

Eastern Quoll *Dasyurus viverrinus*

Key Findings

Eastern Quolls disappeared from the Australian mainland last century, due to disease, predation by foxes, feral cats and domestic dogs, poisoning and persecution. Conservation for wild Eastern Quolls depends on effective ongoing management for feral cats and biosecurity in Tasmania, with ongoing expansion and management of populations on islands and within fenced areas that are cat- and fox-free. Eastern Quolls have been reintroduced to three mainland sites since 2002. Photo: Maree Clout



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

No significant change overall.

Priority future actions

- Effective cat management at strategic sites
- Translocation program between existing populations that considers genetic management
- Translocations to at least two more fenced mainland sites and one fox-free island where feral cats are managed or absent.

Full assessment information

Background information

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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. It has been informed by statutory planning documents that guide recovery of the species, such as Recovery Plans and/or Conservation Advices (see Section 11). The descriptive information in the scorecard is drawn from the summaries of (Fancourt *et al.* 2013; Fancourt *et al.* 2014; Woinarski *et al.* 2014; Fancourt *et al.* 2015; TSSC 2015; Fancourt 2016; Fancourt *et al.* 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	Endangered
TAS	Not Listed
VIC	Threatened (Regionally Extinct)
NSW	Endangered
SA	Endangered
ACT	Not Listed (extinct)

Taxonomy:

No subspecies are recognised.

2. Conservation history and prospects

The Eastern Quoll's previous distribution included Tasmania (including Bruny Island), and the southeast of the Australian mainland, from NSW, through Victoria, to South Australia. Eastern Quolls on the Australian mainland declined rapidly in the late 1800s and early 1900s; by the 1960s, the Eastern Quoll had been extirpated from the mainland: the last live specimen was recorded at Vaucluse in NSW, in 1963. However, a taxidermied specimen was provided to NSW National Parks and Wildlife Service in 2016 was reportedly collected in the Barrington Tops – Gloucester region in 1989, indicating the species may have survived on the Australian mainland for longer than generally accepted (Frankham *et al.* 2017). Evidence suggests that an unknown disease played an important role in historical declines between 1890 and 1910, with quoll populations seemingly disappearing in a matter of weeks to months. Some isolated populations persisted in relatively low densities in some areas until the 1950s or 1960s, with persecution, poisoning and fox predation thought to have contributed to the extirpation of remaining populations.

Eastern Quolls have been reintroduced to the Australian mainland fenced areas of Mt Rothwell in Victoria (2002), Mulligans Flat Woodland Sanctuary (2016, 2017, 2017; with another translocation possible in 2019), and very recently to an unfenced site within Booderee National Park (2018). A 400 ha fenced area at Barrington Tops may also be available for a release within the next year.

In Tasmania the Eastern Quoll is mostly found in the dry-moderate rainfall areas of the eastern part of the island, in open grasslands, farmland, woodlands, dry forests, coastal scrub and alpine heathland. Eastern Quolls are usually absent from rainforest and wet sclerophyll forests. The population in Tasmania declined by over 50% over the ten years preceding 2009, coincident with a prolonged period of above average rainfall and warm winter temperatures during 2002-2003. This period of unsuitable weather reduced quoll populations to an unprecedented low abundance, and populations may now be too small to withstand threats to which they were robust when at higher densities, such as feral cat predation and mortality from vehicle strike. Eastern Quoll numbers on the Tasmanian mainland have not recovered, however the high-density population on Bruny Island has subsequently recovered and has remained fairly stable ever since.

Eastern Quolls have co-existed with feral cats in Tasmania for more than 150 years. However, feral cats do kill juvenile quolls, and while there is evidence that feral cat numbers have not increased following the marked decline of Tasmanian devils, cats are becoming more nocturnal in areas where Tasmanian devils have declined, presenting an increased risk to nocturnal species such as Eastern Quolls.

Eastern Quolls mostly prey on invertebrates, but will take small vertebrates and occasionally eat fruits and other plant material, and will also scavenge on carrion.

