

Action 15.6 Protect and enhance Little Shearwater habitat

Location: Muttonbird Point

Task:

Control Kikuyu and reestablish the *Poa poiformis* Grassland Community on Muttonbird Point.

Action 15.7 Protect and enhance the habitat of Blackburn Island

Location: Blackburn Island

Task:

Develop a strategy for the management of Blackburn Island. This strategy is to aim to protect Blackburn Island from the introduction of rodents and other pests and diseases as well as habitat enhancement activities (e.g. revegetation, weed control).

Objective 16: To reduce impacts of fishing and marine debris on threatened sea birds

Action 16.1: Reduce the amount of plastic bags in use on the LHIG and encourage their responsible disposal

Location: LHIG and surrounding waters

Tasks:

16.1.1 Encourage the use of reusable and biodegradable bags.

16.1.2 Conduct an investigation to consider Lord Howe Island becoming a plastic bag-free island.

16.1.3 Develop guidelines with all fishing boat and tourist boat operators on the LHIG to prevent plastic bait bags and other plastics being deliberately or accidentally disposed of into the ocean.

16.1.4 Undertake research to determine the impact of plastic ingestion by sea birds on survival, breeding success and fledgling condition.

Objective 17: To undertake recovery actions for threatened fauna species identified in existing documents

Action 17.1 Implement the Lord Howe Island Phasmid interim recovery actions

Location: Balls Pyramid, ex-situ.

Recovery actions for the Lord Howe Island Phasmid are based on Interim Recovery Actions by Priddel *et al.* (2001), and Priddel *et al.* (2003b).

Tasks:

17.1.1 Continue to restrict access to Balls Pyramid.

17.1.2 Control Morning Glory *Ipomoea cairica* plants on Balls Pyramid that threatened to encroach upon the habitat of the Phasmid or the *Melaleuca* plants on which these insects feed.

17.1.3 Monitor population numbers on Balls Pyramid annually.

17.1.4 Maintain the captive colonies at Melbourne Zoo and Insektus. The aim of these populations is to secure the immediate survival of the species and to produce the animals needed for its subsequent re-introduction back onto Lord Howe Island.

17.1.5 Investigate availability of institutions with a capability of housing Phasmids.

17.1.6 Undertake research to improve husbandry techniques and maximise egg production, hatch rates and the survival of individuals.

17.1.7 Establish a display of live Phasmids on Lord Howe Island to inform the local community and visitors about the Phasmid, the threats posed by rats and actions being taken to conserve the species.

17.1.8 Develop techniques to reintroduce the Phasmid back onto Lord Howe Island.

Action 17.2: Implement the Lord Howe Island *Placostylus* recovery actions

Location: LHIG, off-island

Tasks:

Implement recovery actions for the Lord Howe Island *Placostylus* from the approved Recovery Plan (NSW NPWS 2001). These are summarised and prioritised in Section 5.

Action 17.3: Implement recovery actions for the Lord Howe Island Gecko and Lord Howe Island Skink

The tasks listed below have been derived from Cogger (unpub).

Location: LHIG

Tasks:

17.3.1 Survey for the Lord Howe Island Gecko and Lord Howe Island Skink where the two species are likely but not known to occur (Admiralty Islands, Gower Island and Muttonbird Island).

17.3.2 Study the biology and ecology of at least one population of each species.

17.3.3 Investigate the impact of the Grass Skink and the Bleating Tree Frog on the main island on the Lord Howe Island Skink and Lord Howe Island Gecko.

Action 17.4: Implement the Lord Howe Island Woodhen Recovery Plan

Location: Main Island, ex-situ.

Task:

Implement actions from the Lord Howe Woodhen Recovery Plan. These are listed and prioritised in Section 5.

Objective 18: To investigate the appropriateness of the reintroduction of locally extinct fauna after rodents have been eradicated

The proposed eradication of rodents from Lord Howe Island and the mitigation of other threats provide the opportunity to reestablish populations of locally extinct species.

Action 18.1: Adapt existing guidelines and protocols on translocation and reintroductions to be specific for the LHIG

Task:

Review existing International, National and State guidelines on translocation and reintroductions to determine whether any adaptation is necessary to enable assessment of any reintroduction or translocation proposals.

Action 18.2: Reestablish populations of species on the main island that still exist within the LHIG

Tasks:

18.2.1 Promote the reestablishment of White-bellied Storm-Petrel and Kermadec Petrel breeding populations on the main Island.

18.2.2 Reintroduce the Lord Howe Island Phasmid onto the main Island by the translocation of captive-bred individuals and eggs.

Action 18.3: Reestablish populations of species lost from the LHIG

Tasks:

18.3.1 Investigate the appropriateness of reintroducing the Endangered Red-crowned Parakeet (*Cyanoramphus novaezelandiae subflavescens*) to Lord Howe Island from Norfolk Island.

18.3.2 Investigate the appropriateness of reintroducing closely allied subspecies of other birds that were previously extirpated from Lord Howe Island by rats.

Objective 19: To coordinate implementation of the LHI BMP and regularly evaluate the biodiversity benefits of implementation

The recovery actions from the LHI BMP will be implemented over a ten-year period, and for the Commonwealth, over a five year period. Ongoing evaluation of the effectiveness of actions will assess optimal biodiversity outcomes and the efficient use of resources.

Coordination of the implementation of the Plan will play an important role in ensuring priorities and timelines are met, given the comprehensive and extensive nature of the actions in the plan. In addition, ongoing evaluation of the effectiveness of actions will assess optimal biodiversity outcomes and the efficient use of resources.

Action 19.1 Coordinate implementation of BMP

Location: LHIG, off-island

Tasks:

19.1.1 Establish a BMP Implementation Group, chaired by a Plan coordinator.

19.1.2 Review progress of all implementation programs on an annual basis, provide guidance on priorities and communicate results to relevant parties.

19.1.3 Update any mapping undertaken for the LHI BMP on an annual basis for all implementation programs.

19.1.4 Evaluate the effectiveness of the implementation program and amend the program as required on an annual basis.

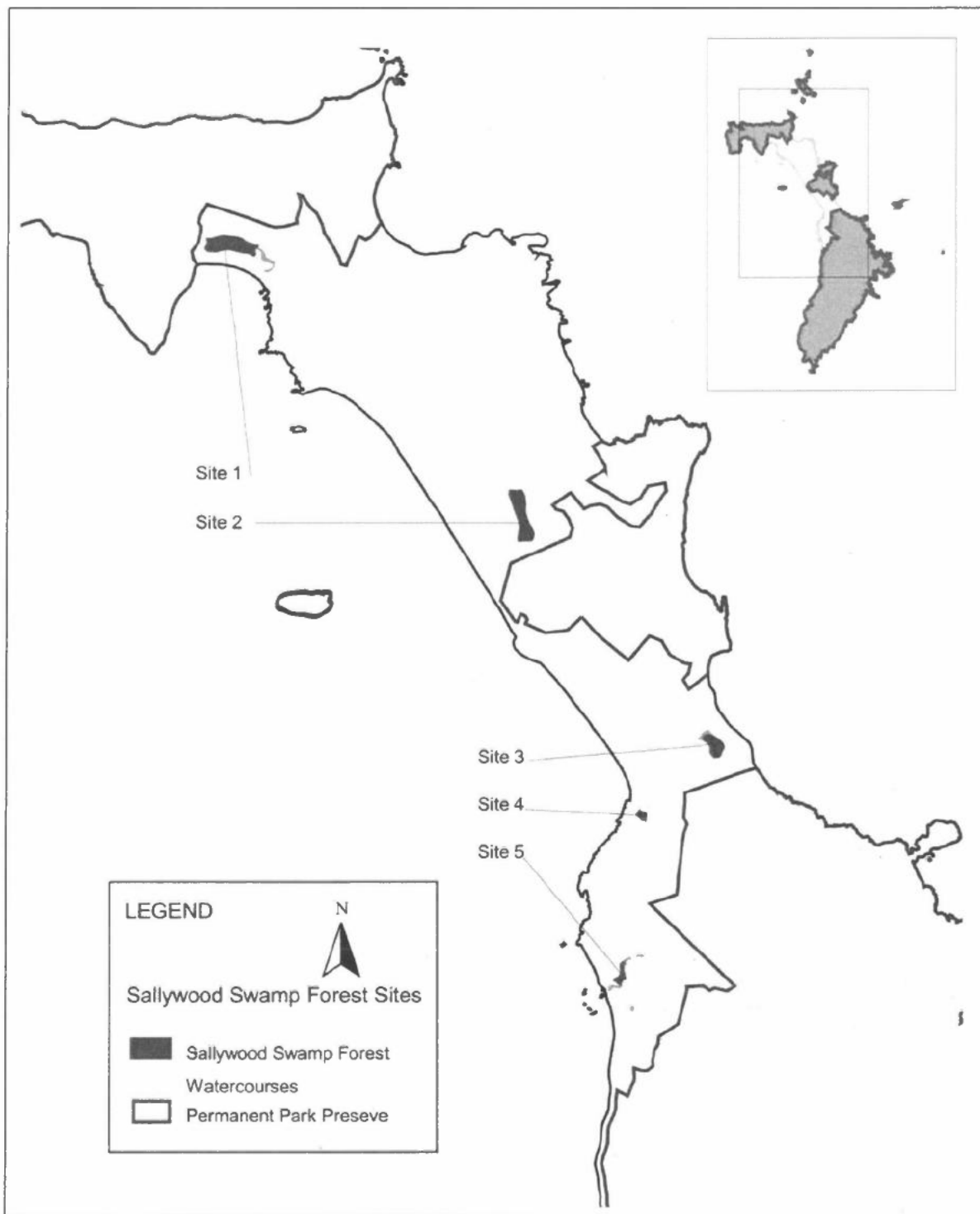


Figure 9. Sallywood Swamp Forest sites

Table 16. Summary of recovery actions and threatened species addressed

Threatened Species	Recovery Actions																		
	1. Quarantine	2. Retain native vegetation	3. Control impacts of introduced pathogens	4. Weed eradication and control	5. Revegetation/rehabilitation	6. Introduced fauna eradication and control	7. Reduce impacts of groundwater pollution	8. Encourage positive appreciation of biodiversity	9. Reduce the impact of illegal collection	10. Reduce human impacts.	11. Monitor consequences of climate	12. Encourage conservation & protection of significant species	13. Promote recovery of threatened flora	14. Improve knowledge & management of fauna	15. Protect & enhance threatened fauna habitat	16. Reduce impacts of fishing & marine debris on sea birds.	17. Undertake recovery of threatened fauna	18. Investigate fauna reintroductions	19. Evaluate implementation of LHI BMP
Fauna																			
LHI Phasmid	0		0	0		0		0	0	0			0	0			0	0	0
LHI Cockroach	0	0	0	0	0	0		0	0	0			0	0				0	0
LHI Earthworm	0	0	0	0		0		0	0	0			0	0					0
LH Placostylus	0	0	0	0	0	0	0	0	0	0			0	0			0		0
LHI Gecko	0	0	0	0	0	0	0	0	0	0			0	0			0		0
LHI Skink	0	0	0	0	0	0	0	0	0	0			0	0			0		0
LHI Currawong	0	0	0	0	0	0		0	0	0			0	0					0
LHI Silvereye	0	0	0	0	0	0		0	0	0			0	0					0
LHI Golden Whistler	0	0	0	0	0	0		0	0	0			0	0					0
LHI Woodhen	0	0	0	0	0	0		0	0	0			0	0			0		0
Flesh-footed Shearwater	0	0	0	0	0	0		0	0	0			0	0	0				0
Grey Ternlet	0		0	0		0		0	0	0			0	0	0				0
Kermadec Petrel	0		0			0		0	0	0			0	0	0				0
Little Shearwater	0	0	0	0	0	0		0	0	0			0	0	0				0
Masked Booby	0		0	0	0	0		0	0	0			0	0	0				0
Providence Petrel	0	0	0	0		0		0	0	0			0	0	0				0
Red-tailed Tropicbird	0		0	0		0		0	0	0			0	0	0				0
Sooty Tern	0		0			0		0	0	0			0	0	0				0
White Tern	0	0	0	0	0	0		0	0	0			0	0	0				0
White-bellied Storm Petrel	0		0	0	0	0		0	0	0			0	0	0				0
Black-winged Petrel	0		0	0	0	0		0	0	0			0	0	0				0
Flora																			
<i>Caesalpinia bonduc</i>	0	0	0	0	0			0	0	0			0						0
<i>Calystegia affinis</i>	0	0	0	0	0	0		0	0	0			0						0
<i>Carmichaelia exsul</i>	0	0	0	0				0	0	0			0						0
<i>Chamaesyce psammogeton</i>	0	0	0	0	0			0	0	0			0						0
<i>Coprosma inopinata</i>	0	0	0	0				0	0	0			0						0
<i>Elymus multiflorus</i> var <i>kingianus</i>	0	0	0	0				0	0	0			0						0
<i>Geniostoma huttonii</i>	0	0	0	0				0	0	0			0						0
<i>Polystichum moorei</i>	0	0	0	0				0	0	0			0						0
<i>Xylosma parvifolium</i>	0	0	0	0				0	0	0			0						0
Vegetation communities																			
Sallywood Swamp Forest	0	0	0	0	0	0	0	0	0	0									0

Table 17. Estimated costs of implementing the actions identified in the biodiversity management plan for Lord Howe Island

(note: where priorities are the same for each sub-action, only the priority of the action is listed. Where priorities vary for sub-actions, the priority of the action is not listed. Total costs are listed for each objective and split for actions and sub-actions where relevant. Costings are defined for sub-actions where possible).

Action No.	Action Title	Priority	Location	Total Cost (\$) / 10 years	Potential partners
Objective 1: To prevent the introduction of exotic fauna, flora and pathogens to LHIG				731 000	
1.1	Review the LHIB Quarantine Strategy	1	LHIG, mainland departure points	10 500	LHIB
1.1.1	Review current LHIB Quarantine Strategy				
1.1.2	Ensure invasive ant risk assessment and control strategy is included				
1.1.3	Ensure offshore island quarantine strategy is included				
1.1.4	Develop a public awareness program for Blackburn Island				
1.1.5	Develop a protocol to minimise risk of rodent introduction to Blackburn Island				
1.2	Implement LHIB Quarantine strategy	1	LHIG, mainland departure points	600 000	LHIB, Biosecurity Australia, AQIS, Australian Government, DECC, DPI
1.3	Review the LHI Plant Importation Policy	1		10 500	LHIB
1.4	Implement the LHI Plant Importation Policy	1	LHIG	10 000	LHIB, Biosecurity Australia, AQIS, DPI
1.5	Increase local native plant production and use	2	settlement area	70 000	LHIB, LHI residents, nursery
1.6	Prepare a rapid response and detection protocol for new introductions of weeds and exotic fauna	1	LHIG, mainland departure points	30 000	LHIB, DECC, DPI, AQIS
1.6.1	Develop an early detection protocol and procedures document to deal with new introductions				
1.6.2	Ensure LHIB staff are trained and equipped to be able to implement the rapid response protocol				

Objective 2: To retain native vegetation				295 000	
2.1	Ensure appropriate environmental assessment is undertaken when assessing development proposals	1	LHIG	35 000	LHIB, proponents
2.2	Liaise with leaseholders regarding protection and management of remnant and significant vegetation	1	settlement area	70 000	LHIB
2.3	Provide assistance for leaseholders to protect native vegetation	1	settlement area	170 000	LHIB, NRCMA
2.4	Encourage protection of vegetation and habitat features that constitutes invertebrate habitat	1	settlement area	20 000	LHIB
Objective 3: To control the impacts of introduced pathogens on native species				125 000	
3.1	Develop and implement measures to minimise the impacts of introduced flora and fauna pathogens				
3.1.1	Develop and implement a set of phytosanitary guidelines for walkers and palm seeders to minimise the risk of introducing pests, weeds and disease to LHIG	1	LHIG	5 000	LHIB, DPI, DECC
3.1.2	Conduct a detailed survey for the presence of <i>Phytophthora cinnamomi</i>	3	LHI	10 000	LHIB, DPI, DECC
3.1.3	Develop and implement a strategy to control spread of <i>P. cinnamomi</i>	1	Settlement area	50 000	LHIB, DPI, DECC
3.1.4	Test native species that have the potential to be susceptible to <i>P. cinnamomi</i>	4	LHIG	10 000	LHIB, DPI, DECC
3.1.5	Investigate the potential for poultry pathogens to adversely impact LHI fauna	2	LHIG	50 000	LHIB, tertiary institution, AQIS, DPI
Objective 4: To eradicate (where feasible) and control existing weeds to reduce their impact on the biodiversity of the LHIG				4 173 000	
4.1	Review Weed Management Strategy for Lord Howe Island	1	LHIG	10 500	
4.2	Implement Weed Management Strategy for LHI			3 807 500	
4.2.1	Eradicate Category 1, 2 & 3 weeds	1	LHIG		LHIB, Environmental Trust, NRCMA, FOLHI

