The Minister approved this conservation advice and included this species in the Endangered category, effective from 3/12/15

Conservation Advice

Dasyurus viverrinus

eastern quoll

Note: The information contained in this conservation advice was primarily sourced from 'The Action Plan for Australian Mammals 2012' (Woinarski et al., 2014). Any substantive additions obtained during the consultation on the draft are cited within the advice. Readers may note that conservation advices resulting from the Action Plan for Australian Mammals show minor differences in formatting relative to other conservation advices. *These reflect the desire to efficiently prepare a large number of advices by adopting the presentation approach of the Action Plan for Australian Mammals, and do not reflect any difference in the evidence used to develop the recommendation.*

Taxonomy

Conventionally accepted as *Dasyurus viverrinus* (Shaw, 1800). No subspecies are recognised.

Summary of assessment

Conservation status

Endangered: Criterion 1 A2(b), A3(b)(c)

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of new information provided to the Committee to list *Dasyurus viverrinus.*

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 32 business days between 24 March 2015 and 8 May 2015. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species Information

Description

The eastern quoll has fawn or black fur, which is covered with small white spots of varying sizes except on the tail. The tail is bushy and may have a white tip. Males have a head and body length of 32-45 cm and a tail length of 20-28 cm; females are slightly smaller. Males weigh around 1250 g (900-2000 g); females weigh around 850 g (700-1100 g). Compared to the spotted-tailed quoll (*Dasyurus maculatus*) the eastern quoll is slightly built with a pointed muzzle, and has only four toes on the hindfoot (Godsell, 1983; Jones, 2008).

Distribution

The eastern quoll is widespread in Tasmania and was previously widespread in mainland south-eastern Australia, including New South Wales, Victoria and eastern South Australia (Wood Jones, 1923; Peacock & Abbott, 2013, 2014). The species rapidly declined in abundance throughout most of its mainland range around 1890−1910 (Peacock & Abbott, 2014). Some isolated populations persisted in low densities in some areas, with sightings at Kew, Ivanhoe, Melbourne, Lake Corangamite, Otway Ranges (all Victoria) and Vaucluse (NSW) until the early 1960s (P. Menkhorst pers. comm., cited in Woinarski et al., 2014; Peacock & Abbott pers. comm., 2015). The species is considered extinct on the mainland, with the last confirmed mainland sighting at Vaucluse in 1963 (Dickman et al., 2001).

The species is now restricted to Tasmania, including Bruny Island where it is mainly found on the north island. However, the Bruny Island population may have been introduced, as eastern quolls have only been recorded on the island since around the early 1990s (Rounsevell et al., 1991; Hird, 2000). Records from the Tasmanian Natural Values Atlas (DPIPWE, 2011) indicate that the eastern quoll occurs in most parts of Tasmania, but is recorded infrequently in the wetter western third of the state. The species' distribution is associated with areas of low rainfall and cold winter minimum temperatures (Fancourt, 2015; Fancourt et al., 2015a). Within this distribution, it is found in a range of vegetation types including open grassland (including farmland), tussock grassland, grassy woodland, dry eucalypt forest, coastal scrub and alpine heathland, but is typically absent from large tracts of wet eucalypt forest and rainforest (Rounsevell et al., 1991; Taylor & Comfort, 1993; Fancourt et al., 2015b). Abundance and occurrence within this broader distribution are often patchy over short distances (Fancourt, pers. comm. 2015).

Relevant Biology/Ecology

The eastern quoll is largely solitary (Bryant, 1988). However, it is not territorial and the home ranges of many individuals may overlap. Females have a slightly smaller home range (35 ha) than males (44 ha), with males ranging more widely during the breeding season (Godsell, 1983). The eastern quoll is nocturnal and only occasionally forages or basks during daylight (Fancourt et al., 2015b). It is commonly associated with dry grassland and forest mosaics which are bounded by agricultural land, particularly where pasture grubs are common (Blackhall, 1980; Godsell, 1983; Fancourt, 2015). Animals sleep in dens made under rocks, in underground burrows or fallen logs. The eastern quoll is an opportunistic carnivore that takes live prey and scavenges (Blackhall, 1980; Jones, 1998). However, the main component of its diet is invertebrates, especially agricultural pests such as cockchafer beetles, southern army worms and corbie grubs, although rodents, birds, small reptiles, frogs, fruits and plant material are also eaten seasonally (Blackhall, 1980; Godsell, 1983; Jones & Barmuta, 1998). In alpine areas, invertebrates form a smaller component of the diet (Jones & Barmuta, 1998).

