recovery Fund
Patch burning to promote Bilby food resources and protect a network of unburnt patches to assist evasion from predators. Fire regimes within the Kiwirrkurra management zone are the same as pre-European levels (1950s).	Kiwirrkurra IPA	2014-2018	Kiwirrkurra Community and Kiwirrkurrra Rangers
Ongoing feral cat and dog/dingo control (shooting, baiting)	Astrebla Downs and Diamantina National Parks (Qld)	2013-ongoing	Qld Dept Envir & Science, QPWS
Monitoring for irruptions of native long-haired rat *Rattus villosissimus* to trigger management response	Astrebla Downs and Diamantina National Parks (Qld)	2013-ongoing	Qld Dept Envir & Science, QPWS

6. Actions undertaken or supported by the Australian Government resulting from inclusion in the Threatened Species Strategy

The Australian Government has supported a number of partnership projects to benefit the Greater Bilby, including:

i. Establishing a feral predator-free area at Newhaven Wildlife Sanctuary; ($750,000). The fence is completed, with feral eradication underway; translocations may begin in 2019.

ii. Delivering ongoing predator control at Astrebla Downs National Park to reduce key threats associated with cat predation ($1.2 million).

iii. Optimising grooming traps for targeted feral cat control ($100,000). This project could result in a control technique that will benefit the Bilby, if used in appropriate circumstances. Field trials are being carried out, but the technology is not yet fully field-operational.

7. Measuring progress towards conservation

Table 6. Progress towards management understanding and management implementation for each of the major threats affecting the Bilby in 2015 (i.e. timing of TSS implementation) and 2018, using the progress framework developed by Garnett et al. 2018.

PROGRESS IN MANAGING THREATS			
Threat	**Year**	**Understanding of how to manage threat**	**Extent to which threat being managed**
1. Increase in fire frequency/ intensity	2015	2.Research has provided strong direction on how to manage threat	1. Management limited to trials
	2018	2.Research has provided strong direction on how to manage threat	2. Work has been initiated to roll out solutions where threat applies across the taxon's range
2. Red foxes	2015	6.Research complete and being applied OR ongoing research associated with adaptive management of threat	4.Solutions are enabling achievement but only with continued conservation intervention
	2018	6.Research complete and being applied OR ongoing research associated with adaptive management of threat	4.Solutions are enabling achievement but only with continued conservation intervention
3a. Feral cats (fenced population)	2015	5.Trial management is providing clear evidence that it can deliver objectives	4.Solutions are enabling achievement but only with continued conservation intervention
	2018	5.Trial management is providing clear evidence that it can deliver objectives	4.Solutions are enabling achievement but only with continued conservation intervention
3b. Feral cats (unfenced population)	2015	1.Research being undertaken or completed but limited understanding on how to manage threat	1.Management limited to trials
	2018	1.Research being undertaken or completed but limited understanding on how to manage threat	1.Management limited to trials
4. Wild dogs/dingoes (Qld)	2015	5. Trial management is providing clear evidence that it can deliver objectives	4. Solutions are enabling achievement but only with continued conservation intervention
	2018	5. Trial management is providing clear evidence that it can deliver objectives	4. Solutions are enabling achievement but only with continued conservation intervention
5. European rabbits	2015	6.Research complete and being applied OR ongoing research associated with adaptive management of threat	4. Solutions are enabling achievement but only with continued conservation intervention
	2018	6.Research complete and being applied OR ongoing research associated with adaptive management of threat	4.Solutions are enabling achievement but only with continued conservation intervention
6. Habitat loss and fragmentation (agriculture and mining)	2015	1.Research being undertaken or completed but limited understanding on how to manage threat	1.Management limited to trials
	2018	1.Research being undertaken or completed but limited understanding on how to manage threat	1.Management limited to trials
7. Lack of acknowledgement of cultural importance of species	2015	1.Research being undertaken or completed but limited understanding on how to manage threat	1.Management limited to trials
	2018	3. Solutions being trialled but work only initiated recently	2.Work has been initiated to roll out solutions where threat applies across the taxon's range
8. Buffel grass	2015	0.No knowledge and no research	1.Management limited to trials
	2018	0.No knowledge and no research	1.Management limited to trials

> Green shading indicates an improvement in our understanding or management of threats between years 2015 and 2018, while red shading indicates deterioration in our understanding or management of threats.