4.2.2	Eradicate Category 4 weeds	2	LHIG		LHIB, Environmental Trust, NRCMA, FOLHI
4.2.3	Continue searching for new recruits, missed plants and new invaders	2	LHIG		LHIB, Environmental Trust, NRCMA, FOLHI
4.2.4	Prevent new weed threats arising	2	LHIG		LHIB, Environmental Trust, NRCMA, DPI
4.3	Extend current weed inventory, mapping and monitoring work			10 500	
4.3.1	Extend current weed mapping programs to include problem species that have not been mapped	2	LHIG		LHIB, NRCMA, Environmental Trust
4.3.2	Develop a comprehensive weed monitoring program	3	LHIG		LHIB, NRCMA, Environmental Trust
4.3.3	Continue current inventory and monitoring of weed distribution and spread	3	LHIG		LHIB, NRCMA, Environmental Trust
4.4	Continue regular weed inspections of leases	1	settlement area	17 500	
4.4.1	LHIB staff to continue to conduct regular inspections of leases for weeds				LHIB, DPI
4.4.2	Investigate the potential to include weed control conditions on vacant crown land leases				LHIB
4.5	Investigate and implement funding incentive schemes for weed management on leases	1	settlement area	170 000	LHIB, Dept Planning, DPI, NRCMA, DECC
4.6	Develop and implement a community awareness and control program on the impacts of weeds and prevention of spread			10 000	
4.6.1	Develop and implement a community awareness program	3	LHIG		LHIB, DEWR, NRCMA, FOLHI, DPI, Australian Government, WWF, Environmental Trust, National Parks Foundation
4.6.2	Encourage the establishment of a leaseholders' weed control group	4	LHIG		LHIB, FOLHI, private tour operators

4.7	Develop a strategy for remote area weed control	2		20 000	
4.7.1	Identify training needs and implement training techniques for weed control in remote terrain		PPP, specifically cliffs and remote terrain in southern mountains and northern hills		LHIB
4.7.2	Monitor remote area weed spread and distribution on a regular basis		PPP, specifically cliffs and remote terrain in southern mountains and northern hills		LHIB, DECC, NRCMA
4.7.3	Establish a rapid response protocol to control any outbreaks of significant weed species		PPP, specifically cliffs and remote terrain in southern mountains and northern hills		LHIB
4.8	Manage herbicide use to minimise any adverse impacts			2 000	
4.8.1	Ensure careful use of herbicide	2	LHIG		LHIB, FOLHI
4.8.2	Use a gradual approach to weed control in important invertebrate habitats	2	LHIG		LHIB, FOLHI
4.8.3	Ensure staff and volunteers are adequately trained in herbicide use	1	LHIG		LHIB, FOLHI
4.9	Conduct research into weed control and biology	3	LHIG	100 000	LHIB, DPI, tertiary institutions
4.9.1	Support research into the control techniques and biology of major weed species				
4.9.2	Monitor current research into the biological control of weed species in inaccessible areas				
4.10	Control exotic grasses			20 000	
4.10.1	Exotic grasses to be gradually controlled and replaced by native grass species	2	Lagoon foreshores, Lovers Bay, Muttonbird Point, Dawsons Point, Admiralty Islands, Muttonbird Island, Jims Point to Stevens Point.		LHIB, FOLHI, NRCMA, Environmental Trust, Australian government
4.10.2	Kikuyu to be controlled where it is threatening <i>Calystegia affinis</i>	1	Old Settlement		LHIB, FOLHI, NRCMA, Environmental Trust, Australian government
4.10.3	Control exotic grass in the habitat of Knicker Nut	2	Neds Beach		LHIB, FOLHI, NRCMA, Environmental Trust, Australian government

4.10.4	Replace exotic grass species with native species in the habitat of <i>Chamaesyce psammogeton</i>	3	Blinky Beach		LHIB, FOLHI, NRCMA, Environmental Trust, Australian government
4.11	Support current LHIB Norfolk Island Pine control procedure	3	settlement area, particularly Lagoon Foreshores	5 000	LHIB, FOLHI, NRCMA, Australian government
4.12	Control weeds in selected priority sites				
4.12.1	Monitor for new weed species on offshore islands	1	Blackburn Island, Muttonbird Island		LHIB, FOLHI, NRCMA, Australian government
4.12.2	Undertake weed control and encourage regeneration of native species	4	Little Island		LHIB, FOLHI, NRCMA, Australian government
Objective 5: To undertake revegetation/rehabilitation works in high conservation priority areas				710 500	
5.1	Regularly review the LHI Vegetation Rehabilitation Plan	1		10 500	LHIB
5.2	Implement the LHI Vegetation Rehabilitation Plan	1	LHIG		LHIB, FOLHI
5.3	Revegetate and rehabilitate degraded high conservation priority sites				
5.3.1	Revegetate and rehabilitate selected Sallywood Swamp Forest sites	1	settlement area		LHIB, FOLHI, leaseholders
5.3.2	Revegetate Mangrove Communities	1	settlement area		LHIB, FOLHI, leaseholders
5.3.3	Revegetate selected watercourse areas	1	settlement area		LHIB, FOLHI, leaseholders
5.3.4	Encourage revegetation of cleared areas where appropriate	3	settlement area		LHIB, FOLHI, leaseholders
5.3.5	Establish a restoration program for <i>Poa poiformis</i> Communities	2	LHIG		LHIB, FOLHI
5.3.6	Revegetate selected old clearing and garden sites	4	LHI		LHIB, leaseholders
5.4	Use best-practise regeneration and rehabilitation principles		LHIG		
5.4.1	Use local provenance plant stock	1			LHIB, FOLHI
5.4.2	Restore vegetation communities as near as possible to their original composition and condition	1			LHIB, FOLHI
5.4.3	Use appropriate herbicide applications	1			LHIB, FOLHI
5.4.4	Investigate training opportunities to maintain up to date skills for LHIB staff undertaking bush regeneration works	3			LHIB

5.5	Establish a monitoring program for revegetation projects	2	LHIG		LHIB
5.5.1	Establish revegetation monitoring programs and measure their success				
5.5.2	Establish a set of marked photo points in a range of sites to assist with the monitoring of revegetation projects				
5.5.3	Undertake quadrat or transect sampling to measure changes to vegetation				
5.5.4	Undertake mapping of implementation of management actions suitable for GIS	2			
5.6	Control trampling, browsing and grazing				LHIB, FOLHI, NRCMA, leaseholders
5.6.1	Fence high conservation priority vegetation communities from domestic stock	1	settlement area		
5.6.2	Fence other patches of remnant vegetation from domestic stock	2	settlement area		
5.6.3	Implement erosion control measures in fenced areas wherever necessary	2	settlement area		
5.7	Buffer vegetation of high conservation value	3	settlement area		LHIB, FOLHI, NRCMA leaseholders
5.7.1	Plant a buffer of hardy species on the edges of significant remnant vegetation patches				
5.7.2	Monitor the success of herbicide treatments for regeneration at vegetation edges				
Objective 6: To eradicate (where feasible and where there is a worthwhile biodiversity outcome) or control introduced fauna and reduce their impact on biodiversity				1 650 000	
6.1	Control introduced rodents		LHI	200 000	LHIB, DECC, Australian government, Environmental Trust, WWF, NRCMA
6.1.1	Continue current rodent baiting program	1	LHI		LHIB
6.1.2	Expand existing baiting program to include additional baiting sites for biodiversity based outcomes	1	LHI		LHIB
6.1.3	Design and implement a monitoring program to evaluate the effectiveness of the program on reducing the threat of rodent predation on target species and locations	3	LHI		LHIB, Australian Museum, tertiary institutions

6.1.4	Investigate impacts from current rodent control program and baiting by residents on the LHI Currawong	2	LHI		LHIB, Australian government, NRCMA, Environmental Trust
6.2	Eradicate introduced rodents	1	LHI	1 000 000	
6.2.1	Convene a Rodent Eradication Taskforce				LHIB, LHI Recovery Team, DECC
6.2.2	Assess and, where appropriate, undertake the recommendations contained in the Feasibility and Cost-benefit studies		LHIG	190 000	LHIB, LHI Recovery Team, DECC, WWF, NRCMA, Australian government
6.2.3	Evaluate the potential use of toxins other than brodifacoum		LHIG		LHIB, DECC, tertiary institutions
6.2.4	Prepare a logistics plan for rodent eradication		LHIG		LHIB, DECC, LHI Recovery Team
6.2.5	Continue studies where necessary to investigate non-target impacts		LHI		LHIB, DECC, Australian government, WWF, NRCMA
6.2.6	Undertake environmental assessment for the proposal		LHI		LHIB, DECC
6.3	Eradicate Mallard-Black Duck hybrids	3	LHIG	10 000	LHIB
6.4	Conduct research into the impacts of introduced vertebrate fauna on the biodiversity of the LHIG and investigate control or eradication	2	LHIG	100 000	LHIB, DECC, tertiary institutions
6.4.1	Investigate the degree of threat through competition and predation posed by introduced faunal species				
6.4.2	Investigate techniques and feasibility for control or eradication of introduced faunal species				
6.4.3	Implement control or eradication techniques where available, feasible and where there is a significant biodiversity benefit				
6.5	Conduct research into the impacts of introduced invertebrate fauna and investigate techniques for control or eradication	2	LHIG	100 000	
6.5.1	Investigate the threat posed by established introduced invertebrates through targeted monitoring sites and research				LHIB, Australian Museum
6.5.2	Investigate techniques and feasibility for control or eradication based on the level of threat				LHIB, Australian Museum, DPI

6.5.3	Implement control or eradication techniques where available, feasible and effective				LHIB
6.6	Control introduced invertebrates in targeted locations	2	LHI	50 000	
6.6.1	Investigate control methods for the <i>Arsipoda</i> beetle on <i>Calystegia affinis</i> site		Old Settlement		LHIB, Australian Museum, DPI
6.6.2	If control methods are found that are effective, undertake a control program		Old Settlement		LHIB
Objective 7: To reduce impacts of groundwater pollution				50 000	
7.1	Protect water quality in freshwater creeks		settlement area		
7.1.1	Develop a ground water management strategy	1	creeklines in Soldiers Creek basin		LHIB
7.1.2	Undertake water quality monitoring in streams, including monitoring of macroinvertebrates	4	settlement area		LHIB
Objective 8: To enhance positive interactions and reduce negative interactions between humans and wildlife				30 000	
8.1	Enhance positive interactions through development of guidelines and public awareness				
8.1.1	Ensure artificial feeding of fauna is undertaken in accordance with guidelines	1	LHIG		LHIB
8.1.2	Develop wildlife interaction guidelines for tour operators	1	LHIG		LHIB
8.1.3	Regularly review and revise Dog importation and management policies and traffic policies	2	LHIG		LHIB
8.1.4	Develop and implement a strategy for the control of non-native fauna	3	LHIG		LHIB
8.1.5	Produce and distribute a booklet on minimising negative human impacts on native fauna	2	LHIG		LHIB
Objective 9: To reduce the impact of commercial, cultural and illegal collecting				30 000	
9.1	Minimise biodiversity impacts of commercial Kentia Palm seed collecting	4	LHI		LHIB
9.2	Control the illegal collection of fauna				
9.2.1	Conduct a review of the LHI Act Regulations 2004	3	LHIG		LHIB
9.2.2	Raise awareness of the issue of illegal collection	2	LHIG, mainland		LHIB, DECC, Australian government

9.2.3	Ensure the LHIB has issued appropriate licences for persons undertaking invertebrate collections	1	LHIG		LHIB, DECC, AQIS, Biosecurity Australia
9.2.4	Restrict access to offshore islands outside the lagoon	2	LHIG		LHIB
9.2.5	Establish protocols to keep significant invertebrate localities secure	1	LHIG		LHIB
9.2.6	Ensure the LHI community is aware of the impacts and licensing requirements of seabird egg collection	1	LHIB		LHIB
Objective 10: To reduce human impacts				20 000	
10.1	Protect vegetation in the vicinity of walking tracks and other areas				
10.1.1	Promote awareness of the importance of staying on walking tracks	3	LHIG		LHIB
10.1.2	Establish and implement an appropriate hygiene protocol for access to the PPP	1	LHIG		LHIB, DECC
10.1.3	Ensure people accessing the PPP are aware of sensitive areas prior to field work commencing	1	LHIG		LHIB
10.1.4	Encourage tourists, residents, seed collectors, researchers and management staff to adopt minimal impact bushwalking practices	2	LHIG		LHIB
Objective 11: To monitor consequences of climate change and develop contingency plans for 'at risk' species				200 000	
11.1	Monitor areas identified at risk from climate change				
11.1.1	Establish biodiversity monitoring sites in as many "at risk" areas as possible	2			LHIB, tertiary institutions, DECC
11.1.2	Establish long-term monitoring sites of flora and fauna along an altitudinal gradient in the southern mountains	2			LHIB, tertiary institutions, DECC
11.1.3	Undertake research to monitor the impact of climate change on sea bird populations	4			LHIB, DECC, tertiary institutions
11.1.4	Develop and implement a monitoring program to assess the impacts of climate change on invertebrate lifecycles and 'at risk' flora	2			LHIB, DECC, Australian Museum, tertiary institutions.
11.1.5	Establish a climate monitoring station on Mt Gower	2			LHIB, DECC, tertiary institutions

11.2	Investigate options for securing species identified as most at risk from climate change	3			LHIB, tertiary institutions, zoological and herbarium institutions
Objective 12: To encourage the conservation and protection of species, populations and ecological communities				10 000	
12.1	Prepare nominations for species, populations, ecological communities or critical habitat as required				LHIB, DECC, tertiary institutions, Australian Museum
12.1.1	Nominate taxa and communities that are assessed as being threatened	4			
12.1.2	Where appropriate, potential nominations to be endorsed by the recovery team	4			
12.1.3	A list of significant taxa and communities to be maintained and regularly updated	3			
Objective 13: To promote recovery of individual threatened flora taxa				200 000	
13.1	Protect habitat of threatened flora	1			LHIB
13.1.1	Habitat of threatened flora must be protected from clearing		LHIG		
13.1.2	Habitat areas should be fenced where possible		settlement area		
13.2	Undertake weed control in the habitat of threatened flora				
13.2.1	<i>Calystegia affinis</i>	1	Old Settlement		LHIB, FOLHI
13.2.2	Knicker Nut	1	settlement area		LHIB, FOLHI
13.2.3	<i>Carmichaelia exsul</i>	2	southern mountains		LHIB
13.2.4	<i>Chamaesyce psammogeton</i>	1	settlement area		LHIB, FOLHI
13.2.5	<i>Coprosma inopinata</i>	4	southern mountains		LHIB
13.2.6	<i>Elymus multiflorus</i> var <i>kingianus</i>	1	Old Settlement		LHIB
13.2.7	<i>Polystichum moorei</i>	2	southern mountains		LHIB
13.3	Undertake monitoring of, and targeted research into threatened and key endemic flora	2	LHIG		LHIB, DECC
13.3.1	Develop a monitoring and targeted research program for threatened and key endemic flora				