3. Past and current trends

The Eastern Quoll was functionally extinct on the mainland by the 1960s. It is still widespread in Tasmania, but spotlighting data from 147 transects across the island indicate a population decline of over 50% in the 10 years to 2009. Numbers have not recovered since then. Trapping surveys confirmed a continuing decline at a number of trapping sites, while camera surveys at an additional 16 sites across the species' range confirmed low densities of quolls at sites where high-density populations were historically recorded. Sites surveyed by trapping in the 1980s and early 1990s, then again in 2010, indicated declines of 61-100%. Capture rates of Eastern Quolls in surveys targeting other species also indicate declines of 51-100% over 1-12 years. Spotlighting data suggests the population has remained stable, but at a low level, since 2004. However, spotlighting is a coarse monitoring method, and it is possible that small populations of Eastern Quolls have become extirpated since 2004.

Eastern Quolls have been reintroduced to three mainland sites: Mt Rothwell Biodiversity Centre in Victoria (about 70 animals there now, after 2002 reintroduction); Mulligans Flat Woodland Sanctuary in the ACT (37 Eastern Quolls released 2016-18), and Booderee National Park in NSW (20 Eastern Quolls released 2018).

Monitoring (existing programs):

Tasmania:

- Department of Primary Industries, Parks, Water and Environment have carried out annual spotlight surveys since 1975. The surveys were originally designed to track trends in the abundance of macropods and possums subject to harvesting, but have provided information on other species, including Eastern Quolls. A core group of 42 transects (each 10 km long) have been surveyed every year from 1975, although protocols for surveying these transects were not standardised until 1985, and they did not traverse core Eastern Quoll habitat. The number of transects increased over time to 189 by 2009. Due to methodological inconsistencies in earlier surveys, long term trends in Eastern Quolls have relied on the standardised data from 1985 to ensure consistency.
- Three sites were trapped for Eastern Quolls from around the 1980s and then again in 2010-2013.
- Camera surveys were undertaken throughout the species' range during 2012-2013.
- Capture rates for Eastern Quolls are available from various surveys designed primarily for other species such as Tasmanian devils.

Threatened Species Strategy – Year 3 Priority Species Scorecard (2018)

Mainland:

- Mt Rothwell: about 70 animals in population, following translocation in 2003. Monitored by staff at Mt Rothwell.
- Mulligans Flat Woodland Sanctuary: 37 translocated Eastern Quolls, released in 2016-18, are closely monitored using VHF- and GPS-tracking, spotlighting, remote cameras and cage trapping by researchers from the Australian National University (ANU, as part of ARC Linkage project), the ACT Government and the Woodlands and Wetlands Trust. Over 180 juveniles have been conceived in the Sanctuary since 2016.
- Booderee NP: 20 translocated Eastern Quolls were released in March 2018, and closely monitored by GPS-tracking, camera trapping and cage trapping (TSR Hub researchers from ANU, Parks Australia staff from Booderee NP and Rewilding Australia).

Population trends:

Tables 1 and 2 summarise the overall trend and status of the Eastern Quoll. The information in these tables is derived from the 2015 Conservation Advice, with some amendments made by contributing experts based on new information.

Table 1. Summary of the available information on Eastern Quoll 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	47,000 km ²	47,000 km ²	47,000 km ²	Low – Booderee and Mulligans enlarge EoO, but in absence of any species management in Tasmania, the EOO is likely to have decreased
Area of Occupancy	2320 km ²	2320 km ²	2320 km ²	Low - The area provided by Mt Rothwell, Mulligans Flat Woodland Sanctuary and Booderee is small compared to Tasmanian distribution, where occupancy may have decreased.
Dates of records and methods used		IUCN guidelines used for records from 1993 – 2012		
No. mature individuals	>10,000	>10,000	>10,000	Low
No. of subpopulations	2	2	2	High
No. of locations	2	2	3	High: addition of Mulligans Flat Woodland Sanctuary.
Generation time	2	n/a	n/a	High (as in MAP)

Threatened Species Strategy – Year 3 Priority Species Scorecard (2018)