Breeding is highly synchronised and occurs in May−June each year. A litter can have up to six young. Juveniles emerge from their dens in November−December, resulting in a 3- to 4- fold increase in population abundance over summer. However, juvenile mortality appears high, with population abundance typically returning to pre-weaning levels by winter. Juveniles of both sexes reach sexual maturity at around 10−11 months of age (Godsell, 1983; Bryant, 1988). Maximum longevity recorded in captivity is 6.8 years (AnAge, 2012), but average longevity in the wild is around 2−3 years (maximum 3−4 years) (Godsell, 1983; Fancourt et al., 2014). Generation length is estimated to be two years (Woinarski et al., 2014).

Threats

Threats to the eastern quoll are outlined in the table below (Woinarski et al., 2014; Fancourt, 2015).

Threat factor	Consequence rating	Extent over which threat may operate	Evidence base
Predation by feral cats	Moderate (Minor on Bruny Island)	Entire, including Bruny Island (cat eradication is planned for Bruny Island)	Quolls, particularly juveniles, are vulnerable to cat predation (Jones et al., 2004; Fancourt et al., 2015b). However, feral cats have been present in Tasmania for > 170 years (Abbott, 2008) and quolls have persisted. Feral cats are unlikely to have population-level impacts on quolls, and no relationship has been found between feral cat abundance and quoll abundance (Fancourt et al., 2015b). However, cats are becoming more nocturnal following decline of the Tasmanian devil, which may be inhibiting recovery of low density quoll populations following weather-induced decline (Fancourt et al., 2015b). Nightly cat and quoll activity overlaps in summer, which creates a high risk of predation of juvenile quolls emerging from natal dens (Fancourt et al., 2015b). On Bruny Island, quolls primarily occur on the north island, where human and feral cat populations are low (Fancourt, pers. comm. 2015).
Disease	Potentially severe, particularly Bruny Island	Entire	A previous episode of rapid, widespread quoll mortality c.1890−1910 has been anecdotally associated with disease; although the causative pathogen is unknown (Peacock & Abbott, 2014). This was likely a major factor in the local extinction of quolls on the mainland (Fancourt, 2015). Disease is potentially a severe threat to the future viability of quoll populations on Bruny Island, should a novel pathogen be introduced (Fancourt, 2015), due to the island's small size, and the high density and low genetic diversity of the quoll population (Cardoso et al., 2014).
Climate change	Severe	Entire	A rapid decline of quoll populations in 2002−2003 has been linked to a sustained period of unfavourable weather (Fancourt 2015; Fancourt et al., 2015a). A predicted increase in the frequency, severity and duration of extreme weather events (White et al., 2010; IPCC, 2013) will increase the frequency at which quoll populations will be reduced (Fancourt, 2015). Increases in minimum winter temperatures, and the frequency and intensity of extreme rainfall events, will also erode the area of suitable habitat for eastern quolls in their current range (Fancourt, 2015).

Predation by red foxes	Potentially severe	Currently localised; large−entire if foxes establish	Foxes have been implicated in the extinction of eastern quolls on the mainland, although disease may have been the main contributor (Peacock & Abbott, 2014). There has been no evidence of foxes in Tasmania since July 2011 (Invasive Species Branch, 2013), which suggests that foxes are currently functionally absent from Tasmania.
Non-target poisoning associated with 1080	Minor	Moderate	The eastern quoll is at low risk of mortality associated with 1080 baiting. 1080 is used in carrot or grain based baits to control wallabies and possums in Tasmania, although at <10% of the volumes used 15 years ago (Hocking, pers. comm. 2015). Widespread fox baiting in Tasmania has ceased. Eastern quolls have a higher tolerance to 1080 (LD_{50}: 1.5-3.73 mg kg^{-1}; King et al., 1989; McIlroy, 1981a) compared to possums and wallabies in Tasmania (LD_{50}: <0.9 mg kg^{-1}; McIlroy, 1981b) or cats and foxes (LD_{50}: <0.7 mg kg^{-1}; McIlroy, 1981a). There is no evidence of them being poisoned by 1080, and they are unlikely to be vulnerable to either primary or secondary poisoning when 1080 is used in accordance with guidelines (Hocking, pers. comm. 2015).
Non-target poisoning associated with rodent control	Moderate	Moderate−large	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 (Eason et al., 2002). There is widespread use of brodifacoum in rodenticides in both urban and agricultural systems frequented by eastern quolls (Fancourt, 2015).
Predation by dogs	Minor	Localised	Dogs can kill eastern quolls (Green, 1967).
Road mortality	Minor	Localised	Can cause significant localised decline (Jones, 2000).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