13.3.2	Implement a threatened and key endemic flora monitoring program				
13.4	Establish <i>ex-situ</i> populations of threatened and key endemic flora	3	LHIG, mainland		LHIB, herbaria
13.4.1	Establish <i>ex-situ</i> populations or seedbanks for all threatened flora				
13.4.2	Investigate whether any endemic non-threatened species with small populations warrant <i>ex-situ</i> conservation				
13.5	Reduce adverse human impacts on threatened flora and communities				LHIB
13.5.1	<i>Calystegia affinis</i>	1	Old Settlement		
13.5.2	Knicker Nut	1	settlement area		
13.5.3	<i>Coprosma inopinata</i>	1	southern mountains		
13.5.4	Implement a strategy that minimises the risk of introduction of <i>Phytophthora cinnamomi</i> to threatened flora and community sites	2	LHIG		
13.6	Promote public awareness of threatened plants and communities	4	LHIG		LHIB
Objective 14: To improve knowledge and management of threatened and significant fauna species				200 000	
14.1	Conduct priority fauna species research	2	LHIG		LHIB, tertiary institutions, DECC
14.1.1	Conduct species-specific fauna research into the ecology of priority species				
14.1.2	Species distributions to be mapped, including point locality data				
14.1.3	Improve species habitat maps produced for this plan for input into GIS-based biodiversity forecasting analyses				
14.2	Design and implement monitoring programs to evaluate effectiveness of recovery actions on listed threatened fauna	2	LHIG		LHIB, DECC
14.2.1	Implement monitoring programs to measure the success or failure of recovery programs for threatened fauna				
14.2.2	Map changes to distribution or abundance in a form suitable for GIS analyses				

Objective 15: To protect and enhance threatened fauna habitat				50 000	
15.1	Protect and enhance Flesh-footed Shearwater habitat		Eastern settlement area		LHIB, DECC
15.1.1	Zone all mapped Flesh-footed Shearwater habitat as Environmental Protection or Significant Vegetation	1			
15.1.2	Rehabilitate Flesh-footed Shearwater nest habitat within grazing leases	2			
15.2	Protect and enhance LHI Silvereye habitat	3	settlement area		LHIB, DECC
15.3	Protect and enhance the Lord Howe Island Wood-feeding Cockroach habitat	1			
15.3.1	Revegetate and Control Rhodes Grass on Blackburn Island		Blackburn Island		LHIB, DECC
15.3.2	Monitor Admiralty Islands for introduced grasses		Admiralty Islands		LHIB, DECC
15.4	Protect habitat of the White-bellied Storm-Petrel and Kermadec Petrel	1	Balls Pyramid, Roach Island		LHIB, DECC
15.5	Protect and enhance Red-tailed Tropicbird habitat	4	Northern cliffines between North Head and Malabar and cliffines in southern mountains		LHIB, DECC
15.6	Protect and enhance Little Shearwater habitat	3	Muttonbird Point		LHIB, DECC
15.6.1	Control Kikuyu and reestablish the <i>Poa poiformis</i> Grassland Community on Muttonbird Point				
15.7	Protect and enhance the habitat of Blackburn Island	1	Blackburn Island		
Objective 16: To reduce impacts of fishing and marine debris on threatened sea birds				30 000	
16.1	Reduce the amount of plastic bags in use on the LHIG		LHIG and surrounding waters		
16.1.1	Encourage use of reusable and biodegradable bags	2			LHIB, tourism operators, island residents
16.1.2	Investigate LHI becoming plastic bag-free	4			LHIB
16.1.3	Develop guidelines with boat operators on the LHIG to prevent plastic bags being disposed in the ocean	3			LHIB, tourism operators
16.1.4	Undertake research to determine the impact of plastic ingestion by sea birds	4			LHIB, DECC, tertiary institutions

Objective 17: To undertake recovery actions for threatened fauna species identified in existing documents				737 000	
17.1	Implement the Lord Howe Island Phasmid Interim recovery actions			100 000	
17.1.1	Continue to restrict access to Balls Pyramid	1	Balls Pyramid		LHIB
17.1.2	Control Morning Glory	1	Balls Pyramid		LHIB, NRCMA
17.1.3	Monitor Balls Pyramid population	1	Balls Pyramid		LHIB, DECC
17.1.4	Maintain captive colonies	3	Off-island		Zoos, Insektus, DECC
17.1.5	Investigate availability of institutions with a capability of housing Phasmids	3	Off-island		Zoos, Insektus, DECC
17.1.6	Undertake research to improve husbandry	2	Off-island		Zoos, Insektus, DECC
17.1.7	Establish a live Phasmid display on LHI	4	LHI		DECC, LHIB
17.1.8	Develop techniques to reintroduce the Phasmid to LHI	4	LHI		DECC, LHIB, tertiary institutions
17.2	Implement the Lord Howe Island Placostylus recovery actions	1, 2, 3	LHI, Blackburn Island	158 000	LHIB, DECC, Australian government, NRCMA
17.3	Implement recommended actions from the draft Gecko and Skink draft National Recovery Plan		LHIG	199 000	
17.3.1	Survey for the LHI Gecko and LHI Skink	3	LHIG	5 000	LHIB, DECC, Australian government, NRCMA
17.3.2	Study the biology and ecology of at least one population	2	LHIG	190 000	LHIB, DECC, Australian government, tertiary institutions
17.3.3	Investigate the impact of the Grass Skink and Bleating Tree Frog on the LHI Skink and LHI Gecko	4		4 000	LHIB, Australian government, tertiary institutions
17.4	Implement the LHI Woodhen Recovery Plan	1, 2, 3	LHI	275 000	LHIB, DECC, Australian government, NRCMA
Objective 18: To investigate the appropriateness of reintroduction of locally extinct taxa				50 000	
18.1	Adapt existing guidelines & protocols to be specific for the LHIG	4	LHIG		LHIB
18.2	Reestablish populations of species on the main island that still exist within the LHIG				

18.2.1	Promote the reestablishment of White-bellied Storm-Petrel & Kermadec Petrel on the main island	3	LHI		LHIB, DECC, Environmental Trust
18.2.2	Reintroduce the LHI Phasmid to the main island	4	LHI		LHIB, DECC, Environmental Trust, tertiary institutions
18.3	Reestablish populations of species lost from the LHIG	4			LHIB, DECC, LHI Recovery Team, Environmental Trust, tertiary institutions
18.3.1	Investigate the appropriateness of reintroducing the Red-crowned Parakeet		LHIG		
18.3.2	Investigate the appropriateness of reintroducing closely allied subspecies of other birds		LHIG		
Objective 19: To coordinate implementation of the LHI BMP and regularly evaluate the biodiversity benefits of implementation				60 000	
19.1	Coordinate the implementation of the BMP	1	LHIG	10 000	DECC
19.1.1	Establish a BMP Implementation Group, chaired by a Plan coordinator				DECC
19.1.2	Review progress of all implementation programs on an annual basis and provide guidance on priorities				LHIB
19.1.3	Update mapping for the BMP on an annual basis				LHIB, DECC
19.1.4	Evaluate effectiveness of the implementation program and re-prioritise the program on an annual basis				LHIB
Total	10 year cost of Recovery Program			9 351 500	

7 Performance Criteria for Recovery Actions

Objective	Performance criteria	Timeframe from plan commencement
1: To prevent the introduction of exotic fauna, flora and pathogens to LHIG	<ol style="list-style-type: none"> 1. The LHIB Quarantine Strategy and Plant Importation Policy is reviewed and fully implemented 2. No exotic plants are imported that are assessed as posing a weed risk 3. The LHI nursery is producing a larger range of indigenous plants for use by the LHI community at reasonable cost 4. A rapid response program to deal with new introductions of exotic fauna or flora has been developed and staff adequately trained 	<p>Priority 1 actions within one year; Priority 3 actions within three years</p> <p>Life of plan</p> <p>Within two years</p> <p>Within two years</p>
2: To retain native vegetation	<ol style="list-style-type: none"> 1. No clearing of significant remnant vegetation occurs on LHI 2. There is minimal clearing of native vegetation approved by the LHIB as part of development proposals 3. Funding has been secured and provided to leaseholders for significant vegetation protection projects 4. Leaseholders have fenced and commenced revegetation of native vegetation on their leases, particularly: <ul style="list-style-type: none"> • in areas of Sallywood Swamp Forest or Mangrove; • in the vicinity of the Soldiers Creek and Cobbys Creek basins, and the watercourses around Old Settlement Creek; • in areas of identified threatened fauna and flora habitat. 	<p>During life of Plan</p> <p>During life of Plan</p> <p>During life of Plan</p> <p>During life of Plan</p>
3: To control the impacts of introduced pathogens on native species	<ol style="list-style-type: none"> 1. Phytosanitary guidelines are produced for walkers 2. Strategy to control the spread of <i>Phytophthora cinnamomi</i> is implemented 3. A detailed survey of the spread of <i>P. cinnamomi</i> and native species 'at risk' is completed 	<p>Within one year</p> <p>Within two years</p> <p>Within five years</p>
4: To eradicate (where feasible) and control existing weeds to reduce their impact on the biodiversity of the LHIG	<ol style="list-style-type: none"> 1. Weed Management Strategy for Lord Howe Island is reviewed 2. Weed Management Strategy for Lord Howe Island is implemented 3. Category 1, 2 and 3 weeds eradicated 4. Category 4 weeds eradicated 5. Ongoing searching for weeds undertaken 6. Weed inventory, mapping and monitoring work extended 	<p>Within six months; then every two years</p> <p>Within six years</p> <p>Within three years</p> <p>Within six years</p> <p>During life of Plan</p> <p>Within five years</p>

	<ul style="list-style-type: none"> 7. Funding of incentive schemes investigated and funding secured 8. Weed community awareness program developed 9. Strategy for remote area weed control developed 10. Herbicide managed to minimise any adverse impacts 11. Research into weed control and biology undertaken 12. Exotic grasses controlled or eradicated 13. Norfolk Island Pine control procedure supported and undertaken 14. Weeds controlled in selected priority sites 	<ul style="list-style-type: none"> Within two years Within two years Within one year During life of Plan Within eight years Within five years During Life of Plan Within two years
5: To undertake revegetation/rehabilitation works in high conservation priority areas	<ul style="list-style-type: none"> 1. The LHI Vegetation Rehabilitation Plan is reviewed 2. The LHI Vegetation Rehabilitation Plan is implemented 3. High conservation priority sites are revegetated and rehabilitated 4. Best practise regeneration and rehabilitation principles used 5. Monitoring program established and commenced for revegetation projects 6. Trampling, browsing and grazing controlled in high conservation priority sites 7. Vegetation of high conservation value buffered 	<ul style="list-style-type: none"> Within one year Life of plan Commenced within one year, ongoing during life of plan Life of plan Within one year Within two years Within five years
6: To eradicate or control introduced fauna and reduce their impact on biodiversity	<ul style="list-style-type: none"> 1. Rodent control program continues and is reviewed to include additional biodiversity baiting sites 2. Rodents are eradicated if studies indicate this to be appropriate and feasible 3. Mallard-Black Duck hybrids are eradicated 4. Research is conducted into the impacts of introduced vertebrate fauna 5. Research is conducted into the impacts of introduced invertebrate fauna 6. Introduced invertebrates controlled at targeted locations 	<ul style="list-style-type: none"> Within one year Within five years Within three years Within ten years Within ten years Within two years
7: To reduce impacts of groundwater pollution	<ul style="list-style-type: none"> 1. Water quality is protected in freshwater creeks 	<ul style="list-style-type: none"> Within two years
8: To enhance positive interactions and reduce negative interactions between humans and wildlife	<ul style="list-style-type: none"> 1. Positive interactions between humans and wildlife are enhanced and negative interactions reduced 	<ul style="list-style-type: none"> Within three years
9: To reduce the impact of commercial, cultural and illegal collecting	<ul style="list-style-type: none"> 1. Impacts of commercial Kentia Palm seed collecting are minimised 2. Illegal collection of fauna is controlled 	<ul style="list-style-type: none"> Within five years Within two years
10: To reduce human impacts.	<ul style="list-style-type: none"> 1. Vegetation in the vicinity of walking tracks is protected 	<ul style="list-style-type: none"> During life of plan

11: To monitor consequences of climate change and develop contingency plans for species at risk.	1. Monitoring is commenced for areas at risk from climate change	Within three years
	2. Options for securing species most at risk are identified and implemented	Within five years
12: To encourage the conservation and protection of significant species, populations and ecological communities.	1. Nominations for listing species, populations and ecological communities or critical habitat are prepared as required	During life of plan
13: To promote recovery of individual threatened flora taxa.	1. Habitat of threatened flora is protected	During life of plan
	2. Weed control is undertaken within habitat of identified threatened flora	Within two years
	3. Monitoring programs are commenced for threatened and key endemic flora	Within two years
	4. <i>Ex-situ</i> collections of threatened and key endemic flora are established	Within five years
	5. Human impacts on threatened flora and communities are reduced	During life of plan
	6. Public awareness of threatened plants and communities is promoted	Within three years
14: To improve knowledge and management of threatened and significant fauna.	1. Research on priority fauna species is commenced	Within four years
	2. Monitoring programs are designed and implemented to assess effectiveness of recovery actions	Within three years
15: To protect and enhance threatened fauna habitat.	1. Flesh-footed Shearwater habitat is protected and enhanced	During life of plan
	2. LHI Silvereye habitat is protected and enhanced	During life of plan
	3. LHI Cockroach habitat is protected and enhanced	During life of plan
	4. Habitat of the White-bellied Storm Petrel and Kermadec Petrel is protected	During life of plan
	5. Red-tailed Tropicbird habitat is protected and enhanced	Within five years
	6. Little Shearwater habitat is protected and enhanced.	Within five years
	7. Habitat on Blackburn Island is protected and enhanced	During life of plan
16: To reduce impacts of fishing and marine debris on threatened sea birds.	1. The use of plastic bags is measurably reduced	Within one year
	2. Amount of plastic bags and plastic debris recorded within sea bird carcasses on Lord Howe Island is measurably reduced	Within five years
17: To undertake recovery actions for threatened fauna species identified in existing documents.	1. The Lord Howe Island Phasmid interim recovery actions have been implemented	Within three years
	2. The Lord Howe Island Placostylus high priority recovery actions are implemented	Within two years
	3. The remaining recovery actions for the Lord Howe Island Placostylus are implemented	Within five years
	4. The Lord Howe Island Gecko and Lord Howe Island Skink high priority recovery actions are implemented	Within two years

	<ol style="list-style-type: none"> 5. The remaining recovery actions for the Lord Howe Island Gecko and Lord Howe Island Skink are implemented 6. The Lord Howe Woodhen high priority recovery actions are implemented 7. The remaining recovery actions for the Lord Howe Woodhen are implemented 	<p>Within five years</p> <p>Within two years</p> <p>Within five years</p>
18: To investigate the appropriateness of reintroduction of locally extinct fauna after rodents have been eradicated.	<ol style="list-style-type: none"> 1. Guidelines for assessing reintroduction or translocation proposals are adapted for the LHIG 2. Populations of species that still exist within the LHIG are reintroduced to the main island 3. Investigations are undertaken and species reintroduced where appropriate 	<p>Within three years</p> <p>After rodent eradication is complete</p> <p>Within ten years</p>
19: To regularly evaluate the biodiversity benefits from implementing the LHI BMP.	<ol style="list-style-type: none"> 1. Mapping of implementation programs is regularly updated 2. Mapping is used for input to appropriate biodiversity forecasting tools, and used to assist the review of recovery actions 	<p>Annually</p> <p>Annually</p>

8 Social and Economic Consequences

Producing a Biodiversity Management Plan for the LHIG provides an efficient use of resources, both in terms of plan preparation, and by efficient and effective prioritisation of recovery actions.

This plan meets the Recovery Plan requirements for 30 listed threatened species, negating the need to produce multiple individual species Recovery Plans. In addition 190 significant species are specifically addressed by this plan.

Addressing the overall biodiversity of Lord Howe Island, with a focus on significant species, as a holistic approach also enables potential future listings on threatened species schedules to be addressed, with a minimal amount of additional work needed to meet the Recovery Plan requirements of these species.

The total cost of implementing the recovery actions will be \$9 351 500 over the ten-year period covered by this plan.