Population parameters	Published baseline	2015 Estimate	2018 Estimate	Confidence in estimates
EXCLOSURES/ISLANDS				
No. mature individuals	Mt Rothwell: 70	Mt Rothwell: 70	Mulligans Flat: ~29 (plus 2018 young). Mt Rothwell: 70	High
No. locations	1	1	2	High
CAPTIVE BREEDING				
No. mature individuals		80 (45 at Devils at Cradle and 35 at Trowunna) 30: Mt Rothwell captive breeding Several institutions in Tasmania including Bonorong Wildlife Sanctuary and East Coast Nature World	90 (60 at Devils at Cradle and 50 at Trowunna) 60:Aussie Ark 30: Mt Rothwell captive breeding Several institutions in Tasmania including Bonorong Wildlife Sanctuary and East Coast Nature World	
No. locations		>5	>5	

*Including translocations

Table 2. Estimated recent (2005-2015) and current (2015-2018) population trends for the Eastern Quoll.

Sub-population	Est. % of total pop'n (pre-2015)	2005-2015 trend	Confidence in 2005-2015 trend	2015-2018 trend	Confidence in 2015-2018 trend	Est. % of total pop'n (2018)	Details
Tasmania	15%		Low		Low	15%	Spotlight surveys from 150 sites across Tasmania over ten years (1999 -2009) revealed a 52% reduction in Eastern Quoll sightings with this decline stopping by 2004; Trapping rates show similar declines. Spotlighting suggests stable since then, but spotlighting is a coarse monitoring tool, and some localised pop decline is possible, so the 2005-15 trend is shown as declining.
Bruny Island	85%		Medium		Low	85%	Numbers captured on Bruny Island increased between 2010 and 2012 but have remained stable ever since.
Mt Rothwell	<<1%		High		High	<<1%	About 70 individuals there. Populations breeding and captive program active. Efforts underway to release Eastern Quolls into 950 ha enclosure at Tiverton.
Mulligans Flat Sanctuary	n/a	n/a	n/a		High	<<1%	Translocated pop'n breeding, with an estimated ~29 mature individuals established (plus 2018 young).
Booderee NP	n/a	n/a	n/a		High	<<1%	High mortality in translocated animals, but nevertheless, Eastern Quolls present and breeding in park.
Whole population	100%		High		Low	100%	Based on Tasmanian population, some loss between 2005-15 likely on the Tasmanian mainland, but offset by increases on Bruny Island. Noted as stable for 2015-18, given short duration.

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 Mammal Action Plan (Woinarski *et al.* 2014) and the latest Conservation Advice (TSSC 2015), with some amendments from 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.

Climate change

Given the apparent sensitivity of Eastern Quolls to changes in weather, it is possible that climate change has had a negative impact on this species, and will continue to adversely impact the species as the frequency, magnitude and duration of extreme weather events increase into the future.

Predation by foxes

Foxes are implicated in the extinction of Eastern Quolls on the Australian mainland, as the spatio-temporal expansion of the fox distribution broadly coincided with patterns of Eastern Quoll decline. However, Eastern Quoll declines in some areas occurred before foxes arrived there, and quoll populations persisted long after the arrival of foxes in other areas. Few detections of foxes in Tasmania in recent years suggests that foxes are currently functionally absent, but if they ever establish, they may have devastating impacts on Eastern Quoll populations.

Predation by cats

Quolls, particularly juveniles, are vulnerable to cat predation, but quolls have persisted in Tasmania despite the presence of cats for >200 years. No relationship has been found between feral cat and quoll abundance. However, shifts in the temporal activity of cats following Tasmanian devil declines might be increasing encounter rates between cats and quolls during summer when juvenile quolls emerge from their natal dens. This increased risk of predation for juvenile quolls could be inhibiting recovery of low-density quoll populations following weather-induced declines. On Bruny Island, quolls primarily occur on the north island, although they do occur in low densities on the south island when climatic conditions are suitable.

Disease

Episodes of rapid, widespread Eastern Quoll mortality dating from the mid-1800s to the early 1900s have been anecdotally associated with disease (e.g. bubonic plague, distemper-like virus, toxoplasmosis). This was likely a major factor in the local extinction of Eastern Quolls on the mainland. Disease is potentially a severe threat to the future viability of Eastern Quoll populations on Bruny Island, should a pathogen be introduced, due to the islands small size, and the high density and low genetic diversity of the Eastern Quoll population.