KEY (Table 6):

Score	Understanding of how to manage threat	Extent to which threat is being managed
0	No knowledge and no research	No management
1	Research being undertaken or completed but limited understanding on how to manage threat	Management limited to trials
2	Research has provided strong direction on how to manage threat	Work has been initiated to roll out solutions where threat applies across the taxon's range
3	Solutions being trialled but work only initiated recently	Solutions have been adopted but too early to demonstrate success
4	Trial management under way but not yet clear evidence that it can deliver objectives	Solutions are enabling achievement but only with continued conservation intervention
5	Trial management is providing clear evidence that it can deliver objectives	Good evidence available that solutions are enabling achievement with little or no conservation intervention
6	Research complete and being applied OR ongoing research associated with adaptive management of threat	The threat no longer needs management

8. Expert elicitation for population trends

An expert elicitation process was undertaken to assess population trends for the period 2005-2015 and post-2015 under the following management scenarios. Please note that differences between Management Scenarios 2 and 3 (Fig. 1) are difficult to attribute, as it can be difficult to determine whether actions undertaken after 2015 were influenced by the Threatened Species Strategy or were independent of it (see Summary Report for details of methods).

Management Scenario 1 (red line): *no conservation management undertaken since 2015, and no new actions implemented*.

- No fire management.
- No rabbit control; rabbit numbers increase inside some fenced areas. Outside fenced areas, rabbits begin to increase after several years, because there are no more releases of disease.
- No feral livestock management; managed livestock increase in density along Fitzroy river in Kimberley, and through La Grange and Pilbara areas.
- No fox or cat control.
- Existing island population persists; four fenced populations persist, but without regular maintenance and surveillance, cats or foxes will eventually gain access to the fenced sites.

Management Scenario 2 (blue line): *continuation of existing conservation management (i.e. actions undertaken before implementation of the Threatened Species Strategy or independent of the Threatened Species Strategy)*.

- In the west and south Kimberley, landscape-scale fire management has been increasing every year in scale and success since 2015 and is expected to continue to increase. Kanyirinpa Jukurrpa management of fire is also increasing every year in the western deserts. In other regions, fire management mostly limited to areas immediately around Indigenous communities. However, it is anticipated that fire management capacity and implementation of desert Indigenous groups will grow over the next decade.
- Rabbit populations across continent controlled by periodic releases of disease.
- No feral livestock management; managed livestock increase in density along Fitzroy river in Kimberley, and through La Grange and Pilbara areas, although these impacts are considered in approval processes.
- Cats and foxes excluded from existing fenced areas and island. Mt Gibson, Newhaven, Pilliga, Mallee Cliffs, Wild Desert, Currawinya projects all go ahead without OTSC support (although one project did receive some support).

Management Scenario 3 (green line): *continuation of existing management, augmented by support mobilised by the Australian Government under the Threatened Species Strategy*.

- In the west and south Kimberley, landscape-scale fire management has increased every year in scale and success since 2015. Kanyirinpa Jukurrpa management of fire is also increasing every year in the western deserts. In other regions, fire management mostly limited to areas immediately around Indigenous communities. However, fire management capacity and implementation of desert Indigenous groups will grow over next decade.
- Rabbit populations across continent controlled by periodic releases of disease.
- No feral livestock management; managed livestock increase in density along Fitzroy river in Kimberley, and through La Grange and Pilbara areas, although these impacts are condsidered in approval processes.
- Cats and foxes excluded from existing fenced areas and island. Mt Gibson, Newhaven, Pilliga, Mallee Cliffs, Wild Desert, Currawinya projects all go (the Newhaven project received some support). OTSC also support the construction of a fenced area at Astrebla NP, but this project has been delayed.
- OTSC support has also enhanced general awareness of Bilbies, of Indigenous land management and of cat impacts, but difficult to partition specific outcomes.