It is anticipated that there will be no significant adverse social or economic costs associated with the implementation of this Biodiversity Management Plan and that the overall benefits to society of implementation of the Biodiversity Management Plan will outweigh any specific costs.

8.1 Responsible parties

Most of the implementation of the actions in this plan are the responsibility of the LHIB, in conjunction with the DECC.

Other potential responsible parties include: the Commonwealth DEWR, the Australian Museum,

AQIS, Biosecurity Australia, the Northern Rivers Catchment Management Authority (Lord Howe Island is within the Northern Rivers Catchment), Department of Primary Industries, Friends of Lord Howe Island, Coastcare, Worldwide Fund for Nature, Natural Heritage Trust, Environmental Trust, tertiary institutions, and Lord Howe Island leaseholders.

8.2 Implementation and costs

Table 18 outlines the implementation of recovery actions specified in this biodiversity management plan to relevant government agencies and/or parties for the period of ten years from publication.

8.3 Preparation details

This Recovery Plan has been prepared by Dianne Brown, Lynn Baker, Katrina McKay and Michael Murphy (DECC, North East Branch) in consultation with the Lord Howe Island recovery team and the LHIB. Contributions to species profiles were provided by Ian Hutton, Dean Hiscox, Dianne Brown, Michael Murphy and Sean Thompson.

8.4 Review date

This Recovery Plan will be reviewed within ten years of the date of its publication.

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10 Glossary of Terms

Biodiversity Forecasting Tool	GIS-based tool that allows analysis of multiple sources of biological and threat data to predict biodiversity persistence and outcomes dependant on management actions.
Biodiversity hot spots	Areas where species richness or endemism is particularly high.
Biodiversity persistence index	Estimate of the probability of persistence of overall biodiversity over time, predicted using active threats.
Dissimilarity	Refers to communities or groups of species that are dissimilar, to each other, i.e. the greatest dissimilarity indicates communities or assemblages of species that are most unique.
Endemic	A species which occurs only on the Lord Howe Island Group.
Exotic species	Species not indigenous to the Lord Howe Island Group.
Extant species	Species that are not extinct.
Extinct species	Species that no longer exist.
Ex-situ	Collection and storage of living animal or plant material off site.
Habitat richness	The number of species habitats that display similar distributions. A high level of habitat richness is where a relatively high number of species habitats overlap.
Indigenous species	Species native to the Lord Howe Island Group prior to settlement.
Introduced species	Species not native to the Lord Howe Island Group prior to settlement.
Naturalised species	Non-indigenous species that are reproducing in the wild.
Species assemblage	A group of species that display similar distributions.
Species richness	The number of species that occur at any one location. Areas of high species richness are those where there are a relatively high number of species.
Vegetation community	A vegetation community refers to vegetation mapping by Pickard (1983), modified for this report by Hunter and Hutton.
Weed	A plant species that has naturalised in the wild.

11 Acronyms Used in this Document

AQIS	Australian Quarantine Inspection Service
BFT	Biodiversity Forecasting Tool
CAA	Companion Animals Act 1998
DECC	NSW Department of Environment and Climate Change
DEWR	Commonwealth Department of Environment and Water Resources
DPI	Department of Primary Industries
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FOLHI	Friends of Lord Howe Island
GIS	Geographical Information Systems
GPS	Global Positioning System
KTP	Key Threatening Process (under the TSC Act or the EPBC Act)
LHI	Lord Howe Island
LHIB	Lord Howe Island Board
LHI BMP	Lord Howe Island Biodiversity Management Plan
LHIG	Refers to the Lord Howe Island Group, consisting of Lord Howe Island, Blackburn Island, Muttonbird Island, Gower Island, the Admiralty Islands and Balls Pyramid.
NPW Act	NSW <i>National Parks and Wildlife Act 1974</i>
NPWS	NSW National Parks and Wildlife Service
NRCMA	Northern Rivers Catchment Management Authority
PPP	Permanent Park Preserve
REP	Regional Environment Plan
SIS	Species Impact Statement
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>
WWF	Worldwide Fund for Nature



Australian Government

Department of the Environment, Water, Heritage and the Arts

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3.8.17

THREAT ABATEMENT PLAN

**to reduce the impacts of exotic rodents on biodiversity on
Australian offshore islands of less than 100 000 hectares**

2009

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1 Summary

1.1 Rationale for a threat abatement plan

Human dispersal and colonisation over the last few millennia has spread four species of Eurasian rodents to many of the world's islands. These rodents are: ship, or black, rats (*Rattus rattus*); Norway, or brown, rats (*R. norvegicus*); Pacific rats (*R. exulans*); and house mice (*Mus musculus*). Together with other exotic pests, they are a major threat to native biodiversity on islands. Australian islands have been no exception, especially since European colonisation. Exotic rodents, particularly ship rats and perhaps mice, have been a key (and often the critical) cause of extinction, extirpation (local population loss) and decline of many native species, adverse changes to island ecosystems, as well as economic damage to island peoples' livelihoods and potentially to their health. The presence of rodents on islands also precludes many positive options to restore island values, and their presence on mainland Australia and elsewhere presents an ongoing risk to biodiversity. For Australian islands not currently invaded there is also a high risk.

Managing the threat from exotic rodents to island biodiversity therefore requires *in situ* management, by eradication or sustained control on invaded islands, reduction of the risk that rodent-free islands will be invaded, and/or timely reaction to invasions when quarantine is breached.

In 2006 the Australian Government listed exotic rodents on islands as a key threatening process under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and initiated the development of a threat abatement plan (hereafter the plan) for rats and mice on islands less than 100 000 ha in area. This plan and its background document (Commonwealth of Australia 2008) provide a national framework to guide and coordinate Australia's management of exotic rodents on islands to remove, mitigate and prevent their impacts on native species (Appendix A) and ecological communities.

1.2 Objectives of the plan

The plan contains three objectives, and a series of actions that will be required to achieve them. Knowledge gaps and other constraints and uncertainties and the need for stakeholder commitment and capacity building are identified in each strategic objective. The objectives are to:

- eradicate exotic rodents from high-priority islands
- mitigate the impacts of exotic rodents on biodiversity values on high-priority islands where they cannot be eradicated, and
- prevent the invasion of islands currently free of exotic rodents.

1.3 Actions under the Threat Abatement Plan

The threat to biodiversity from exotic rodents on islands is clear but manageable. Generic actions and those required to achieve the objectives are noted in this plan. Each action is prioritised and presented with an assessment of the current 'state of play' and with ways to measure progress.

1.4 Outcomes of the actions

As the plan objectives are achieved the condition and trend of native species and communities on islands currently with exotic rodents will improve, and those on islands

without rodents will not decline due to rodent impacts. Removal of exotic rodents will also open options for both natural recolonisation and active restoration of island ecosystems. Economic damage to residents' resources, the nuisance and unwanted effects, and potential risks to health caused by exotic rodents will be removed or abated.

In addition to these main outcomes, science-based and traditional knowledge (both indigenous and that of current island residents) will be used, where available, to inform feasibility and operational planning. This knowledge will be improved as the results of management are monitored, e.g. by adaptive management or learn-by-doing approaches, leading to better-informed decisions and actions in the future. Implementation of the plan will also increase community awareness and engagement, and coordination across all tiers of government. This will result in Australians being better informed about the threat from exotic rodents and better motivated to continue the implementation.

2 Background

2.1 Threat abatement plans

The Australian Government develops threat abatement plans and facilitates their implementation under the EPBC Act. The Department of the Environment, Water, Heritage and the Arts has a role to assess the potential for and promotion of the partnerships between government agencies and other stakeholders that are required to conduct the actions identified in the plans.

A threat abatement plan for exotic rodents on islands can be more focused than plans for other invasive species because the sites for action are clearly identified, the control tools are available, the impacts of the rodents are mostly on biodiversity rather than on production values, and in many cases the pest can be eradicated. Nevertheless, each island has unique circumstances, not the least being the presence of people on many candidate islands. Therefore, like other plans, this plan also advocates the social and economic aspects of management.

Australia has seven islands, all with exotic rodents, larger than 100 000 ha, the upper cut-off size for this plan. However, eradication on islands this size is currently impractical so, although they are excluded from this plan, that should not preclude sustained control at priority sites on these larger islands if that strategy is justified by local needs.

2.2 Exotic rodents on Australian islands

The four exotic rodent species in this threat abatement plan have variously invaded over 80% of the world's major island archipelagos, and have been responsible for many of the extinctions and ecosystem changes that have occurred on these important fragments and refuges for biodiversity. Exotic rodents continue to invade islands, but since the 1980s, when techniques to eradicate them were developed in New Zealand, the rate at which they have been eradicated has exceeded the rate of invasion of new islands. To date, invasive rodents have been eradicated from 350 islands in 21 countries around the world.

Australia has over 8300 islands under 100 000 ha, of which at least 133 are now known to have one or more species of exotic rodents. House mice, ship rats and the two together are by far the most common rodents on Australian islands. Exotic rodents have been eradicated from 39 islands, almost all from Western Australia.

About 31% of these 133 islands are connected to or are within easy swimming distance (for a ship rat) of the mainland. Thus, eradication will be difficult on this subset of islands unless backed by effective 'border' control and quarantine measures.

About 57% of the islands are entirely or substantially managed under various reserved tenures, about 34% are privately owned or leased, and about 9% are owned by indigenous people. Many islands that are important for biodiversity have permanent residents. Thus governments, private citizens and indigenous groups have generic and island-specific interests in this plan. Islands themselves are often iconic sites and many harbour iconic species, so wider stakeholders include groups with a conservation focus, to private companies promoting ecotourism, as well as the wider Australian public – and for some islands the international community.

2.3 Impacts on biodiversity

The contribution of islands to Australia's biodiversity assets is out of proportion to their area. This is due to continental islands often representing less-disturbed examples of mainland ecosystems and offering refuges for species threatened on the mainland. In addition, oceanic islands have high degrees of endemism and are thus unique evolutionary units in their own right. Both types of islands are key places for breeding marine birds, turtles and seals.

Seven lines of evidence prove that exotic rodents have and continue to adversely affect native biodiversity on Australian islands, prevent some restoration options and are a potential threat to island ecosystems currently free of exotic rodents. Exotic rodents:

- eat native species and compete for food
- carry diseases that may affect native animals
- drive some species endemic to the island to extinction
- extirpate some species from particular islands
- continue to threaten native species on many islands
- change ecosystems by more complex indirect effects by causing changes in species that 'engineer' the ecosystem – such as seabirds
- act as the primary prey for other exotic predators such as feral cats or foxes, which then threaten native species.

Of the two common rodents on Australian islands, ship rats are the most obvious threat judging by their known impacts to biodiversity on both Australian and other islands. For example, five birds endemic to Lord Howe Island had survived decades with mice but became extinct after the rats arrived in 1918. The effect of mice has been more subtle as they have not had such catastrophic effects on avian species. However, recent evidence from Gough Island (a British island in the Atlantic Ocean) shows that under some circumstances mice can kill large naïve prey such as albatross chicks. Mice are efficient predators of invertebrates (particularly spiders) but their impacts on these prey species at population levels remains unknown.

Exotic rodents are also social and economic pest on islands inhabited by people. For example, the palm seed horticultural industry on Lord Howe Island would benefit by over \$5 million over 30 years if ship rats could be eradicated.

2.4 Managing the threat

The options to manage exotic rodents on Australian islands are to eradicate them, to reduce them to some lower density over all or part of the island by sustained control, or to do nothing when neither of the above is possible or when there is no need. Unlike some threats to biodiversity in Australia, the threat from exotic rodents on islands can in large part be removed at a realistic cost to provide clear and permanent benefits.

Managing invasion pathways and new incursions is also required for the islands undergoing eradication or control programs, as well as for islands without exotic rodents. The optimal way to reduce invasion risks – by pre-border, on-ship, or post-border actions – will depend very much on the particular risks, costs and consequences for each island.

The tools to achieve eradication are well-tested elsewhere in the world and in Western Australia. The tools to achieve sustained control are available but their optimal application needs to be refined for each case. The tools to limit, detect and manage invasions include

the need for new policies to encourage or enforce quarantine practices and better methods to detect and intercept invasive rodents.

Australian agencies have eradicated exotic rodents from 39 islands and are currently planning to do so from four more: Macquarie, Lord Howe, Montague and Mutton Bird islands.

3 Threat abatement

3.1 Goal

The goal of this Threat Abatement Plan is to eliminate, or reduce to an acceptable level, the current and potential impacts of exotic rodents on offshore Australian islands, in order to maximise the chances of the long-term survival in nature of affected native species and ecological communities.

Successful eradication of exotic rodents on islands will also open opportunities for the natural return of some extirpated native species such as seabirds, for active restoration programs, or for the possibility of using some islands as biodiversity arks for species threatened on the mainland.

3.2 Objectives

The plan has three objectives, each of which requires different emphases for supporting information, research and stakeholder involvement and thus for actions.

The objectives are to:

- eradicate exotic rodents from high-priority islands
- mitigate the impacts of exotic rodents on biodiversity values on high-priority islands where they cannot be eradicated, and
- prevent the invasion of islands currently free of exotic rodents.

3.3 Actions

The following actions are proposed under the plan. They are in part sequential although different jurisdictions will be at different points along the process, and so the judgement about their relative priorities may vary between jurisdictions.

The first set of actions aims to provide better information on the conservation status of islands as these are affected by exotic rodents. The next two sets of actions prescribe alternative strategies (eradication or sustained control) that can be used to manage islands with exotic rodents. The fourth set of actions prescribes how to stop the problem getting worse and how to defend islands from which exotic rodents have been eradicated. The next set of actions introduces the social and cultural needs of islanders and other stakeholders to ensure they support actions to control rodents, benefit from them, and participate in ongoing management such as quarantine and surveillance. Finally, the actions identify the priority needs for research and information.

Priorities are ranked very high, high or medium within each set of actions and indicate when each should start. The timeframes give an initial indication on how long each action might take to achieve. Generally, a short timeframe indicates a 1 – 3 year action, a medium timeframe up to 5 years, a long timeframe indicates an ongoing effort but with a definite end point, and an ongoing timeframe has no endpoint but requires investment in perpetuity. Clearly decisions around the priority score and timeframe are interactive, the sets of actions are interdependent, and the final sequence, duration and length of actions will depend on budgets.

3.3.1 Actions to set priorities and plan strategic options

This group of actions covers the preliminary information needs and actions required to establish a basis for implementing the plan. The key questions the actions aim to answer are:

- Which islands, whose rodent status is unknown, might be of concern if they were present? These islands should be surveyed and brought into the following selection process should they be discovered to have exotic rodents.
- Which islands known to have exotic rodents are candidates for the preferred option of eradication and which, by implication, would require sustained control?
- Which islands that are candidates for eradication should be treated first, and where should sustained control be started?

Therefore, two parallel processes need to be followed to answer these questions. The first process (actions 1.1 and 1.2) is a prioritisation system to select islands for survey where information is lacking, or to confirm information on islands where the status (presence or species) of exotic rodents is unclear.

The second process aims to identify whether eradication is feasible on each island and then prioritise those islands for action (actions 1.3 to 1.5). Past success on similar islands and species or analyses of the island-specific rules and constraints can be used to judge this. For these islands a second prioritisation process is required. Generally, precedence should be given to those where there is a clear current threat to native species or communities and where substantial benefits to the island's biodiversity would be expected if the rodents were eradicated. This rule tends to favour remote islands because of the vulnerability of their biota and their higher levels of endemism. However, cases can be made for eradication on in-shore islands by some jurisdictions either to act as arks for mainland biota or as demonstration or capacity-building sites.

1 - Actions to set priorities and plan strategic options	Priority and timeframe
1.1 Complete state/territory databases	High priority, completed in 2008
1.2 Survey high-priority islands (see Background Document for options to rank islands) with no current information on exotic rodents for the presence/absence of rodents	Medium priority, timeframe depends on State needs
1.3 Formulate and circulate best-practice rules and examples to determine whether eradication is feasible	High priority, short term
1.4 Identify islands known to have exotic rodents where eradication is feasible, and by implication, where sustained control is the only option	Very high priority, short term
1.5 Develop a network of Australian and overseas technical experts	Medium priority, medium term

Current state of actions

The Department of Environment, Water, Heritage and the Arts has contracted the collation of data on the presence of vertebrate species (including exotic rodents) on Australian islands. However, significant uncertainties remain in the databases. Rodents may be present on some islands despite surveys but not found, or found but not noted in the literature. Rodents

are known to be present on some islands but the species remains unclear. Many islands, some with high biodiversity values, have not been surveyed for exotic rodents.