Although *Toxoplasma gondii* is present in Tasmanian Eastern Quolls, it does not appear to negatively affect Eastern Quolls and hence would not have been responsible for Eastern Quoll declines, either on the Australian mainland or in Tasmania.

Habitat modification

Land clearing has been anecdotally implicated as a factor in the historic Australian mainland declines, however as Eastern Quolls occur at highest densities in open farmland, this is unlikely to have been the most significant driver of historic Eastern Quoll declines. In Tasmania, recent conversion of agricultural

land or native forest to plantation monocultures could potentially reduce habitat quality for Eastern Quolls.

Non-target poisoning (1080 baits and rodenticides)

The Eastern Quoll has a high risk of mortality associated with 1080 baiting for foxes (or dogs on the Australian mainland). While widespread fox baiting in Tasmania has ceased, 1080 is widely used on the Australian mainland for the landscape control of foxes and wild dogs and presents a significant threat to the Eastern Quoll. Reintroducing Eastern Quolls to sites on the Australian mainland where 1080 is regularly used to control canids exposes Eastern Quolls to a high risk of mortality. 1080 is also used in carrot or grain-based baits to control wallabies and possums in Tasmania, although at <10% of the volumes used 15 years ago. Eastern Quolls are unlikely to eat baits designed for herbivores. There is potential mortality from primary ingestion of rodenticides containing second generation anticoagulants (e.g. brodifacoum) and secondary poisoning from scavenging or consuming poisoned rodents (sub-lethal doses of brodifacoum can rapidly bioaccumulate to toxic levels with prolonged persistence). The use of brodifacoum in rodenticides in both urban and agricultural systems frequented by Eastern Quolls has increased in recent decades due to its unrestricted availability from supermarkets.

The impacts of the major threats are summarised in Table 3.

Table 3. The major threats facing the Eastern Quoll and their associated impact scores.

CURRENT THREAT IMPACT			
Threat	Timing	Extent	Severity
1. Climate change and severe weather	Continuing/ongoing	>90% of range	50-100%
2. Red foxes	Continuing/ongoing	<1% of range	50-100%
3. Feral cats	Continuing/ongoing	>90% of range	20-29%
4. Disease	Distant future	1-50% of range	50-100%
5. Habitat modification	Continuing/ongoing	1-50% of range	Not negligible but <20%
6. Poisoning from toxic baits (1080)	Continuing/ongoing	<1% of range	50-100%
7. Poisoning from toxic baits (rodenticide)	Continuing/ongoing	1-50% of range	50-100%

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

Recent and current management actions that support the conservation of Eastern Quolls are summarised in Table 4. This information is a collation of material provided by contributors.

Conservation Advice approved in 2015 guides recovery action for this species (see Section 11).

Table 4. Management actions that support the conservation of the Eastern Quoll.

Action	Location	Timing	Est. % pop'n	Contributors and partners
Reintroduction to Mt Rothwell, Victoria	VIC	2003	<<1%	Mt Rothwell Biodiversity Interpretation Centre; Odonata
Translocation to Mulligans Flat Woodland Sanctuary	ACT	2016-17	<<1%	ACT Govt., ANU, Woodlands and Wetlands Trust, James Cook University, Charles Darwin University (funded by ARC Linkage grants)
Translocation to Booderee NP	Booderee National Park, Jervis Bay	2018	<<1%	Parks Australia; ANU; Wreck Bay Community; Taronga Conservation Society; Rewilding Australia; WWF Australia
Expansion of captive breeding facilities in Tasmania	Devils at Cradle; Trowunna Wildlife Sanctuary	2016-2018	<<1%	Rewilding Australia and WWF Australia
Expansion of captive breeding facilities in NSW	Tomala, NSW	2018	<<1%	Aussie Ark, Australian Geographic
Completion of 400ha feral predator proof sanctuary.	Tomala, NSW	2018	NA	Aussie Ark
Expand the area of fenced enclosure on mainland, with 12.5 km new fencing, enclosing 801 ha, to a total of 12.9 km ²	Goorooyarroo (adjacent to Mulligans Flat, ACT)	Complete 2018	0%	ACT Government, Australian Government
Reducing predation: feral cat control and domestic cat management	Bruny Island	2017	10%	Implementation of Threatened Species Strategy, partnership between Australian Govt and Tasmanian Govt
Establishment of the Eastern Quoll Mainland Recovery Team	Mainland	2014		Mt Rothwell Biodiversity Interpretation Centre, Cesar, Melbourne University, ACT Government, ANU, East Coast Nature World, Odonata
Efforts underway to eradicate pests from Tiverton (950 ha fenced enclosure) in Dundonnel	Tiverton	2019		Mt Rothwell Biodiversity Interpretation Centre, Odonata