Overall estimated population trajectories subject to management scenarios considered

The Bilby is currently being managed under Scenario 3 (green line).

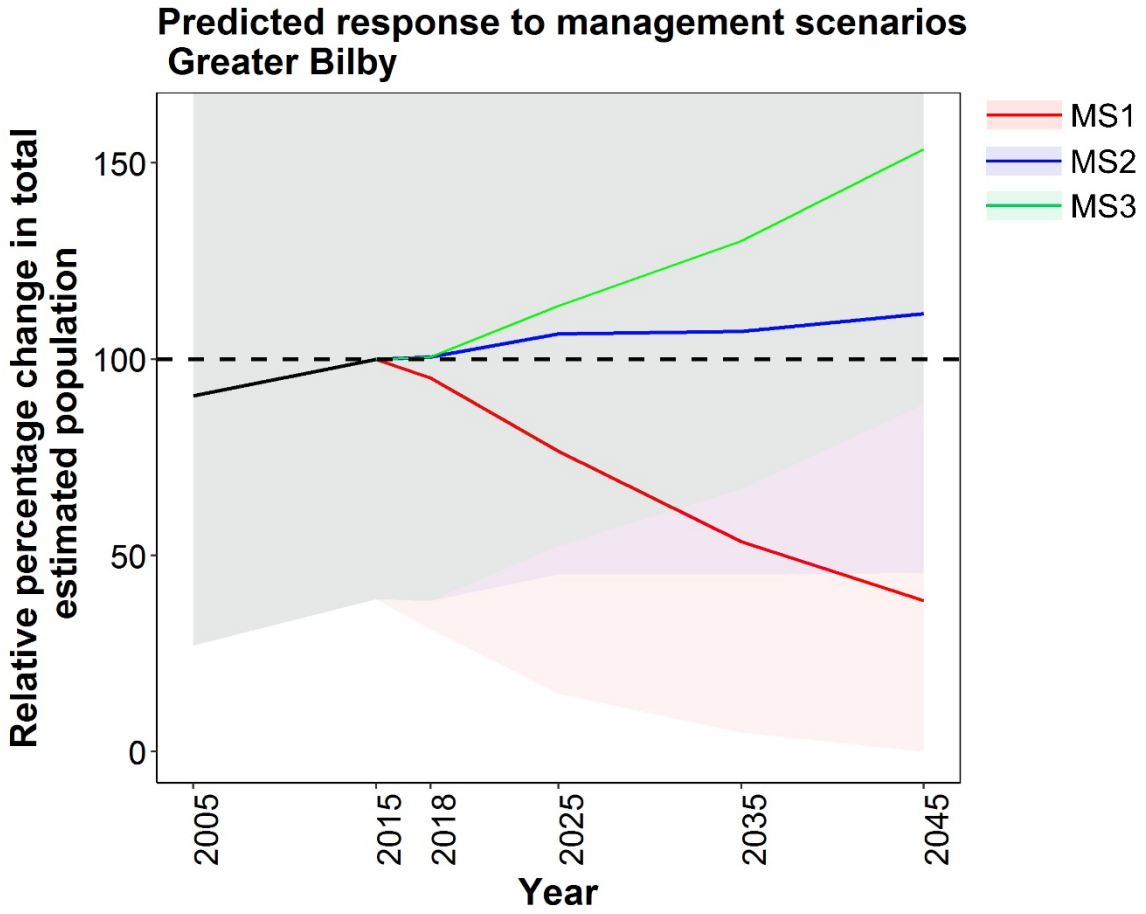

Figure 1. Estimated relative percentage change in population under each of the management scenarios described above. Data derived from 8 expert assessments of Bilby expected response to management, using four-step elicitation and the IDEA protocol (Hemming et al. 2017), where experts are asked to provide best estimates, lowest and highest plausible estimates, and an associated level of confidence. The dashed line represents the baseline value (i.e. as at 2015, standardised to 100). Values above this line indicate a relative increase in population size, while values below this line indicate a relative decrease in population size. Shading indicates confidence bounds (i.e. the lowest and highest plausible estimates). NB: lower and upper bounds wider than what is shown in top graph.