Setting national or regional priorities would be improved with more complete information on the presence/absence of particular exotic rodent species; and feasibility or operational planning for any island would require information on both the exotic rodents and non-target species.

Action 1.4 might be completed at a national level using current data (e.g. see Table 2.3 in the Background document). The outcomes of this would give state and territory agencies a clear guide in their process to prioritise and set timetables for eradication or sustained control among the islands in their jurisdictions (see actions under 3.3.2 and 3.3.3 below).

Performance indicators

- The current island databases are updated periodically, and any islands with high-priority conservation values such as threatened species or unique communities, but with uncertain rodent status, are checked.
- Templates of best practice feasibility studies and operational plans on rodent eradication are circulated to key state and territory agencies and used to develop capacity and the network of experts.
- A national list of the highest priority islands for eradication is developed.

3.3.2 Actions to achieve eradication

This group of actions flows from state and territory commitment to use the national list produced in action 1.4 to progress eradication as an option to manage exotic rodents on islands in each jurisdiction.

The direction of the recommended action to start the planning process for islands other than the four noted below will depend on success on the two large islands (Macquarie and Lord Howe). If rodents are eradicated from these two islands then other remote, large islands with significant biodiversity values at risk (e.g. Norfolk, Christmas, the Cocos group) might be considered. If the rodents are not eradicated from Macquarie or Lord Howe then further research to identify the causes of failure and its solution would be required before attempting other large islands. The initial priorities might switch to achieving success on smaller islands, perhaps with a single species of exotic rodents as the priority. Whenever possible in undertaking research on, or control of, exotic rodents on islands the disease status of the species (and, where appropriate, co-occurring native mammals) should be assessed. Such assessment will help refine the evaluation of risks and the prioritisation of control for island occurrences of exotic rodents.

The final actions in this section are to ensure the benefits of successful eradication of exotic rodents are measured, known to stakeholders and celebrated, successes are defended against re-invasion by rodents (expanded in section 3.4.4), and removal of exotic rodents is seen as an opportunity to manage other threats present on the island. The benefits of removing rodents will be island-specific. These might extend from the re-categorisation of a listed threatened species to a safer category to the contingent opportunities to return extirpated species to the island.

2 - Actions to achieve eradication	Priority and timeframe
2.1 Eradicate rodents from Lord Howe, Macquarie, Montague and Mutton Bird islands	Very high priority, short to medium term
2.2 Consider Australian registration for an aerial bait with anticoagulant for use on island eradications	Medium priority, medium term
2.3. Enhance skills to plan and conduct eradication operations in Australia	High priority, ongoing
2.4 Eradicate exotic rodents on other islands where high-priority conservation benefits will accrue	High priority, long term
2.5 Measure benefits of eradication	High priority, ongoing as projects are conducted
2.6 Eradicate or control other pests on islands from which rodents are to be eradicated	High priority, ongoing as projects are conducted

Current state of actions

Effective baiting protocols are available and the planning and operational skills can be acquired or developed. Therefore, the current plans to eradicate exotic rodents from two large islands (Macquarie and Lord Howe), and two small islands (Mutton Bird and Montague, in NSW) will act as new examples for others to follow. Success in eradicating rodents from the large islands would lead the world and give confidence that other large Australian islands could be attempted with a high likelihood of success.

The use of brodifacoum baits sown from the air is now permitted in Australia under 'minor use' permits. Bait manufacturers intend to use the data collected from Macquarie Island to consider the costs and benefits of registering the bait under the Agriculture and Veterinary Code Regulations 1995.

An outcome of these projects will be to strengthen and widen (past the current expertise in Western Australia) the capacity of Australian agencies to plan, conduct and monitor the eradication of exotic rodents. Developing institutional capacity is important as the program of management of exotic rodents on islands is likely to exceed the working life of those staff currently involved.

Performance indicators

- Exotic rodents eradicated from Macquarie, Lord Howe, Mutton Bird and Montague islands, or causes of failure identified.
- A bait with an anticoagulant toxin is registered for use for eradication of exotic rodents on islands.
- The first tranche of islands identified as high priority for eradication are introduced into state and territory planning processes.
- All eradication plans identify and monitor pre- and post-eradication indicator native species expected to benefit from eradication of exotic rodents, and indicator native species that may be at risk from the control methods.
- All eradication plans consider the costs, benefits and risks of including other invasive species present on the island within the planning process.

3.3.3 Actions to achieve sustained control

Sustained control is second best after eradication, but is required to protect biodiversity values on islands where eradication is not feasible or as a holding strategy to protect critically threatened species until an eradication campaign can be mounted. The time frame is either 'ongoing' or 'until eradication is proposed and achieved' for each island under this objective.

The key actions required are first to identify what control tools are available for use on Australian islands and to develop best practice for their application for sustained control. Second, there is a need to enhance the capacity of island residents and agencies to deliver sustained control and to monitor outcomes so that actions can be adapted as required.

3 – Actions to achieve sustained control	Priority and timeframe
3.1 Review rodent control tools registered for use in Australia	Medium priority, short term
3.2 Promote trials to develop and test best-practice sequential use of rodent control tools on islands	High priority, medium term
3.3 Train island residents or rangers as primary deliverers of sustained control on their islands	High priority, ongoing

Current state of actions

Rodents are controlled as commensal and agricultural pests and for biodiversity protection on populated islands such as Lord Howe and Norfolk. However, the islanders and island managers who conduct these operations usually do not use current best practice.

Performance indicators

- A users' manual is produced to identify the technical options and their best use for purpose to sustain control of exotic rodents on islands.

3.3.4 Actions to prevent invasion or reinvasion

There is a need to apply appropriate management to reduce the risks of invasion or reinvasion of islands by exotic rodents and to detect and deal with any failures of this management. The problem is that in the absence of data on these risks, costs and consequences it is unclear how to intervene in an optimal way.

The actions in this objective aim to develop appropriate procedures that can be applied and monitored in ways to clarify best-practice border management and responses to incursions on islands with different risk and consequence profiles.

4 – Actions to prevent invasion or re-invasion	Priority and timeframe
4.1 Develop generic contingency plans for reaction to any new rodent invasions	High priority, short term
4.2 Apply quarantine systems on rodent-free islands and where eradication is achieved	High priority, ongoing
4.3 Develop island-specific contingency capabilities for islands at high risk of invasion	High priority, short term
4.4 Reduce risk of rodents gaining access to key vessels at key ports	Medium priority, medium term
4.5 Identify and reduce the frequency of rodent infestation on key Australian vessels, i.e. those regularly berthing on priority islands	Medium priority, medium term
4.6 Survey rodent species and prevalence on foreign boats that present risks to Australian islands	Medium priority, short term
4.7 Develop and test on-island prophylactic (e.g. permanent bait stations at high-risk sites) and reactive (e.g. surveillance and prompt control after any detection of rodents) strategies to detect and deal with incursions	High priority, short term and ongoing
4.8 Develop fast response capabilities to react to shipwrecks on priority islands	High priority, short term
4.9 Actively involve island residents and ship owners in the management of incursion risks	High priority, long term

Current state of actions

There are overseas and Australian models for these border management actions, but all are work in progress. For example, Lord Howe and Christmas islands have quarantine strategies that include rodents (which would become critical if the extant rodents were eradicated).

The managers of Barrow Island (free of exotic rodents) are developing a formal detection and search protocol for invasive species to reduce risks and improve responses as a consequence of the planned influx of shipping and aircraft to service the new oil and gas facilities being established on the island.

The use of genetic tools to identify individual animals, their parentage, discrete populations, as well as the more usual use as a mark-recapture method to assess population size allows managers to quantify some aspects of invasion risk to direct and optimise management options.

Performance indicators

- Contingency quarantine and response plans for all islands are in place as part of feasibility studies or quarantine plans for high priority rodent-free islands.
- Infestation rates on key Australian and foreign vessels are measured.
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3.3.5 Actions to achieve outreach and public education

These actions aim to ensure the plan's actions and outcomes are understood and actively supported by island residents, traditional owners and other interested parties. This support is important during feasibility planning for eradication to address potential concerns about the risks involved with control methods such as aerial poisoning, which by its nature is conducted by agencies or contractors. However, it is even more important to involve island residents and other parties in the ongoing management of reinvasion risks, quarantine and sustained control, which by its nature requires the active participation of the wider public.

5 – Actions to achieve outreach and public education	Priority and timeframe
5.1 Promote stakeholder input and involvement as the Threat Abatement Plan is implemented	High priority, short term
5.2 Actively consult with traditional owners of islands	High priority, short term and ongoing
5.3 Promote the conservation benefits of successful eradications to the wider Australian public	Medium priority, medium term
5.4 Identify boat owners who visit key islands, and develop an education package to ensure their vessels are free of rodents	High priority, long term

Current state of actions

Stakeholder interest in this plan is high for some conservation groups and from the residents of some islands. However, there has been no formal consultation with traditional owner organisations or boat owners about the Threat Abatement Plan. The lack of input from traditional owners will have to be remedied particularly at the level of detailed consultation with the actual owners of any islands intended for actions.

Performance indicators

- The Plan is widely accepted as an action resource by stakeholders
- The Plan will be used as the basis for ongoing consultation with appropriate representatives of traditional owner groups, and direct consultations with particular traditional owners of islands mooted for actions
- A resource kit 'keeping your boat free of rodents' for boat owners is developed and made available.

3.4 Research and information needs

Research on the management of exotic rodents on islands is being conducted in many countries and Australian researchers and managers need to access these results. However, within Australia five key gaps are identified:

- The possibility that the presence of ship rats reduces the chance to eradicate mice needs to be tested and the causes identified. This is not just an Australian problem so researchers need to liaise with overseas colleagues to develop dual-species or one-at-a-time strategies for managing mice in the presence of ship rats.
- Best-practice use of toxic baits (and other control methods) and adequate monitoring protocols for sustained control options need to be formulated and tested.
- The humaneness of control methods remains an issue and ongoing research is required to improve the animal welfare costs of rodent control.
- Information on the risks of invasion by exotic rodents on islands of different types needs to be gathered to develop a risk profile for key islands. Best-practice surveillance and intervention (by prophylactic measures such as permanent bait station around wharfs, or reactive measures such as surveillance and prompt response to a detection) need to be developed, applied where appropriate, and tested over the long term.
- The consequence of exotic (or native) predators switching to native prey from exotic rodents as primary prey may be an issue on islands. The precautionary approach is to remove exotic predators at the same time as the exotic rodents, but if this is not possible predicting and testing the consequences is desirable before rodents are removed.
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6 – Actions for research and information needs	Priority and timeframe
6.1 Determine why mice appear to be more difficult to eradicate in the presence of rats	Very high priority, short term
6.2 Develop best-practice guidelines for sustained control of rodents on islands	High priority, short term
6.3 Improve the humaneness of eradication tools	High priority, long term
6.4 Develop and test risk-based methods to detect and manage incursions by rodents	High priority, short term
6.5 Predict and test the consequences of prey switching	Medium priority, medium term

Current state of actions

All of these research actions are being addressed either in Australia or elsewhere. The issue of sympatric mice and ship rats is a particular problem on Australian islands.

Performance indicators

- Australian research on the mouse-rat issue is developed and integrated with research being conducted in New Zealand and the USA.

4 Implementation

4.1 Implementing the plan

The Department of the Environment, Water, Heritage and the Arts will work with other Australian Government departments, appropriate state/territory government representatives, and other individuals or groups with expertise, to facilitate the implementation of this plan. The Department will support the implementation of the Plan through targeted investment from programs such as Caring for our Country and appropriate management through committees such as the Environmental Biosecurity Committee.

Many islands with rodents, including some potentially high priority ones such as Lord Howe, Norfolk and Christmas islands, are also inhabited by people. Involving these primary stakeholders is essential across all objectives, but for the eradication objective the particular need is at the planning level of decision making. The participation and support of island residents, where present, is a key factor in any eradication feasibility plan and their approval and support is more readily given if they are involved throughout the planning phases. The level of residents' involvement in the actual eradication operation (rather than the planning) depends on how the control is done. For example, large-scale aerial baiting requires technical skills beyond those available to island residents, and often beyond those within government agencies. Elsewhere in the world these skills are usually contracted to experts.

In contrast, ongoing actions under the sustained control and quarantine objectives will require active involvement of island residents or permanent ranger staff of governments in both planning and delivery of the control.

Indigenous people have an interest in many islands and own and live on many. Thus they are key stakeholders both during planning and as actions are developed on each island.

4.2 Duration and cost

This plan provides a framework that will guide stakeholders in determining and undertaking targeted priority actions. The level of investment in many of the actions will be determined by the level of resources that stakeholders commit to management of the problems caused by exotic rodents on islands, and therefore the cost of implementing the plan cannot be quantified at this time. There may be budgetary or other constraints on achieving the objectives set out in this plan, and as knowledge changes the actions proposed in the plan may be modified over the life of the plan.

The plan has both finite (eradication of exotic rodents) and ongoing (sustained control and quarantine) objectives. The costs for eradication can be estimated for each island where this strategy is possible and then funds allocated as different islands are proposed, with deadlines identified by jurisdictions according to their respective capacities and priorities. Annual costs for the eradication actions will vary depending on the size and location of islands from millions of dollars for large remote islands to a few thousands of dollars on small accessible islands – and the budgets of funding agencies will need flexibility to meet such circumstances.

Costs for sustained control and ongoing routine quarantine would need to be maintained within base-line budgets, although perhaps at a declining level as eradications succeed and efficiencies improve.

Tasmania and New South Wales have committed to two large eradication projects (Macquarie and Lord Howe islands respectively) and other jurisdictions might begin or recommence by selecting smaller islands where benefits would be clear and on which to develop planning and operational expertise. This proportion of the costs should fall as success removes islands from the list.

Traditionally, most funding for island eradications has come directly from relevant government agencies. However, increasingly around the world funding is being made available for one-off projects, such as eradication, from non-government and private donors and from industries paying to mitigate adverse effects of their actions. Eradication of rats to increase nesting success of seabirds has been funded from levies on commercial fisheries responsible for deaths of the adult birds, and industrial users of islands have offered to remit some of the conservation loss they cause by funding conservation projects.

4.3 Evaluating progress

Under the EPBC Act (s.279 [2]) a threat abatement plan must be reviewed by the Minister at intervals of not longer than five years.

The number of islands where exotic rodents are eradicated or effectively controlled and the trend in islands invaded will form short- and long-term proximal measures of the success of the plan. However, the real benefit of the plan will be measured by monitoring and evaluating improvements in the biodiversity condition of the islands, including improved conservation status for key island endemic species.

5 References

Commonwealth of Australia (2009). Background document for the threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100 000 ha. Department of the Environment, Water, Heritage and the Arts, Canberra.

Garnett ST and Crowley GM (2000). *The action plan for Australian birds*. Environment Australia, Canberra.

Appendix A Threatened species listed under the EPBC Act or in state/territory legislation (as noted in the tables) that are affected or potentially affected by exotic rodents on islands under 100 000 ha

Table A1. Listed Australian species that are reported to be threatened by exotic rodents.