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

The Australian Government, in partnership with the Australian Capital Territory Government, has contributed \$600,000 towards the construction of predator-proof fencing around 801 ha of Gorooyarroo Woodland (adjacent to Mulligans Woodland Sanctuary) that will act as another safe haven for Eastern Quolls on the mainland.

A Threatened Species Partnership has also been implemented between the Australian Government and Tasmanian Government to reduce the impacts of feral cat predation on Bruny Island (\$681,500 provided by the Australian Government).

The NESP TSR Hub is supporting recovery of Eastern Quolls through a trial reintroduction to an unfenced site within Booderee National Park, in collaboration with Parks Australia and Rewilding Australia. This research will help shape guidelines for future translocations.

7. Measuring progress towards conservation

Table 5. Progress towards management understanding and management implementation for each of the major threats affecting the Eastern Quoll 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. Climate change and severe weather	2015	1. Research being undertaken or completed but limited understanding on how to manage threat	0.No management
	2018	2. Research has provided strong direction on how to manage threat	0.No management
2. Red foxes	2015	2. Research has provided strong direction on how to manage threat	0.No management
	2018	4.Trial management under way but not yet clear evidence that it can deliver objectives	1. Management limited to trials
3. Feral cats	2015	1. Research being undertaken or completed but limited understanding on how to manage threat	0.No management
	2018	1. Research being undertaken or completed but limited understanding on how to manage threat	1. Management limited to trials
4. Disease	2015	1. Research being undertaken or completed but limited understanding on how to manage threat	0.No management
	2018	1. Research being undertaken or completed but limited understanding on how to manage threat	0.No management
5. Habitat modification	2015	2. Research has provided strong direction on how to manage threat	0.No management
	2018	2. Research has provided strong direction on how to manage threat	0.No management
6. Poisoning from toxic baits (1080)	2015	2. Research has provided strong direction on how to manage threat	0.No management
	2018	2. Research has provided strong direction on how to manage threat	0.No management
7. Poisoning from toxic baits (rodenticide)	2015	2. Research has provided strong direction on how to manage threat	0.No management
	2018	2. Research has provided strong direction on how to manage threat	0.No management

> 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.

Threatened Species Strategy – Year 3 Priority Species Scorecard (2018)

KEY:

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 cat management (including no conservation action to restore devil populations)
- No biosecurity for fox invasions
- No representation in mainland fenced enclosures, nor releases to unfenced sites on the mainland

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).*

- Some cat management (including conservation action to restore devil populations)
- Biosecurity for fox invasions
- Establish captive breeding program to maintain genetic diversity
- Representation in three mainland fenced enclosures (Mulligans Flat, Tiverton, Mt Rothwell)

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

- Some cat management (including conservation action to restore devil populations)
- Biosecurity for fox invasions
- Establish captive breeding program to maintain genetic diversity
- Representation in three mainland fenced enclosures (Mulligans Flat, Tiverton, Mt Rothwell)
- Translocation to an unfenced site on the mainland (i.e. Booderee National Park)

Overall estimated population trajectories subject to management scenarios considered

The Eastern Quoll is currently being managed under Scenario 3 (green line). The OTSC investments into translocating the Eastern Quoll to an unfenced site on the mainland affects <1% of the overall population, and thus it is not likely to result in any marked changes in population size (so Management Scenarios 2 and 3 follow similar trajectories).