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

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

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

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

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

(d) actual or potential levels of exploitation

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

Evidence:

Eligible under Criterion 1 A2(b), A3(b)(c) for listing as Endangered

An analysis of 147 spotlighting transects across Tasmania, surveyed every year between 1990 and 2009, revealed a 52% reduction in the number of eastern quoll sightings over the 10 years to 2009 (Fig. 1; Fancourt, et al., 2013). Declines of 61−100% were observed in trapping surveys at three study sites compared with trapping conducted 18−31 years earlier. A reduction in trap success was recorded in five of six non-target surveys, with declines of 51−100% over 1−12 years. Subsequent monitoring of 16 subpopulations using a combination of trapping and camera surveys across Tasmania has confirmed continuing low densities and some further declines (Fancourt, 2015; Fancourt et al., 2015b). Spotlight surveys between 2010 and 2014 do not reveal any sign of recovery (B. Fancourt pers. comm., based on G. Hocking (DPIPWE) unpublished data).

The above data shows that the species meets the threshold under Criterion A2(b) for a severe reduction in population size in the past 10 years.

While trapping and camera surveys confirm the decline on the main island, numbers of quolls captured on Bruny Island increased between 2010−11 and 2012−13, and have remained stable thereafter (Fancourt, 2010, 2015; Fancourt et al., 2015b). Populations on Bruny Island, unlike populations on mainland Tasmania, are not threatened by feral cats and have greater ability to recover following a decline in numbers (Fancourt, pers. comm. 2015). Anecdotal reports by locals indicate that populations on Bruny Island recovered after a decline around 2002-2003 due to unfavourable weather (Fancourt, pers. comm. 2015).

Dynamic population modelling shows that a severe decline in quoll abundance between 2001 and 2003 coincided with a sustained period of unsuitable weather (warm winters, high precipitation in the wettest quarter) over much of the species' distribution (Fancourt, 2015; Fancourt et al., 2015a), resulting in a 74% reduction in the amount of suitable habitat during this

18 month period (Fig. 1). Since 2004, populations have not fully recovered on mainland Tasmania despite a return to suitable conditions, indicating this was a true decline and not the downward phase of a fluctuation. Fancourt (2015) suggests that this period of unsuitable weather reduced quoll populations to a very low level, and that populations are now too small to withstand threats (e.g. predation from feral cats) to which they were less susceptible at higher densities (Fancourt et al., 2015b). The eastern quoll appears to be trapped in a 'predator pit' – where environmental conditions have caused a sudden and severe collapse in abundance, leading to a significant increase in predation pressure on small surviving quoll populations, thereby preventing quolls from increasing their abundance when environmental conditions improved, and possibly contributing to further declines. Recovery is unlikely without management intervention (Fancourt, 2015).