Species	Island	Only found or nests on the island(s)	Status
Christmas Island Pipistrelle (Bat) (<i>Pipistrellus murrayi</i>)	Christmas	Yes	Critically endangered
Lord Howe flax snail (<i>Placostylus bivaricosus</i>)	Lord Howe	Yes	Endangered
Christmas Island thrush (<i>Turdus poliocephalus erythropleurus</i>)	Christmas	Yes	Endangered
Norfolk Island Green parrot (<i>Cyanoramphus novaezelandiae cookii</i>)	Norfolk	Yes	Endangered
Christmas Island Shrew (<i>Crocidura attenuata trichura</i>)	Christmas	Yes	Endangered
Emerald dove (<i>Chalcophaps indica natalis</i>)	Christmas	Yes	Endangered
Cockroach (<i>Panesthia lata</i>)	Lord Howe	Yes	Endangered (NSW)
Lord Howe Island Gecko (<i>Christinus guentheri</i>)	Lord Howe, Norfolk	Yes	Vulnerable
Lord Howe Island Skink (<i>Oligosoma lichenigera</i>)	Lord Howe	Yes	Vulnerable
Christmas Island Gecko (<i>Lepidodactylus listeri</i>)	Christmas	Yes	Vulnerable
Blind snake (<i>Typhlops exocoeti</i>)	Christmas	Yes	Vulnerable
Golden whistler (<i>Pachycephala pectoralis xanthoprocta</i>)	Norfolk	Yes	Vulnerable
Scarlet robin (<i>Petroica m. multicolor</i>)	Norfolk	Yes	Vulnerable
Southern fairy prion (<i>Pachyptila turtur subantactica</i>)	Macquarie	No	Vulnerable
Grey ternlet (<i>Procelsterna cerulean</i>)	Lord Howe	No	Vulnerable (NSW)
Little shearwater (<i>Puffinus assimilis</i>)	Lord Howe	No	Vulnerable (NSW)
Masked booby (<i>Sula dactylatra</i>)	Lord Howe	No	Vulnerable (NSW)
Providence petrel (<i>Pterodroma solandri</i>)	Lord Howe, Phillip	Yes	Vulnerable (NSW)
Sooty tern (<i>Sterna fuscata</i>)	Lord Howe, Norfolk	No	Vulnerable (NSW)
Black-winged petrel (<i>Pterodroma nigripennis</i>)	Lord Howe	No	Vulnerable (NSW)
White-headed petrel (<i>Pterodroma lessonii</i>)	Macquarie	No	Vulnerable (Tas)
Wilson's storm petrel (<i>Oceanites o. oceanicus</i>)	Macquarie	No	Vulnerable (Tas)

Table A2. Listed Australian endemic and native species that are not specifically reported to be threatened by exotic rodents present on the island but may benefit indirectly from their removal

Species	Island	Only found or nests on the island(s)	Status
Christmas Island Goshawk (<i>Accipiter fasciatus natalis</i>)	Christmas	Yes	Endangered
Norfolk Island Boobook (<i>Ninox novaeseelandiae undulata</i>)	Norfolk	Yes	Endangered
Southern giant petrel (<i>Macronectes giganteus</i>)	Macquarie	No	Endangered
Northern giant petrel (<i>Macronectes halli</i>)	Macquarie	No	Vulnerable
Lord Howe Woodhen (<i>Gallirallus sylvestris</i>)	Lord Howe	Yes	Vulnerable
Lord Howe Island Currawong (<i>Strepera graculina crissalis</i>)	Lord Howe	Yes	Vulnerable
Christmas Island Frigate bird (<i>Fregata andrewsi</i>)	Christmas	No	Vulnerable
Christmas Island Hawk owl (<i>Ninox natalis</i>)	Christmas	Yes	Vulnerable
Black-browed albatross (<i>Thalassarche melanophris</i>)	Macquarie	No	Vulnerable
Grey-headed albatross (<i>Thalassarche chrysostoma</i>)	Macquarie	No	Vulnerable
Wandering albatross (<i>Diomedea exulans</i>)	Macquarie	No	Vulnerable
Light-mantled albatross (<i>Phoebastria palpebrata</i>)	Macquarie	No	Vulnerable

Table A3. Listed Australian species that occur on rodent-free islands but that are likely to be threatened (to various extents) if exotic rodents invade and establish

Species	Island	Only found or nests on the island(s)	Status
Phasmid (<i>Dryococelus australis</i>)	Islets off Lord Howe	Yes	Critically endangered
Round Island petrel (<i>Pterodroma arminjonata</i>)	N. Keeling	No	Critically endangered
Herald petrel (<i>Pterodroma heraldica</i>)	Raine (Coral Sea)	No	Critically endangered
Buff-banded rail (<i>Gallirallus philippensis andrewsi</i>)	North Keeling	Yes	Endangered
Gould's petrel (<i>Pterodroma l. leucoptera</i>)	Cabbage Tree	Yes	Endangered
Antarctic tern (<i>Sterna vittata vittata/ bethunei</i>)	Heard, Stacks off Macquarie	No	Endangered
Bramble Cay melomys (<i>Melomys rubicola</i>)	Bramble Cay	Yes	Endangered
Western barred bandicoot (<i>Perameles b. bougainville</i>)	Bernier, Dorre, Faure	Yes	Endangered
Kermadec petrel (<i>Pterodroma n. neglecta</i>)	Islets off Lord Howe	No	Vulnerable

Species	Island	Only found or nests on the island(s)	Status
Blue petrel (<i>Halobaena caerulea</i>)	Stacks off Macquarie	No	Vulnerable
Flesh-footed shearwater (<i>Puffinus carneipes</i>)	Islets off Lord Howe	No	Vulnerable
Burrowing bettong (<i>Bettongia lesueur</i>)	Boodie	Yes	Vulnerable
White-bellied storm petrel (<i>Fregetta g. grallaria</i>)	Islets off Lord Howe	No	Vulnerable
Golden bandicoot (<i>Isodon auratus barrowensis</i>)	Barrow	Yes	Vulnerable
Spectacled hare wallaby (<i>Lagorchestes c. conspicillatus</i>)	Barrow	Yes	Vulnerable
Barrow Island euro (<i>Macropus robustus isabellinus</i>)	Barrow	Yes	Vulnerable
Rufous hare wallaby (<i>Lagorchestes hirsutus bernieri</i>)	Bernier	Yes	Vulnerable
Rufous hare wallaby (<i>Lagorchestes hirsutus dorreeae</i>)	Dorre	Yes	Vulnerable
Worm lizard (<i>Aprasia r. rostrata</i>)	Hermite	Yes	Vulnerable
Airlie Island ctenotus (<i>Ctenotus angusticeps</i>)	Airlie	Yes	Vulnerable
Lancelin skink (<i>Ctenotus lanceolini</i>)	Lancelin	Yes	Vulnerable
Spiny-scale skink (<i>Egernia stokesii aethiops</i>)	Baudin	Yes	Vulnerable
Lesser noddy (<i>Anous tenuirostris melanops</i>)	Pelsaert, Wooded, Morlay	Yes	Vulnerable
Cape Barren goose (<i>Cereopsis novaehollandiae grisea</i>)	Recherche Archipelago	No	Vulnerable
Recherche rock wallaby (<i>Petrogale lateralis hacketti</i>)	Mondrian, Wilson, Westall	Yes	Vulnerable
Pearson rock wallaby (<i>Petrogale lateralis pearsonii</i>)	Pearson, Thistle, Wedge	Yes	Vulnerable
Imperial shag (<i>Leucocarbo atriceps nivalis</i>)	Heard	Yes	Vulnerable
Fairy wren (<i>Malurus leucopterus edouardi</i>)	Barrow	Yes	Vulnerable
Fairy wren (<i>Malurus l. leucopterus</i>)	Dirk Hartog	Yes	Vulnerable
Soft-plumage petrel (<i>Pterodroma mollis deceptornis</i>)	Maatsuyker	No	Vulnerable
Shy albatross (<i>Thalassarche cauta</i>)	Albatross, Mewstone, Pedra Blanca	No	Vulnerable



Australian Government
Department of the Environment

Threat abatement plan for predation by feral cats



2015



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1 Introduction

This *Threat abatement plan for predation by feral cats* establishes a national framework to guide and coordinate Australia's response to the impacts of feral cats (*Felis catus*) on biodiversity. It identifies the research, management and other actions needed to ensure the long-term survival of native species and ecological communities affected by predation by feral cats. It replaces the previous threat abatement plan for predation by feral cats published in 2008 (DEWHA, 2008a). A review of the previous threat abatement plan found some significant advances in feral cat research and control since 2008 (Department of the Environment, 2015a).

This plan should be read in conjunction with the publication *Background document for the Threat abatement plan for predation by feral cats* (Department of the Environment, 2015b). The background document provides information on feral cat characteristics, biology and distribution; impacts on environmental, social and cultural values; and current management practices and measures. The document also provides additional detail on some of the concepts and research included in the plan.

The plan is supported by the Australian Government's Threatened Species Strategy. The Threatened Species Strategy outlines an action-based approach to protecting and recovering our nation's threatened plants and animals. Its approach of 'science, action and partnership' can be used to achieve the long-term goal of reversing threatened species declines and supporting species recovery. Feral cat control is a priority area for the Threatened Species Strategy, with key actions including: deployment of Curiosity®, the new humane feral cat bait; working with protected area partners to increase feral cat management in reserves; and supporting the establishment of feral free areas and feral free islands as safe havens for threatened species. The feral cat targets in the Threatened Species Strategy drive activity that complements the objectives and actions in the plan.

1.1 Threat abatement plans

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for the identification and listing of key threatening processes. In 1999, with the commencement of the Act, predation by feral cats was listed as a key threatening process and a threat abatement plan developed.

The Australian Government develops threat abatement plans with assistance from other governments, natural resource managers and scientific experts, and facilitates their implementation. To progress the main actions within the threat abatement plan, the Department of the Environment relies on partnerships and co-investments with other government agencies, industry and other stakeholders. An important part of implementation of the threat abatement plan is ensuring that knowledge of improved abatement methods is disseminated to potential users.

Mitigating the threat of invasive species is not only a matter of providing better technical solutions such as improved baits for pest animal management. It also involves understanding and addressing social, legal and economic factors; for example, through supporting the efforts of private landholders, leaseholders and volunteers to manage invasive species on their lands to achieve the desired outcomes for biodiversity conservation and primary production. In addition, research and development programs for managing vertebrate pest species need to integrate interests relating to both primary production and environmental conservation.

Regional natural resource management plans and site-based plans provide the best scale and context for developing operational plans to manage invasive species. They allow primary production and environmental considerations to be jointly addressed, and allow management to be integrated across the local priority vertebrate pests within the scope of other natural resource management priorities.

The national coordination of pest animal management activities occurs under the Australian Pest Animal Strategy. The Invasive Plants and Animals Committee, comprising representatives from all Australian, state and territory governments, has responsibility for implementation of the strategy. This threat abatement plan provides guidance for the management of feral cats within that broader context.

1.1.1 The review of the 2008 threat abatement plan

In accordance with the requirements of the EPBC Act, the threat abatement plan for predation by feral cats (DEWHA, 2008a) was reviewed in 2014 by the Department of the Environment (Department of the Environment, 2014).

This document replaces the 2008 threat abatement plan. It incorporates the knowledge gained in the intervening years and has been modified in line with recommendations from the review. The threat abatement plan aims to guide the responsible use of public resources and the best outcome for native species and ecological communities threatened by predation by feral cats. The plan seeks to achieve these outcomes by recognising the opportunities and limitations that exist, and ensuring that field experience and research are used to further improve management of feral cats. The activities and priorities under the threat abatement plan will need to adapt to changes as they occur.

1.1.2 Involvement of stakeholders

The successful implementation of this threat abatement plan will depend on a high level of cooperation between landholders, non-government organisations, community groups, individual volunteers, local government, state and territory conservation and pest management and research agencies, and the Australian Government and its agencies. Success will depend on all participants assessing cat impacts and allocating adequate resources to achieve effective on-ground control of feral cats at critical sites, improve the effectiveness of management programs, and measure and assess outcomes for threatened species and biodiversity more broadly. Various programs in natural resource management, at national, state and regional levels, can make significant contributions to implementing the plan. In particular, regional natural resource management plans can identify links and contributions between their pest animal management actions and this threat abatement plan.

1.2 Threat abatement plan for predation by feral cats

Section 1.2 provides an overview of the threat, impacts and management of predation by feral cats. The background document should be referred to for further information.

1.2.1 The threat

Feral cats are a serious vertebrate pest in Australia, and have severe to catastrophic effects on native fauna (Woinarski et al. 2014).

Predation of native species by feral cats is the focus of threat abatement and this plan. However, feral cats also have impacts, although lesser, through competition and disease transmission. These are incorporated into actions within the plan to ensure a holistic approach is taken to managing the impact of feral cats.

The first recorded instance of cats being brought to Australia was by English settlers in the 18th century with feral cats spreading across the continent by the 1890s (Abbott 2002, Abbot 2008). Cats were deliberately released into the wild during the 19th century to control introduced rabbits and house mice (Rolls 1969). Today feral cats are distributed through all habitats in mainland Australia and Tasmania and on some offshore islands.

It is very difficult to accurately estimate the number of feral cats in Australia because feral cat density varies significantly depending on rainfall, food availability, presence of other predators and other factors. There have been a number of estimates of the density of cats based on studies from different areas of Australia; Denny and Dickman (2010) list some published figures up to 2010. These estimates provide an idea of cat densities in that particular habitat (e.g. mallee, desert, temperate forest) and at that point in time. Some of these studies, such as Burrows and Christensen (1994), provide drought and non-drought estimates, and some, such as

Jones and Coman (1982), provide winter and summer estimates. In the past, these estimates have been extrapolated to all habitats across Australia to provide an estimate of the number of feral cats nationally. Instead of attempting to accurately estimate how many feral cats there are across all of Australia, there should instead be better estimates of the impact that feral cats are having on threatened and non-threatened native fauna. Doherty et al. (2015) state that reducing the impacts of feral cats is a priority for conservation managers across the globe, and success in achieving this aim requires a detailed understanding of the species' ecology across a broad spectrum of climatic and environmental conditions. Predation by feral cats is recognised as one of the primary factors in the decline and extinction of a number of native mammal species in Australia (Woinarski et al. 2014).

Adult feral cats weigh three to five kilograms on average (Read & Bowen 2001; Johnston et al. 2012, Johnston et al. 2012a; Johnston et al. 2013). Feral cats are carnivores and can survive with limited access to drinking water because they can consume adequate moisture from their prey: small and medium-sized mammals, birds, reptiles, amphibians, fish and invertebrates. Feral cats will also consume carrion when live prey is scarce, and some smaller amounts of vegetation.

Feral cats are solitary and predominantly nocturnal (some may be more crepuscular – that is active during twilight hours – or even diurnal in colder areas or months of the year), spending most of the day in burrows, logs or rock piles. They occupy home ranges that vary from less than one square kilometre up to 20–30 square kilometres in areas of scarce resources (Molsher et al. 2005; Moseby et al. 2009; Buckmaster 2011). Mature (one year or older) feral cats can breed in any season and may produce two litters per year (Jones & Coman, 1982), each of about four kittens, however, few kittens survive (Denny & Dickman, 2010 provide a review of all the studies estimating litter size).

Cats can be grouped into categories according to how and where they live. The definitions and categories used vary widely, so the following terms are used for the purposes of this plan:

- *feral cats* are those that live and reproduce in the wild (e.g. forests, woodlands, grasslands, deserts) and survive by hunting or scavenging; none of their needs are satisfied intentionally by humans;
- *stray cats* are those found in and around cities, towns and rural properties; they may depend on some resources provided by humans but are not owned; and
- *domestic cats* are those owned by an individual, a household, a business or corporation; most or all of their needs are supplied by their owners. If the confinement of domestic cats becomes more common, the category of a domestic cat may need to be divided to confined and unconfined cats because the potential for these two groups to impact on native fauna is different.

These categories of cats are artificial and reflect a continuum, and individuals may move from one category to another (Newsome 1991; Moodie 1995). In any given situation, the category causing the most damage to wildlife needs to be identified because management actions will depend on the type of cat causing the damage. Where domestic cats are the primary cause, management is likely to concentrate on owners and consist of promoting responsible ownership through education and local or state/territory legislation. For feral cats, the focus is on reducing numbers or inhibiting predation through the use of mechanical, chemical or biological methods. Management of stray cats often requires a combination of technical and social approaches. It is noted that in some remote Indigenous communities the complex relationships between people, families, groups and their companion animals may require a different approach to addressing the problem of predation by feral cats. The approach taken will need to be developed in consultation with the communities.