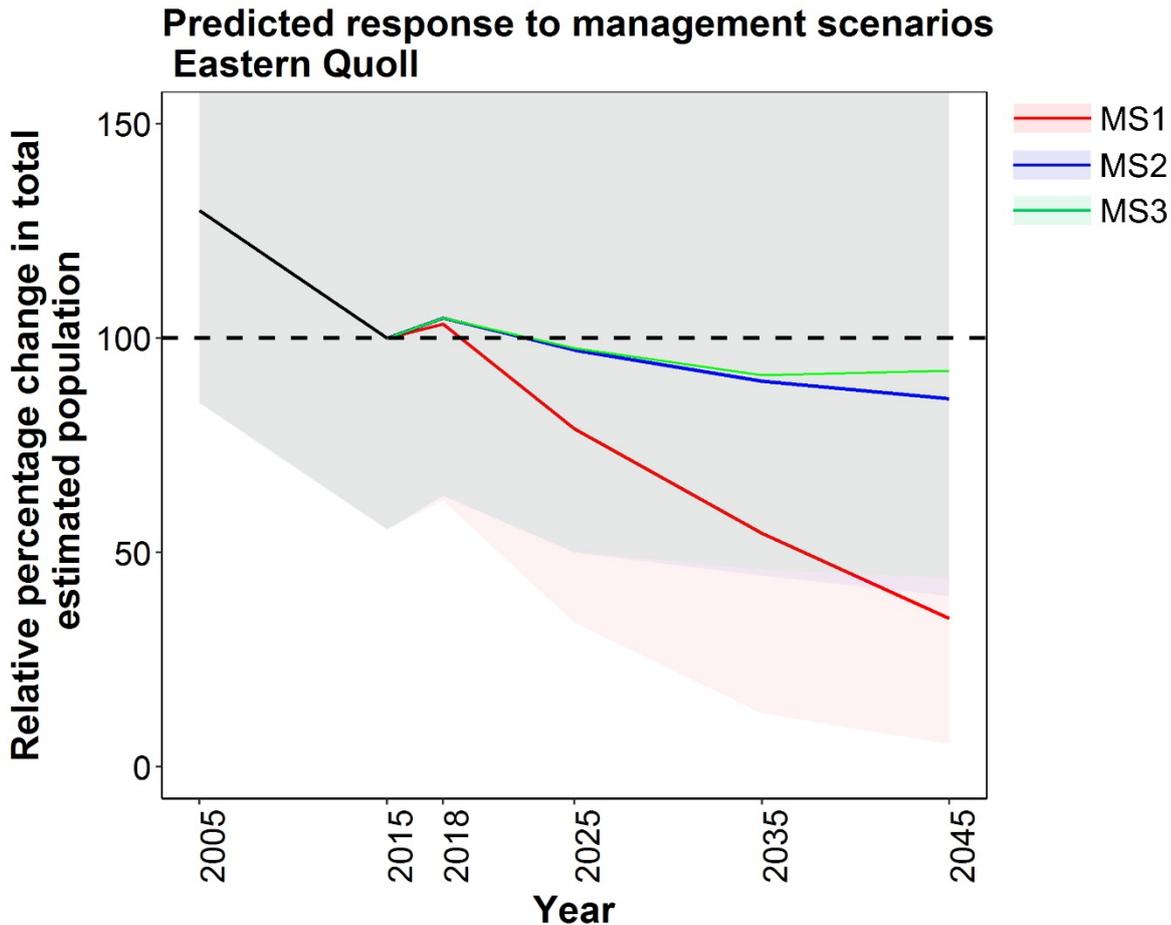


Figure 1. Estimated relative percentage change in population under each of the management scenarios described above. Data derived from 8 expert assessments of Eastern Quoll expected response to management, using four-step elicitation and the IDEA protocol (Hemming et al. 2017), where experts are asked 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: upper bounds wider than shown in graphs.