Population size projections based on expert elicitation are extended here to 2025, 2035 and 2045 (i.e. 10, 20 and 30 years after the establishment of the Threatened Species Strategy) on the grounds that some priority conservation management actions may take many years to achieve substantial conservation outcomes. However, we note also that there will be greater uncertainty around estimates of population size into the more distant future because, for example, novel threats may affect the species, managers may develop new and more efficient conservation options, and the impacts of climate change may be challenging to predict.

Improved trajectory (Threatened Species Strategy Year 3 target):

The primary purpose of this scorecard is to assess progress against achieving the year three targets outlined in the Australian Government's Threatened Species Strategy, i.e. a demonstrated improved trajectory for at least half of the priority species (10 birds and 10 mammals). To assess this, we first use the expert-derived trend between 2005-15 (i.e. 10 years prior to implementation of the TSS) as a baseline for assessing whether there has been an improvement in trajectory in the time since implementation of the TSS (i.e. 2015-18). Table 6 below summarises this information, where negative values indicate a declining population, and positive values indicate an increasing population. We used Wilcoxon match-paired tests to compare trajectories for these two periods; a significant result (probability <0.05) indicates that there was a high concordance amongst experts that their trajectory estimates for 2005-15 were different to their estimates for 2015-18.

Table 7. A comparison of the relative annual percentage population change for the periods 2005-2015 and 2015-2018.

	Pre-TSS trend (2005-2015)	Post-TSS trend (2015-2018)	Year 3 target met?	Significant concordance among elicitors?
Annual percentage population change	0.93	0.21	✗	Elicitors were inconsistent in estimating trajectory changes from the 2005-15 period to 2015-18

*Most data are unpublished and not publicy accessible. Recently initiated monitoring, including using new techniques, may improve estimates of both population size and trends in the future.

The key investment from the TSS directed specifically to this species was contributing to the construction of one new fenced area (Newhaven); the benefit of this investment will become apparent after 2018. The TSS also contributed to general improvements in cat control, and to increased awareness and support for Bilby conservation. Apportioning the impact of this support to the Bilby's population trajectory is challenging.

Additional actions that could improve trajectory

The potential impact of carrying out specific additional conservation measures on the population trajectory of the Bilby was also evaluated through expert elicitation. Additional actions that could further improve the population trajectory of the Bilby include:

- Effective landscape-scale fire management is implemented from west Kimberley through to the deserts and all of distribution.
- Rabbit distribution is maintained or shrunk.
- Agricultural intensification in the south and west Kimberley is managed to minimise loss of Bilby habitat, and to maintain connectivity between Bilby populations.
- Cat impacts lessened mainly by fire management actions, but targeted cat control also implemented at key Bilby sites.

- Bilbies are represented within 11 fenced and island areas (the 6 existing, the 5 underway or planned), plus cats and foxes at Venus Bay and Peron Pensinsula are cleared or effectively controlled, providing two additional areas free of introduced predators.

9. Immediate priorities from 2019

Identification of these priorities in this document is for information and is non-statutory. For statutory conservation planning documents, such as Recovery Plans or Conservation Advices, please see Section 11.

Data collection:

- Collate the current, dispersed survey and monitoring activity (mostly based on 2 ha sandplot surveys) into a national program; this will require devleoping data quality, sharing and management framework and protocols to make the collection of data more robust and adequate to detect trend and response to management
- Understand the relationships between the intensity of threats and Bilby presence, including identifying threshold levels of each threat in different contexts
- In Queensland, research to understand the dynamics between dingoes, cats and Bilbies
- Continue to test whether management of threats (especially fire and cats) to threshold levels can effectively support Bilby persistence (e.g. Peron Peninsula, Matuwa-Lorna Glen)

Management actions:

- Support and resource National Recovery team and implementation of National Recovery Plan and Meta-population Management Plan 2018
- Support, resource and recognise contribution of Aboriginal Rangers and communities who manage 80% of the Bilby's current range; this should include support for cultural management practices that pertain to Bilbies (e.g. small-scale hunting fires for cats and goannas, in Bilby habitat)
- Targeted fox and cat management; and (in Qld) wild dog/dingo management.
- Targeted fire management
- Greatly enhance fire management and feral animal control across the arid part of the Bilby distribution (e.g. through Ten Deserts collaboration)
- Undertake reintroductions to unfenced areas with adequate threat management, especially at sites just on the edge of the current distribution
- Complete reintroduction projects at the fenced projects of Newhaven, Mallee Cliffs, Pilliga, Wild Deserts, Currawinya
- Maintain fenced and island populations, but further investment in fenced populations may be a lesser priority than managing wild populations of Bilbies in open landscapes.
- Implement plan to manage the meta-population of Bilbies within the growing network of fenced exclosures and on Thistle Island, as well as the unfenced populations
- Support Indigenous groups to develop and 'own' the Bilby national recovery plan, and support efforts to align targets in Healthy Country Plans with Bilby recovery plan
- Align relevant activities (including reporting) funded under WOC and IPA with those under the Bilby recovery plan (and other species recovery plans)

10. Contributors

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11. Legislative documents

SPRAT profile: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=282

Threatened Species Scientific Committee (2016). *Conservation Advice* Macrotis lagotis *Greater Bilby*. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/282-conservation-advice-15072016.pdf. In effect under the EPBC Act from 15-Jul-2016.

Pavey, C. (2006). National Recovery Plan for the Greater Bilby Macrotis lagotis. Northern Territory Department of Natural Resources, Environment and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-greater-Bilby-macrotis-lagotis. In effect under the EPBC Act from 09-May-2007.

Commonwealth of Australia (2019). Recovery Plan for the Greater Bilby *Macrotis lagotis* (Draft for consultation). Commonwealth of Australia, Canberra. *(Note this document is not yet broadly available).*

12. References

Andrew, P., Bradley, K., Buchecker, J., Ford, C., Kemp, L., Lees, C., Nally, S., and Page, M. (2018). The Greater Bilby Meta-population Management Plan 2018-2028. (Greater Bilby National Recovery Team.)

Bradley, K., Lees, C., Lundie-Jenkins, G., Copley, P., Paltridge, R., Dziminski, M., Southgate, R., Nally, S., and Kemp, L. (2015). Greater Bilby Conservation Summit and Interim Conservation Plan: an initiative of the Save the Bilby Fund. *IUCN SSC Conservation Breeding Specialist Group, Apple Valley, MN*.

Commonwealth of Australia (2019). Draft Recovery Plan for the Greater Bilby *Macrotis lagotis*. (Department of the Environment and Energy: Canberra.)

Dziminski, M. A., Bettink, K., Carpenter, F., Dickinson, R., MacKenzie, D. I., Shovellor, W., Taylor, B., Kitty, S., Hunter, R., Hunter, I., Smith, J., and Mamid, J. (2018). Greater Bilby Survey: La Grange Project Area. (Department of Parks and Wildlife, Western Australia: Perth.)

Dziminski, M. A. and Carpenter, F. (2017). The conservation and management of the Bilby (*Macrotis lagotis*) in the Pilbara: Progress Report 2017. (Department of Parks and Wildlife, Western Australia: Perth.)

Garnett, S.T., Butchart, S.H.M., Baker, G.B., Bayraktarov, E., Buchanan, K.L., Burbidge, A.A., Chauvenet, A.L.M., Christidis, L., Ehmke, G., Grace, M., Hoccom, D.G., Legge, S.M., Leiper, I., Lindenmayer, D.B., Loyn, R.H., Maron, M., McDonald, P., Menkhorst, P., Possingham, H.P.,

Radford, J., Reside, A.E., Watson, D.M., Watson, J.E.M., Wintle, B., Woinarski, J.C.Z., and Geyle, H.M. (2018) Metrics of progress in the understanding and management of threats to Australian Birds. *Conservation Biology* https://doi.org/10.1111/cobi.13220.