This plan focuses primarily on managing the negative impact of feral cats. Broadly, native species listed as threatened under the EPBC Act that are susceptible to cat predation affecting their populations, are located in areas where domestic and stray cats are absent or in much lower numbers. It is generally accepted that improvements in the management of domestic and stray cats are necessary near human habitation and these improvements may reduce recruitment to the feral cat population. For eradication and control efforts to be sustained, the transition of cats from domestic or stray to feral must be prevented so that feral cat populations are not enhanced or new populations established.

Feral cats occur on Commonwealth land, such as Department of Defence properties and Commonwealth-managed national parks. On a national scale, however, management of feral cats on Commonwealth land is only a small part of the larger picture of conserving threatened species affected by cat predation. Many state and territory wildlife agencies have a history of research into and practical on-ground management of feral cats. In addition, private sector and community initiatives also contribute to feral cat management activities.

1.2.2 The impacts

Feral cats are recognised as a potential threat to 74 mammal species and sub-species (Woinarski et al. 2014), 40 birds, 21 reptiles and four amphibians. The mammal species and subspecies are identified in the 2014 Mammal Action Plan (Woinarski et al. 2014). The birds, reptiles and amphibians are all listed as threatened under the EPBC Act, and there are 19 bird species listed as migratory or marine whose profiles identify predation by feral cats as a threat (see Appendix A). It should be noted that the impacts of predation by feral cats is not restricted to these species.

Cats have direct negative impacts on native fauna through predation (Copley, 1991; Dickman 1994; Dowling et al. 1994; Risbey et al. 2000; Coutts-Smith et al. 2007; Dickman, 2009). They prey on mammals, birds, reptiles, amphibians and invertebrates depending on resource availability. Live prey is almost the sole source of food for cats. Mammals tend to be the dominant prey item when available. They also eat introduced mammals including rabbits, hares, rats and mice (Risby et al. 1999; Read & Bowen 2001; Holden & Mutze 2002; Doherty 2014).

Feral cats have contributed to the extinction of many small to medium-sized mammals and ground-nesting birds in the arid zone, and have seriously affected or caused extinction of populations of species such as mala and woylie. (e.g. Gibson et al 1994; Start et al. 1995; Department of the Environment 2015a). The ongoing decline of small mammals across northern Australia to very low numbers is also believed to be due, in a major part, to predation by the feral cat (Gibson et al. 1994; Christensen & Burrows 1995; Fisher et al. 2013; Frank et al. 2014; Woinarski et al. 2014).

Typically, terrestrial vertebrates consumed by feral cats will weigh less than 220 grams (Dickman 1996) but individuals up to three to four kilograms (Fancourt 2015) are at risk. Birds are also a major prey item with species up to 200 grams being taken, mostly ground-dwelling birds. Reptiles are also an important dietary component, especially in arid areas (Doherty et al. 2015). Examples of other prey items include grasshoppers, centipedes, fish, frogs, freshwater crustaceans and marine turtle hatchlings (Doherty et al. 2015). Some cats become specialists in particular types of prey while others remain generalists (Dickman & Newsome 2014).

Feral cats have direct and indirect impacts on native predators. Dasyurids, such as quolls, may be killed by feral cats and have a dietary overlap. As well as quolls, other native predators such as raptors and varanids may also compete with feral cats for dietary resources (Sutherland et al. 2011; Debus, 2012).

Feral cats in Australia are hosts to a number of disease-causing agents including viruses (three species), bacteria (>40 species), fungi (>17 species), protozoa (21 species), helminths (26 species) and arthropods (19 species) (Moodie 1995). Some of these can be transmitted to native species, particularly mammals, and also humans. *Toxoplasma gondii* is one significant protozoan species that uses the cat as the definitive host and is particularly concerning for native Australian mammals, and immunocompromised people and pregnant women (Gebremedin et al. 2013). Abortions or pre-natal transmission to offspring can occur in livestock following infection with *Toxoplasma gondii* (Hartley & Marshall, 1957; Buxton et al. 2007; Pam et al. 2014) and one possible impact of the disease in some native animals is the loss of a sense of fear making these animals more vulnerable to predators (Hutchinson et al. 1980; Webster et al. 1994; Berdoy et al. 2000; Vyas et al. 2007). The tapeworm *Spirometra erinacei* also parasitizes the cat as a definitive host and has been recorded in a wide range of native mammals (Adams 2003). For some livestock producing areas of Australia, sarcosporidiosis spread from feral cats can be a significant economic cost due to cysts in sheep muscles that result in carcass downgrades or rejection by abattoirs (Bomford & Hart, 2002). This organism can infect a wide range of mammals.

1.2.3 Managing the threat

As feral cats are so thoroughly established in Australia, the focus of management is generally on impact abatement rather than eradication. Control of cats is difficult as they are found in very low densities and have large home ranges, making them difficult to locate. They are also extremely cautious in nature, making them hard to cost-effectively control with traditional measures such as shooting and trapping. Fenced enclosures are a resource-intensive but effective way to control feral cat impacts in these restricted areas, as is the eradication of feral cats from offshore islands.

As a control technique, shooting is more effective if applied for an extended period or timed strategically. Shooting is most likely to be humane when the shooters are experienced, skilled and responsible (Sharp 2012a). However, because shooting is expensive, labour intensive and time consuming it is typically only done on a relatively small scale.

Feral cats are caught live using either leg-hold traps or cage traps. Leg-hold traps used in Australia have padded jaws. As at 2015, leg-hold traps for feral cats are not permitted in all states and territories. Cage traps can also be used for trapping stray and domestic cats around rubbish dumps and in nature reserves close to urban development. To successfully trap feral cats, the lure or attractant chosen is important, with individual feral cats preferring different styles of lure or some feral cats may not be attracted by any lures. There are other control methods in development, such as automated grooming traps, that are not dependent on a lure. Like shooting, trapping as a control method requires skilled operators, is usually expensive, labour intensive and time consuming, and is only recommended on a small scale or where eradication within an area safe from further immigration (e.g. an island or fenced area) is the objective.

Baiting for feral cats is a broad-scale technique that has potential to reduce feral cat populations over larger areas. However, feral cats prefer live prey and will only take carrion (baits) when other resources are scarce (Christensen et al. 2012). The baits must also be laid on the surface as feral cats, unlike wild dogs/dingoes or European red foxes will not dig up a bait. The Eradicat® bait is injected with 1080 and may be used in Western Australia. This bait is effective when applied strategically to target the feral cats when they are hungry (Christensen et al. 2012; Algar et al. 2013). A second type of bait, Curiosity®, with the toxin PAPP (para-aminopropiophenone) has the toxin encapsulated in a hard plastic pellet. Curiosity® bait is designed for use where there are non-target species that would be placed at risk by the Eradicat® bait and is anticipated to be available for use during the life of this threat abatement plan (Hetherington 2007; Johnston et al. 2012; Johnston et al 2014). The PAPP toxin also has the benefit of a greater level of humaneness than 1080 toxin, but does have different non-target species risks. Research and development is ongoing into other baits, such as Hisstory (using encapsulated 1080), to ensure the availability of this control technique across all of Australia.

Predator-proof or exclusion fencing is used as an effective management technique for small populations of threatened species vulnerable to terrestrial predators, such as feral cats, European red foxes and wild dogs (Robley et al. 2007; Hayward et al. 2014). To minimise the risk of breaches to the fence integrated baiting, trapping and shooting in the area surrounding the fence may be needed to reduce the frequency of challenge to the fence by predators. Fencing also affects the movement of other wildlife, preventing their dispersal and interbreeding with other populations. Fencing is expensive and requires ongoing maintenance to ensure its predator-proof integrity.

Interactions between pest species mean that control of feral cats can have flow-on effects on other invasive animals, such as rabbits, rats and mice, that feral cats may have otherwise preyed on. For example, rabbit populations may require managing in conjunction with the feral cats. If feral cats are consuming rabbits as major prey items, rabbit numbers could potentially increase with feral cat control. The converse is also possible with rabbit control potentially affecting feral cat abundances. The interactions between the introduced predators (wild dog, European red fox, cat) and native predators may also influence the design of a control program. An understanding of these potentially complex ecological interactions is important when designing and recommending pest animal control programs, and in many situations, concurrent multi-species programs will be required. Integrating control techniques may also maximise the success of management programs.

Although total mainland *eradication* may be the ideal goal of a feral cat threat abatement plan, it is not feasible with current resources and techniques. Feral cat populations must instead be suppressed and managed to mitigate impacts in targeted areas where they pose the greatest threat to biodiversity. In doing so, care must be taken to ensure that the suppression and management techniques being employed are actually meeting the goal of improving biodiversity. In addition, eradication may be achievable in isolated areas, such as small reserves, peninsulas and offshore islands. For example, cats were eradicated from Tasman Island in 2011 (Tasmanian Parks and Wildlife Service 2011). Progress in management programs must be monitored to ensure that objectives are met and to allow management options to be adapted to changing circumstances.

Best-practice management of feral cats must involve a reduction of the threat, not only to targeted threatened species, but also to other native species that may be affected by feral cat predation. For any given area this will require a determination of the level of feral cat control required, which should be measured through monitoring of population changes and native species recovery. It may be possible in some situations to instead measure a feral cat population reduction that can be linked to threatened species recovery.

2 Goal, objectives and actions

The goal of this threat abatement plan is to minimise the impact of feral cats on biodiversity in Australia and its territories by:

- Protecting affected threatened species; and
- Preventing further species and ecological communities from becoming threatened.

To achieve this goal, the plan has four objectives, developed through the review (Department of the Environment 2014) of the previous threat abatement plan and consultation with experts. These objectives are to:

1. Effectively control feral cats in different landscapes;
2. Improve effectiveness of existing control options for feral cats;
3. Develop or maintain alternative strategies for threatened species recovery;
4. Increase public support for feral cat management and promote responsible cat ownership.

Each objective is accompanied by a set of actions, which, when implemented, will help to achieve the goal of the plan. Performance indicators have been established for each objective.

The sections below provide background on each objective, followed by a table listing the actions required to meet the objective. Twenty-two actions have been developed to meet the four objectives.

Priorities for each action are given in the tables below, categorised as 'very high', 'high' or 'medium'. Each action has also been assigned a timeframe within which the outcome could be achieved once the action has commenced. Timeframes are categorised as short-term (i.e. within three years), medium-term (i.e. within three to five years) or long-term (i.e. taking five years or longer). The expected output and outcome from implementation of the action is described. Where there is a clear party identified as responsible for the implementation of the action (be this a government, organisation or group of individuals) this is noted. The identification of responsibility should not be taken as excluding the involvement of other parties where needed. By articulating these actions, this threat abatement plan allows partnerships to be formed around activities that will have the greatest impact. Through partnerships between governments, non-government organisations, scientists, community groups, regional groups, and individuals, the best outcomes for threatened species under threat from predation by feral cats will be achieved.

Most actions within the plan will require investment to achieve the outcomes. Section 3.2 of the plan discusses investment in the plan and provides some estimates of costs anticipated or known at the time of the plan's development. These have been placed in a separate section because it is difficult to fully cost the implementation of each action because of unknown variables.

The actions have a strong focus on encouraging and facilitating practical interventions and providing control options for feral cats, and have been divided amongst the four objectives. However, there is overlap for some actions between the different objectives and readers may determine that an action would provide them a better outcome under an alternative objective. For example, the development of alternative strategies to conventional control will assist in effectively managing feral cats in different landscapes.

Objective 1 Effectively control feral cats in different landscapes

Predation by cats is a threat that needs to be interpreted and managed according to the landscape type and particular pressures in the area being managed. The landscape in which feral cats are being managed will determine which tools are most effective to use (for example, management in an alpine boulder field will be quite different to a tropical floodplain). Timing of management is also critical to achieve threatened species protection (for example, timing to protect ground nesting birds, or in anticipation of or at the end of

mouse/rat/rabbit plagues when the abundant feral cats are switching to other prey resources such as small threatened mammals). Site specific characteristics also need to be taken into account including the potential for immigration of new cats to the area, other management actions that are being undertaken (for example, prescribed burning) and other predators being controlled (for example, European red foxes) or conserved (for example, dingoes). The degree of control required to achieve the desired outcome (for example, recovery of threatened species) must also be determined. Ensuring the management plan is interpreted and appropriately implemented for the area is important so that control programs for feral cats achieve the outcome of reduced predation of threatened and near-threatened native species, and other native species.

While this threat abatement plan is focused on the impact on biodiversity, feral cats also have an impact on agriculture through spreading disease and on tourism by reducing the numbers of unique Australian species to be seen.

This objective builds on two ongoing research streams: first, research into new control options that will reduce land managers' expenditure on time-intensive, skilled labour; and secondly, research on the roles of feral cats within landscapes and how a range of land management practices may be used or manipulated to exert additional control pressure on feral cats. This can include possible suppression by other predators, exploitation by feral cats of phenomena such as fire and prey irruptions, the sites to which cats and/or their prey retreat during harsh conditions such as drought, and the role of cat-borne diseases. When research and development are being undertaken, evaluation of the success of control options for feral cats needs to consider how the biodiversity outcomes can be monitored as well as knowing how many feral cats have been killed or the change in their abundance/activity.

Action 1.1 Ensure broad-scale toxic baits targeting feral cats are developed, registered and available for use across all of Australia, including northern Australia

Land managers require effective tools for achieving feral cat control. These have been lacking on a broad-scale for feral cats with shooting, trapping and fencing being the main options available.

In 2014, a toxic bait (Eradicat®) was made available for use on Western Australian lands managed by or in agreement with the Western Australian Department of Parks and Wildlife. Eradicat® represents an additional tool for that state. Eradicat® contains the toxin 1080 (sodium monofluoroacetate) directly injected to the sausage bait (Algar et al. 2013). The Eradicat® baits can be surface laid in southern Western Australia with minimal risk to native animals that may consume the baits because native species in this area have a degree of tolerance to the toxin. This is because some plants in Western Australia naturally contain the toxin allowing tolerance to develop in the native species.

In the rest of southern and central Australia, with the exception of Tasmania, a new bait (Curiosity®) is being developed for use. Instead of directly injecting the sausage bait, the Curiosity® bait encapsulates the toxin para-aminopropiophenone (PAPP) in a hard plastic pellet to reduce the risk to non-target native species that may eat the sausage bait. Most of these non-target species have been shown to reliably reject the hard plastic pellet while eating the bait (Department of the Environment 2015a). During the life of this threat abatement plan it is expected that the Curiosity® bait will be registered for use.

In northern Australia and Tasmania, neither Eradicat® nor Curiosity® are suitable for use due to risks to the non-target species of varaniids (goannas) and Tasmanian devils (*Sarcophilus harrisi*). However, a variation to the existing baits — Hisstory — is likely to be suitable. The Hisstory bait encapsulates the the toxin 1080 instead of PAPP, because varaniids and Tasmanian devils are tolerant to it. It is intended that Hisstory will be able to be laid where varaniids and Tasmanian devils are active but still provide protection for other non-target native species. The Hisstory bait still requires additional research and development.

There is additional information on baiting for feral cats in the background document and Department of the Environment website.

It should be noted that with all of the toxic baits it will be necessary for land managers to determine the risk to valued, non-target fauna at a particular site based on guidance from bait manufacturers. As with any feral animal control tool or program, it is not possible to reduce all the risks to zero, and land managers must consider this in designing their baiting programs. Specifically, dingoes may be at risk if multiple toxic baits intended for feral cats are consumed.

As with Eradicat® baits, governments will be required to restrict access to toxic baits and areas where they may be applied in order to maximise target specificity of baiting programs for feral cats, similar to other introduced predator control programs. Bait suppliers will also need to ensure that users understand the suitable environmental conditions for putting out baits so that they are effective.

Action 1.1 seeks to ensure that toxic baits are registered and available for feral cat control across all of Australia. It should be emphasised that baiting is not the complete answer to feral cat control but rather is another promising tool which can be applied in a broad-scale manner.