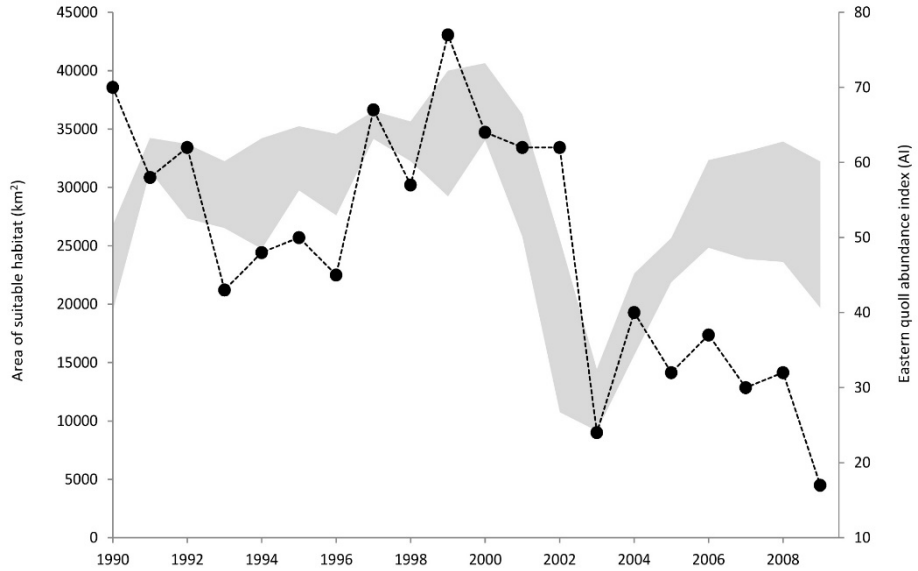

Fig. 1. Temporal variation in area of environmentally suitable habitat and quoll abundance from 1990 to 2009 (Source: Fancourt, 2015, p.34; Fancourt et al., 2015a). Grey shading represents the total area of suitable habitat across Tasmania for each year (left axis). Width of shading indicates variability of suitable area within each year (lower and upper bounds of shading represent the months with the lowest and highest amounts of suitable habitat respectively). Black dots represent the quoll abundance index (AI), being the total number of eastern quoll sightings recorded in annual spotlight surveys across all transects (n = 147) surveyed every year from 1990 to 2009 inclusive (right axis) (Fancourt et al., 2013).

Given the magnitude of the weather-driven decline in Tasmania between 2001 and 2003 and the predicted increase in frequency of such events over coming decades, eastern quoll populations are projected to decline a further ≥50% over the next 10 years (B. Fancourt pers. comm., 2015). If quoll populations are unable to recover unassisted under current threat intensities, subsequent extreme weather events may compound the problem and drive current small populations to extinction (Fancourt, 2015). This projection excludes the population on Bruny Island which is currently stable; although the island's small geographic size and the low genetic diversity of the population (Cardoso et al., 2014) suggest that it is vulnerable to extinction from catastrophic events or an introduced novel pathogen (Fancourt, 2015). Population modelling predicts shows that the species has undergone a severe population reduction and meets the threshold as listing for Endangerd under Criterion A2(b).

The above data shows that the species meets the threshold under Criterion A3(b),(c) for a severe reduction in population size projected to be met in the future.

The Committee considers that the species has undergone a severe reduction in numbers over the past 10 years, equivalent to at least 50 percent and the reduction has not ceased, the cause has not ceased and is not fully understood. Numbers are also projected to decline by more than 50 percent in the future due to declining habitat suitability and ongoing threats. Therefore, the

species has been demonstrated to have met the relevant elements of Criterion 1 to make it eligible for listing as Endangered.

Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km^2**	**< 5,000 km^2**	**< 20,000 km^2**
B2. Area of occupancy (AOO)	**< 10 km^2**	**< 500 km^2**	**< 2,000 km^2**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Not eligible

Woinarski et al. (2014) estimate the extent of occurrence to be 47 000 km^2 and the area of occupancy to be 2300 km^2. Using species distribution modelling performed by Fancourt (2015), the extent of occurrence is estimated to be 41 629 km^2 and the area of occupancy to be 2556 km^2 (B. Fancourt, pers. comm., 2015). Therefore, the species does not meet the thresholds for listing under Criterion B1 or B2.

Following assessment of the data the Committee has determined that the geographic distribution is not limited. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 3. Population size and decline			
	Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals	**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
(a) (ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b) Extreme fluctuations in the number of mature individuals			

Evidence:

Not eligible

There is no robust assessment of population size, although estimates have been performed for some subpopulations (Fancourt et al., 2015b). Woinarki et al. (2014) suggest that the number of mature individuals is likely to be more than 10 000, based on survey data. Fancourt et al. (2015b) estimated the abundance of several subpopulations using occupancy modelling. Extrapolating these abundance estimates across the species' area of occupancy, the estimated number of mature individuals is likely to be > 10,000 (B Fancourt, pers. comm., 2015).

Following assessment of the information the Committee has determined that the population size is not limited. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

There is no robust assessment of population size, although estimates have been performed for some subpopulations (Fancourt et al., 2015b). Woinarski et al. (2014) suggest that the number of mature individuals is likely to be more than 10 000, based on survey data. Fancourt et al., (2015b) estimated the abundance of several subpopulations using occupancy modelling. Extrapolating these abundance estimates across the species' area of occupancy, the estimated number of mature individuals is likely to be > 10,000 (B Fancourt, pers. comm. 2015).

Following assessment of the information the Committee has determined that the population size is not low. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Not eligible

Population viability analysis has not been undertaken.