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 6. 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	-2.98	1.56		Elicitors generally agreed that population trajectory improved from the 2005-15 period to 2015-18, but the concordance among elicitors did not reach the threshold of statistical significance, with p=0.075

Additional actions that could improve trajectory

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

- Further cat management (at strategic sites, including Bruny Island)
- Biosecurity for fox invasions
- Biosecurity for pathogen introduction to Bruny Island
- Translocations between Bruny Island and Tasmanian mainland to manage population genetic diversity
- Translocation to 3+ islands where feral cats and foxes are absent (to bring total number of sites where introduced predators are excluded to at least 6)
- Representation in mainland fenced exclosures (Mulligans Flat, Tiverton, Mt Rothwell, Aussie Ark)
- Additional translocations to Booderee National Park (or another unfenced site on the mainland) continued, after threats managed
- Design an implement survey program to find relict populations in Tasmania
- Design and implement monitoring program to track population change in Tasmania

9. Immediate priorities from 2019

The priorities listed here are derived from the most recent Conservation Advice (TSSC 2015) and the Mammal Action Plan, with some amendments made by contributing experts based on new information. 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:

- Continue spotlighting surveys that track long-term trends in Eastern Quoll populations; extend these surveys to Bruny Island
- Continue monitoring at Mt Rothwell and Mulligans Flat Woodland Sanctuary, and at Booderee National Park
- Implement survey program to identify relict high-density populations of Eastern Quolls in Tasmania
- Implement new monitoring program for Eastern Quolls in Tasmania that is more sensitive to interannual population change (compared with current spotlighting surveys), and ideally that could be related to potential threats
- Identify options for additional fenced mainland sites, and cat- and fox-free islands, for future translocations, as well as mainland sites where fox density is low or can be managed adequately

Management actions:

- Implement cat management at strategic sites
- Design program of translocations between Bruny Island, Tasmanian mainland, and offshore islands/fenced areas that considers genetic management
- Carry out translocations to at least two more fenced mainland sites (e.g. Tiverton) and one fox-free island where feral cats are managed or absent.

10. Contributors

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11. Legislative documents

SPRAT profile: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=333

Threatened Species Scientific Committee (2015). Conservation Advice *Dasyurus viverrinus* Eastern Quoll. Canberra: Department of the Environment. Available from:

<http://www.environment.gov.au/biodiversity/threatened/species/pubs/333-conservation-advice-2015123.pdf>. In effect under the EPBC Act from 03-Dec-2015.

12. References

- Fancourt, B. A. (2016). Diagnosing species decline: a contextual review of threats, causes and future directions for management and conservation of the Eastern Quoll. *Wildlife Research* **43**, 197-211.
- Fancourt, B. A., Hawkins, C. E., Cameron, E. Z., Jones, M. E., and Nicol, S. C. (2015). Devil declines and catastrophic cascades: is mesopredator release of feral cats inhibiting recovery of the Eastern Quoll? *PLoS ONE* **10**, e0119303.
- Fancourt, B. A., Hawkins, C. E., and Nicol, S. C. (2013). Evidence of rapid population decline of the Eastern Quoll (*Dasyurus viverrinus*) in Tasmania. *Australian Mammalogy* **35**, 195-205.
- Fancourt, B. A., Hawkins, C. E., and Nicol, S. C. (2019). Mechanisms of climate-change-induced species decline: spatial, temporal and long-term variation in the diet of an endangered marsupial carnivore, the Eastern Quoll. *Wildlife Research* **45**, 737-750.
- Fancourt, B. A. and Nicol, S. C. (2019). Hematologic and serum biochemical reference intervals for wild Eastern Quolls (*Dasyurus viverrinus*): variation by age, sex and season. *Veterinary Clinical Pathology* **in press**.
- Fancourt, B. A., Nicol, S. C., Hawkins, C. E., Jones, M. E., and Johnson, C. N. (2014). Beyond the disease: Is *Toxoplasma gondii* infection causing population declines in the Eastern Quoll (*Dasyurus viverrinus*)? *International Journal for Parasitology: Parasites and Wildlife* **3**, 102-112.
- Frankham, G. J., Thompson, S., Ingleby, S., Soderquist, T., and Eldridge, M. D. (2017). Does the 'extinct' Eastern Quoll (*Dasyurus viverrinus*) persist in Barrington Tops, New South Wales? *Australian Mammalogy* **39**, 243-247.
- TSSC (2015). Conservation Advice *Dasyurus viverrinus* Eastern Quoll. (Department of the Environment: 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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