Hemming, V., Burgman, M.A., Hanea, A.M., McBride, M.F., and Wintle B.C. (2017) A practical guide to structured expert elicitation using the IDEA protocol. *Methods in Ecology and Evolution*, **9**, 169-180.

Legge, S., Woinarski, J., Burbidge, A., Palmer, R., Ringma, J., Mitchell, N., Radford, J., Bode, M., Wintle, B., Baseler, M., Bentley, J., Carter, O., Copley, P., Dexter, N., Dickman, C., Gillespie, G., Hill, B., Johnson, C., Latch, P., Letnic, M., Manning, A., Menkhorst, P., Morris, K., Moseby, K., Page, M., Pannell, D., and Tuft, K. (2018). Havens for threatened Australian mammals: the contributions of fenced areas and offshore islands to protecting mammal species that are susceptible to introduced predators. *Wildlife Research* 45, 627-644.

McRae, P. D. (2004). Aspects of the ecology of the Greater Bilby, *Macrotis lagotis*, in Queensland. (University of Sydney: Sydney.)

Moritz, C., Heideman, A., Geffen, E., and McRae, P. (1997). Genetic population structure of the Greater Bilby *Macrotis lagotis*, a marsupial in decline. *Molecular Ecology* **6**, 925-936.

Palmer, R. (1999). The ecology of feral cats in the mid-reaches of the Diamantina River in far western Queensland. Final report to the Invasive Species Section of the Biodiversity Group, Environment Australia. (Department of Zoology and Centre for Conservation Biology, University of Queensland: Brisbane.)

Paltridge, R. (2016). What did we learn from the 2016 Ninu Festival? (Desert Wildlife Services: Alice Springs.)

Radford, J., Woinarski, J., Legge, S., Baseler, M., Bentley, J., Burbidge, A., Bode, M., Carter, O., Copley, P., Dexter, N., Dickman, C., Gillespie, G., Hill, B., Johnson, C., Kanowski, J., Letnic, M., Manning, A., Menkhorst, P. W., Mitchell, N., Morris, K., Moseby, K. E., Page, M., Pannell, D., Ringma, J., and Wintle, B. (2018). Degrees of population-level susceptibility of Australian mammal species to predation by the introduced red fox *Vulpes vulpes* and feral cat *Felis catus*. *Wildlife Research* 45, 645-657.

Rich, M., Nolan, B., Gentle, M., and Speed, J. (2014). Lessons in feral cat control. Can adaptive management provide the solution? A case study from Astrebla Downs National Park, western Queensland. 16th Australasian Vertebrate Pest Conference 2014. (Eds. M. Gentle). (Biosecurity Queensland: Brisbane.)

Skroblin, A., Carboon, T., and Martu (2017). Martu knowledge of mankarr (Greater Bilby): distribution, habitat, management. (NESP Threatened Species Recovery Hub: Melbourne.)

Southgate, R. and Adams, M. (1994). Genetic variation in the Greater Bilby (*Macrotis lagotis*). *Pacific Conservation Biology* 1, 46-52.

Southgate, R. and Bradley, K. (2018). A preliminary survey of Bilby occurrence and habitat use in southwest Queensland.

Southgate, R. and Carthew, S. M. (2006). Diet of the Bilby (*Macrotis lagotis*) in relation to substrate, fire and rainfall characteristics in the Tanami Desert. *Wildlife Research* **33**, 507-519.

Southgate, R., Paltridge, R., Masters, P., and Carthew, S. (2007). Bilby distribution and fire: a test of alternative models of habitat suitability in the Tanami Desert, Australia. *Ecography* **30**, 759-776.

TSSC (2016). Conservation Advice *Macrotis lagotis* Greater Bilby (Department of Environment and Energy: Canberra.)

Woinarski, J. C. Z., Burbidge, A. A., and Harrison, P. L. (2014). 'The Action Plan for Australian Mammals 2012.' (CSIRO Publishing: Melbourne.)

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