Conservation Actions

Recovery Plan

The eastern quoll is currently not listed at a state level, and there is no recovery plan. However, the species exists in a single jurisdiction and a comprehensive set of recommended actions are outlined in Fancourt (2015), the key ones of which have been incorporated into this conservation advice.

The Committee recommends that there should not be a recovery plan for *Dasyurus viverrinus* (eastern quoll), as approved conservation advice provides sufficient direction to implement priority actions and mitigate against key threats.

Conservation and Management Actions

Recommended management actions are outlined in the table below (Woinarski et al., 2014; Fancourt, 2015).

Theme	Specific actions	Priority
Active mitigation of threats	Eradicate or control red foxes (should they become established in Tasmania).	High
	Control feral cats on Bruny Island Neck Reserve and across South Bruny to limit feral cat immigration from South Bruny into the quoll population on North Bruny.	High
	Limit future recruitment of feral cats from domestic pets on Bruny Island.	High
	Control feral cat numbers at a number of relict quoll populations on mainland Tasmania, to assess effectiveness of control measures and any impact on quoll population growth rates and recovery.	High
	Strengthen domestic cat ownership and management legislation to mandate desexing and cat containment.	High
Captive breeding	Establish a captive population to ensure preservation of genetic representation and increase genetic diversity of potential insurance populations for future translocations and reintroductions.	Medium
Quarantine isolated populations	Develop and implement biosecurity plan to protect isolated population on Bruny Island from new threats (e.g. establishment of red fox, introduction of novel pathogen).	High
Translocation	Translocate groups of quolls from Bruny Island to supplement relict low density subpopulations on mainland Tasmania to increase population size and growth rate.	High
	Translocate individuals from genetically diverse subpopulations on mainland Tasmania to Bruny Island to facilitate genetic mixture and enhance genetic diversity of the Bruny Island population.	High

	Identify islands (Tasmanian and Australian mainland) that could be targets for quoll translocation should foxes become widely established in Tasmania.	High
Establish insurance populations	Establish free-range insurance populations in predator-proof sanctuaries.	High
Reintroductions to Australian mainland	Reintroduce the species into parts of its former distribution where threats have been adequately ameliorated	Low
Community engagement	Encourage reporting of (validated) sightings, and store data in the Natural Values Atlas	Medium
	Encourage tourism operators to record sightings on existing commercial spotlight tours, thereby establishing tour routes as long-term monitoring sites	Medium
	Encourage community participation in cat control activities on Bruny Island and at localised test sites on mainland Tasmania	Medium

Survey and monitoring priorities

Theme	Specific actions	Priority
Identify additional relict high-density populations	Expand previous camera monitoring to survey new sites throughout the species' distribution to potentially identify any relict high-density populations for active management and conservation priority.	High
Establish or enhance monitoring program	Continue spotlight monitoring of eastern quolls along existing routes; establish new spotlight survey routes in key eastern quoll areas (e.g. Bruny Island, Cradoc-Cygnet-Snug Tiers); continue intensive monitoring of camera and trapping survey sites established in Fancourt et al. (2015b) to understand processes influencing changes in abundance of eastern quolls; expand camera monitoring sites to survey new sites throughout the species' distribution to identify any relict high-density populations for priority management and conservation.	High
	Establish long-term monitoring sites using camera and trapping data baselines at sites established in Fancourt et al. (2015b); monitor any additional relict high density populations identified to determine variables associated with persistence/recovery of these populations.	High

Information and research priorities

Theme	Specific actions	Priority
Assess impacts of threats on species	Assess impacts of feral cat predation on quoll populations (e.g. by manipulating feral cat densities)	High
	Supplement low-density quoll populations to increase population size and assess increased robustness to current threat intensities	High

	Re-establish devil populations in areas with high nocturnal feral cat activity, and assess any temporal shifts in cat activity and any subsequent increase in quoll populations	
	Assess (or model) impacts of red fox predation on quoll populations	Low
	Assess population-level impact of 1080 fox baiting on quoll populations (e.g. via field sensitivity trials)	Low
	Assess impacts of second generation anticoagulants (e.g. brodifacoum-based rodenticides) on quoll populations	Medium
	Investigate how precipitation and temperature influence eastern quoll population viability	Medium
Assess effectiveness of threat mitigation options	Assess efficacy of a range of feral cat control mechanisms	High
	Model quoll viability under a range of cat densities	High
	Assess changes in population growth rates and model viability following supplementation of low-density quoll populations; determine minimum population size required to attain population growth under current threat regimes	High
	Quantify any benefits of additionally performing cat control at quoll supplementation sites	High
Resolve taxonomic uncertainties	n/a	
Assess habitat requirements	n/a	
Assess diet, life history	Investigate spatial and temporal variation in dietary composition; assess dietary overlap and potential competition with feral cats	Medium
	Perform demographic modelling to determine whether differences between declining and stable populations are attributable to key life cycle stages. Investigate sources of mortality in these stages	High
Undertake research to develop new or enhance existing management mechanisms	Develop broad-scale, targeted feral cat eradication methods	High
	Improve captive breeding techniques and centralise the breeding program	Medium

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Endangered category:

Dasyurus viverrinus

(ii) The Committee recommends that there should not be a recovery plan for this species.

Threatened Species Scientific Committee

02/09/2015

References cited in the advice

Abbott, I. (2008). The spread of the cat, *Felis catus*, in Australia: Re-examination of the current conceptual model with additional information. *Conservation Science Western Australia 7*, 1-17.

AnAge (2012). *The animal aging and longevity database*. Available on the internet at: http://genomics.senescence.info/species/]

Belcher (1998). Susceptibility of the tiger quoll, *Dasyurus* maculates, and the eastern quoll, *D. viverrinus*, to 1080-poisoned baits in control programmes for vertebrate pests in eastern Australia. *Wildlife Research 25*, 33-40.

Blackhall, S. (1980). Diet of the Eastern Native-Cat, *Dasyurus viverrinus* (Shaw), in southern Tasmania. *Australian Wildlife Research 7*, 191-197.

Bryant, S. L. (1988). *Seasonal breeding in the Eastern Quoll,* Dasyurus viverrinus *(Marsupialia: Dasyuridae)*. Ph.D. Thesis, University of Tasmania, Hobart.

Cardoso, M. J., Mooney, N., Eldridge, M. D. B., Firestone, K. B. & Sherwin, W. B. (2014). Genetic monitoring reveals significant population structure in eastern quolls: implications for the conservation of a threatened carnivorous marsupial. *Australian Mammalogy 36*, 169-177.

Department of Primary Industries, Parks, Water and Environment (DPIPWE) (2011). The Natural Values Atlas. © Department of Primary Industries, Parks, Water and Environment, State of Tasmania. Available on the internet at: http://www.naturalvaluesatlas.tas.gov.au [accessed 1 November 2011].

Dickman, C. R., Lunney, D. and Matthews, A. (2001). Ecological attributes and conservation of dasyurid marsupials in New South Wales, Australia. *Pacific Conservation Biology 7*, 124-133.

Eason, C. T., Murphy, E. C., Wright, G. R. G. and Spurr, E. B. (2002). Assessment of risks of brodifacoum to non-target birds and mammals in New Zealand. *Ecotoxicology 11*, 35-48.

Fancourt, B. A. (2010). *Spatial and temporal variation in declining eastern quoll (*Dasyurus viverrinus*) populations in Tasmania*. BSc Honours thesis, University of Tasmania.

Fancourt, B. A. (2015). *Drought, disease or devil declines? Identifying the cause of decline of the eastern quoll,* Dasyurus viverrinus. *Implications for conservation and management*. PhD thesis, University of Tasmania, Hobart.

Fancourt, B.A. (2015). Personal communication by email, 8 May 2015. University of Tasmania.

Fancourt, B. A., Bateman, B.L., VanDerWal, J., Nicol, S.C., Hawkins, C. E., Jones, M. E. and Johnson, C. N. (2015a). Testing the role of climate change in species decline: is the eastern quoll a victim of a change in the weather? *PLoS ONE 10(6)*: e0129420.

Fancourt, B. A., Hawkins, C. E., Cameron, E. Z., Jones, M. E. and Nicol, S. C. (2015b). Devil declines and catastrophic cascades: is mesopredator release of feral cats inhibiting recovery of the eastern quoll? *PLoS ONE 10*, e0119303.

Fancourt, B. A., Nicol, S. C., and Hawkins, C. E. (2013). Evidence of rapid population decline of the eastern quoll (*Dasyurus viverrinus*) in Tasmania. *Australian Mammalogy 35(2)*, 195-205. Available on the internet at: http://dx.doi.org/10.1071/AM13004

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.

Godsell, J. (1983). *Ecology of the eastern quoll* Dasyurus viverrinus (*Dasyuridae: Marsupialia*). Ph. D. Thesis, Australian National University, Canberra.

Green, R. H. (1967). Notes on the devil (*Sarcophilus harrisi*) and the quoll (*Dasyurus viverrinus*) in north-eastern Tasmania. *Records of the Queen Victoria Museum 27*, 1-13.

Hird, D. (2000). Terrestrial mammals of Dennes Hill, North Bruny Island. *The Tasmanian Naturalist 122*, 9-14.

Hocking, G. (2015). Personal communication by email, 7 August 2015. Department of Primary Industries, Parks, Water and Environment, Tasmania.

Invasive Species Branch (2013). *Fox Eradication Program Review Recommendations*. *Version 1.1.* Prospect, Tasmania. Available on the internet at: http://dpipwe.tas.gov.au/Documents/ISB-Response-to-Independent-Review-Recommendations-(2013).pdf

IPCC (2013). Summary for Policymakers. In T. F. Stocker, D. Qin, G-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex & P.M. Midgley, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom & New York, USA: Cambridge University Press.

Jones, M. (2008). Eastern quoll *Dasyurus viverrinus*. In 'The mammals of Australia'. Third edition. (Eds S. Van Dyck and R. Strahan.) pp. 62-64. Reed New Holland: Sydney.

Jones, M. E. (1998). The function of vigilance in sympatric marsupial carnivores: the eastern quoll and the Tasmanian devil. *Animal Behaviour 56*, 1279-1284.

Jones, M. E. (2000). Road upgrade, road mortality and remedial measures: impacts on a population of eastern quolls and Tasmanian devils. *Wildlife Research 27*, 289-296.

Jones, M. E. and Barmuta, L. A. (1998). Diet overlap and relative abundance of sympatric dasyurid carnivores: a hypothesis of competition. *Journal of Animal Ecology 67*, 410-421.

Jones, M. E., Smith, G. C. and Jones, S. M. (2004). Is anti-predator behaviour in Tasmanian eastern quolls (*Dasyurus viverrinus*) effective against introduced predators? *Animal Conservation 7*, 155-160.

King, D.R., Twigg, L. E. and Gardner, J. L. (1989). Tolerance to sodium monofluoroacetate in dasyurids from Western Australia. *Australian Wildlife Research 16*, 131-140.

McIlroy, J.C. (1981a). The sensitivity of Australian animals to 1080 poison II. Marsupial and eutherian carnivores. *Australian Wildlife Research 8*, 385-399.

McIlroy, J.C. (1981b). The sensitivity of Australian animals to 1080 poison III. Marsupial and eutherian herbivores. *Australian Wildlife Research 9*, 487-503.

Peacock, D. and Abbott, I. (2013). The role of quoll (*Dasyurus*) predation in the outcome of pre-1900 introductions of rabbits (*Oryctolagus cuniculus*) to the mainland and islands of Australia. *Australian Journal of Zoology 61*, 206-280.

Peacock, D. and Abbott, I. (2014). When the "native cat" would "plague": historical hyper-abundance in the quoll (Marsupialia: Dasyuridae) and the role of disease, cats and foxes in its curtailment. *Australian Journal of Zoology 62*, 294-344.

Peacock, D. and Abbott, I. (2015). Personal communication by email, 8 May 2015. Primary Industries and Regions South Australia, and Department of Parks and Wildlife Western Australia.

Rounsevell, D. E., Taylor, R. J. and Hocking, G. J. (1991). Distribution records of native terrestrial mammals in Tasmania. *Wildlife Research 18*, 699-717.

Taylor, R. J. and Comfort, M. D. (1993). Small terrestrial mammals and bats of Melaleuca and Claytons, southwestern Tasmania. *Papers & Proceedings - Royal Society of Tasmania 127*, 33-37.

White, C. J., Grose, M. R., Corney, S. P., Bennett, J. C., Holz, G. K., Sanabria, L. A., McInnes, K. L., Cechet, R. P., Gaynor, S. M. and Bindoff, N. L. (2010). *Climate Futures for Tasmania: extreme events technical report.* Hobart, Tasmania: Antarctic Climate and Ecosystems Cooperative Research Centre

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

Wood Jones, F. (1923). *The Mammals of South Australia - Part I*. Adelaide, Australia: Government Printer.