Action 1.2 Develop and register other cat control tools, including devices exploiting cat grooming habits

Action 1.2 recognises that scientists have been investigating a number of devices for cat control utilising particular traits of cats such as their fastidiousness for grooming. The designs of these devices are able to distinguish non-target species. These tools may be particularly useful in some locations where cat activity in the landscape is restricted; for example along animal trails through thick vegetation or alongside watercourses, or where non-target species are vulnerable to other control techniques (Moseby et al. 2011). Another potential techniques being investigated is using encapsulated toxin implanted in threatened species or collars on the threatened species containing a toxin to kill any feral cat or other predator that may specialise in preying upon that threatened species. As with Action 1.1, this action focuses on getting these tools to land managers for use within cat control programs. Although not an explicit action, ongoing improvements to the design and operation of existing management options for feral cats are also important. Exclosure fence designs are an example where refinements continue to be made for different situations.

Action 1.3 Continue research into understanding interactions between feral cats and other predators: (i) in different landscapes; and (ii) any potential beneficial/perverse outcomes if other predator populations are modified

Feral cats have natural enemies or competitors in the form of other mammalian predators – the European red fox, wild dogs/dingoes (*Canis* species) and Tasmanian devils will all kill feral cats. These species and quolls will compete with feral cats for food resources. Section 1.3 in the background document provides information on competition between feral cats and other species. For the purposes of this threat abatement plan wild dogs and dingoes are considered together because they freely inter-breed and there is a continuum of animals across the continent that contain varying degrees of dog and dingo DNA (Stephens, 2011). A great deal of recent research has focussed on interactions between feral cats and these other predators. Section 3.3 in the background document provides further information about the relationship between wild dogs/dingoes and feral cats. Although much of this work is ongoing and is not conclusive enough to make any broad-scale recommendations, an important theme is that relationships between the mammalian predators can vary in space and time. In some places European red foxes and/or dingoes seem likely to suppress feral cats (i.e. their numbers, behaviour or both) whilst in other parts of Australia one species appears to have little or no affect on the other (e.g. Fleming et al. 2012; Johnson and Ritchie 2012; Kennedy et al. 2012; Wang and Fisher 2012; Allen et al. 2014; Allen et al. 2014a; Greenville et al. 2014). Further understanding these relationships, through research, is the focus of Action 1.3 so that land managers can make informed decisions about predator interactions when designing and implementing effective local management programs.

Action 1.4 Continue research into understanding the role of other major landscape modifiers, such as fire or grazing by introduced herbivores, in feral cat activities and control

Other landscape modifiers such as grazing, woody weeds and introduced grasses have a less obvious impact on predation by feral cats. However, these modifiers can affect feral cat hunting behaviour and success in positive and negative ways. Cats will respond to changes in landscapes through population changes or activity changes, including in response to:

- natural phenomena (for example: prey irruptions such as plague rat (*Rattus villosissimus*) and mice (*Mus musculus*) following good rains);
- landscape management (for example: prescribed burning or land clearing); and
- management programs for other invasive species (for example: an increase in rabbit numbers due to declining effectiveness of biocontrols may provide additional food for feral cats (Doherty et al. 2015)).

Research is providing insights into these responses, such as the preferential use by feral cats of areas recently burnt with high intensity fires to get easy access to prey species that have no vegetation cover to hide in (McGregor et al. 2014). This knowledge is valuable for land managers to adapt management programs for feral cats in order to exploit these responses, although this should not be to the detriment of the overall biodiversity outcomes sought. Action 1.4 seeks to provide what is known to land managers, and continue this research and provide it to land managers. Overlaid on the responses of feral cats to landscape changes is the changing climate due to global warming, which will need to be taken into account.

Action 1.5 Continue research into the scale, efficiency, cost-effectiveness, sustainability and risks of feral cat control options

When designing a program for feral cat management it is important to understand the scale of control required, the cost-effectiveness of the method/s being employed and their long-term sustainability. Action 1.5 is aimed at further improving our knowledge of how much and when to undertake control; the short and long term efficiency of that control, especially with feral cats immigrating from outside the site; the cost-effectiveness of the control for the threatened species (or other matter being protected) and what combinations of control methods may work best in different locations. Included in any program must be monitoring to understand the outcome for the program, such as the recovery of a particular threatened species. An element of this research is to examine the effectiveness at a suitable scale and the comparative cost of creating a feral cat (and other predator) free area through intensive predator control in the surrounding area to prevent immigration of new animals. The potential for perverse outcomes, such as low level control leading to an increase in feral cat numbers, needs to be understood (e.g. Lazenby et al. 2015). As mentioned in the previous section, this knowledge must focus on the recovery of threatened species as well as the control of feral cats. This information on program design should be provided to land managers in order for ongoing effective delivery of the management program.

Action 1.6 Continue development of new or enhanced attractants for cats to improve cat control and monitoring. Ensure availability of any attractants that are developed

Robust monitoring of feral cats can be difficult because of their dispersed spread and occurrence at low densities. In some circumstances it is necessary to use lures to attract cats into monitoring locations and control locations (e.g. traps). Although a range of visual, olfactory and auditory lures have been developed to attract feral cats; all lures are only partially successful. Action 1.6 identifies the development and assessment of other lures so that land managers get better results with their monitoring or control.

Action 1.7 Research into other control and monitoring technologies and enhancing available technology

Action 1.7 identifies the need for ongoing research into new control and monitoring tools. Included in the new control tools is support for the development or provision of humane killing methods, particularly for small community groups where the current options (e.g. shooting, lethal injection administered by a vet) are not available or are too expensive/inhumane.

There are two elements to the monitoring tools. Firstly, there is a need for simple, low cost and low effort monitoring tools for small community groups with few resources. These monitoring tools should be accompanied by education to ensure the community groups can use them effectively. These monitoring tools should be accompanied by education to ensure the community groups can use them effectively. Secondly, there is a need to develop or enhance cost-effective monitoring technologies for feral cats more broadly and, where possible, collate the results. Further to this, a greater understanding of the links between feral cat numbers and impacts will allow land managers to know the appropriate level of control required. Unfortunately, there may be instances where the majority of the impact is caused by one or two individuals that have specialized in a particular prey item (e.g. the threatened species).

Action 1.8 Re-investigate diseases and other potential biocontrol agents, biotechnology and immunocontraceptive options for cats, and commence research on promising options. Undertake social research on promising options to gauge community support

Biological control agents such as cat-specific diseases have been reviewed in the past (e.g. Moodie 1995). However, with new techniques, a greater capacity to gather international information, and the possibility of other emergent diseases, it is appropriate to undertake a new review to search for biological control, and immunocontraceptive options.

In addition, the field of biotechnology has platform technologies that may be applicable to feral cat sterilization. Outlined in the background document is information about the emerging technology of RNA-guided gene drives. While this technology is still only in its infancy for applications in vertebrate pest species there is potential for population suppression through guiding changes to particular genes that alter the sex bias of new animals or sensitize a species to a particular toxin. It should be noted that this is a long-term potential technology and is not likely to be realized for feral cat control within the life time of this threat abatement plan.

These ideas are captured in Action 1.8. The search for new biological tools, and any subsequent research on promising agents or biotechnology options, will need to consider the risk to and protections for domestic cats and to other felid species internationally should the agent or technology escape from the country. In addition, the potential suffering of the feral cats must also be taken into account as a biological control that involves prolonged suffering is unlikely to be accepted for release. If a promising agent or technology is identified, social research would need to be undertaken to ensure there would be community understanding and support for a potential release. An effective method for gauging community support could be via a deliberative process of decision-making (for example an iterative approach using a focus group or citizen jury to listen to experts, discuss the rationale for their views, and modify their views following the discussion and feedback).

Captured within this action is also the concept of an indirect control for feral cats through a reduction in abundance of some of their introduced prey species (ie. rabbit, black rat, house mouse), which may be done through improved biological controls for those species.

Action 1.9 Code of Practice and/or Standard Operating Procedures developed for new tools and agreed by governments

There is a nationally agreed *Code of practice for the humane control of feral cats* (Sharp & Saunders 2010) and Standard operating procedures for ground-shooting of feral cats, trapping of feral cats using cage traps and trapping of feral cats using padded-jaw traps (Sharp 2012a; Sharp 2012b; Sharp 2012c). As new tools become available the code of practice will require updating and new standard operating procedures may be required.

Standard operating procedures will also require updating as technology changes (e.g. suitable firearms). In particular, standard operating procedures are required for baiting with the different toxins, 1080 and PAPP, and for feral cat-proof fencing. Note that state or territory legislation must also be complied with when managing feral cats. In developing a new code of practice or a standard operating procedure the tool should be assessed through the model for assessing the relative humaneness of pest animal control methods (Sharp & Saunders 2008). Action 1.9 seeks updates to the code of practice and updates or new standard operating procedures, in consultation with all stakeholders (government and non-government), and endorsement by all governments through the national biosecurity system.

Performance indicators

- Additional tools, including toxic baiting, are included as elements of effective management programs for cats in all states and territories.
- Broad-scale toxic bait available for use in all Australian environments.
- Interactions between predator species are well understood and, if suitable, actively incorporated into management programs for feral cats.
- The role of other major landscape modifiers is understood and, where suitable, these are exploited in management programs for feral cats.
- New or enhanced attractants available for feral cat monitoring and used within control programs.
- New research or continuing research projects addressing the difficulties of effective and efficient control and monitoring of feral cats undertaken and published.
- Monitoring of feral cats undertaken and results nationally reported (e.g. via Feral Catscan or the Atlas of Living Australia).
- Contemporary understanding gained of potential biocontrol agents and biotechnology options for feral cats. Community support for promising options measured.
- Standard operating procedures (SOP) developed for new tools and the code of practice (COP) updated to include these. SOPs and COP agreed and adopted by governments.

Action	Priority and timeframe	Output	Outcome	Responsibility
1.1 Ensure broad-scale toxic baits targeting feral cats are developed, registered and available for use across all of Australia, including northern Australia.	Very high priority, medium term	Toxic baits available to registered users	Effective broad scale control programs using toxic baits can be undertaken in conservation areas	Bait developers and governments
1.2 Develop and register other cat control tools, including devices exploiting cat grooming habits.	Very high priority, medium term and ongoing	Tools available to registered users	Effective control programs using the tool can be undertaken	Tool developers and governments
1.3 Continue research into understanding interactions between feral cats and other predators: (i) in different landscapes; and (ii) any potential beneficial/perverse outcomes if other predator populations are	Very high priority, medium term	A clear understanding of how other predators influence and are influenced by management	If suitable, land managers are able implement management programs for cats that have regard to other	Researchers and land managers

Action	Priority and timeframe	Output	Outcome	Responsibility
modified.		programs for feral cats	predators	
1.4 Continue research into understanding the role of other major landscape modifiers, such as fire or grazing by introduced herbivores, in cat activities and control.	Very high priority, long term	An understanding of how other landscape modifiers may impact on cat predation	Land managers are able to understand the impacts of landscape modifiers to better implement cat management programs.	Researchers and land managers
1.5 Continue research into the scale, efficiency, cost-effectiveness, sustainability and risks of feral cat control options	High priority, medium term	Knowledge about effective feral cat control options suitable for different sites	Land managers are able to understand the complexities of different control method choices and implement effective options.	Researchers and land managers (including groups, NRM bodies and individuals)
1.6 Continue development of new or enhanced attractants for cats to improve cat control and monitoring. Ensure availability of any attractants that are developed.	Medium priority, medium term	New or enhanced attractants available	More effective control and monitoring for cats	Researchers for development and product manufacturers
1.7 Research into other control and monitoring technologies and enhancing available technology	Medium priority, long term - ongoing	New tools for control and monitoring of cats	Greater range of options for land managers to control and monitor cats	Researchers and product manufacturers
1.8 Re-investigate diseases and other potential biocontrol agents, biotechnology and immunocontraceptive options for cats, and commence research on promising options. Undertake social research on promising options to gauge community support.	High priority, long term - ongoing	Report outlining potential biocontrol options for cats. If appropriate, a long-term research project commenced.	Stakeholder understanding of the potential for biocontrol for cats. Start of research into promising biocontrol agent(s).	Government and researchers
1.9 Code of Practice and/or Standard Operating Procedures developed for new tools and agreed by	High priority, short-medium term.	Code of Practice or Standard Operating	Control of feral cats is undertaken in	Product developers and governments

Action	Priority and timeframe	Output	Outcome	Responsibility
governments	Ongoing for new tools as they are developed.	Procedures available for all control tools	an effective manner as humanely as possible	

Objective 2 Improve effectiveness of existing control options for feral cats

Objective 2 focuses on delivering management options to land managers and ensuring they are able to conduct control programs effectively according to current best practice techniques and knowledge. Linking land managers with the outputs from research will improve programs for threatened species recovery where predation by feral cats is a contributing factor. In this threat abatement plan land managers are considered to encompass any person or group that has a responsibility for land management including individual land owners, community groups, Indigenous people caring for their country, non-government organisations, NRM bodies, and government agencies managing parks and reserves.

Action 2.1 Understand motivations and provide incentives for land managers to include feral cat management into standard land management for biodiversity outcomes

Land managers are typically very busy with competing priorities for management activities and this action is intended to provide improved support for these people and groups. Action 2.1 is a behavioural science focused action to determine the motivations and best incentives (and possible penalties if necessary) to encourage land managers to include a cat management program into their many activities. Understanding what is required to build and maintain social licence and pressure to control feral cats can help governments and other agencies to provide leverage for feral cat control. This action can include groups of people across tenures or action by volunteer groups for land managers to conduct feral cat control programs. Naturally, the outcome of this action will assist in the delivery of training material in Action 2.2 below.

Action 2.2 Provide information, in various media and through training, on best practice methods and standard operating procedures for controlling and monitoring feral cats

Action 2.2 focuses on providing training material to land managers, community groups etc. so that they can access information on the best way to undertake both monitoring and control for feral cats in their landscape. Land managers are rarely experts on feral cats so being able to provide this information will take the guesswork out of when and how to control and monitor. The information and training should be linked not only to the control of the feral cats but also to ensuring that the outcome (for example, recovery of a particular threatened species) is going to be achieved. It also provides an opportunity for researchers and land managers to collaborate to improve the on-ground outcomes, and for land managers to form collaborative links to undertake cross-tenure control programs.

There is information on feral cats, monitoring methods, and standard operating procedures on the PestSmart Connect website (Invasive Animals CRC) that may assist in the implementation of this action. Action 2.2 also has links with action 1.5 to provide an analysis of the costs and benefits of management strategies for feral cats so that land managers have an economic understanding of their actions.

Action 2.3 Ensure areas prioritized for feral cat management across to Australia maximize benefits to biodiversity at a local, regional and national level

The 2008 threat abatement plan contained an action to identify priority areas based on criteria linked to threatened species and ecological communities and a national prioritisation framework was developed (Dickman et al. 2010). The outcomes from this are still relevant. Action 2.3 takes this concept a step further to make sure that the scale of prioritisation is captured. For national threatened species recovery it is important to consider populations of the species across their entire range and prioritise threat abatement actions for important populations at threat from predation by feral cats. These particular sites may or may not be identified at a regional or local level due to other factors, or vice versa. An understanding of where it is critical to undertake feral cat management for threatened species will assist in more holistic cat management across Australia and provide decision-making guidance for national funding programs. Decision making should consider the costs and benefits for the different actions that may be required for each area.

Action 2.4 Governments agree to consistent legislation that identifies feral cats as a pest, has requirements for control, and identifies control techniques that may be used

Feral cats are not declared as a pest in legislation in all states and territories, and requirements for control of feral cats are variable across the country. While recognising the means of achieving pest status and control requirements does not need to be uniform, it is desirable that land managers are able to legally undertake, or have legislative support to undertake, effective control programs as needed. Action 2.4 seeks to gain support from all state and territory governments to consider their legislation and, if necessary, amend it to provide a mechanism for effective and efficient control of feral cats. An element of this action will be for governments to ensure that administrative requirements are practical and efficient so as to minimise any administrative burdens on land managers undertaking feral cat control programs.

Performance indicators

- Training material and information widely available, including via the internet, for land managers on effective management and monitoring techniques for cats. Training programs delivered in all states and territories by government agencies, non-government organisations, natural resource management groups, Invasive Animals Cooperative Research Centre or Centre for Invasive Species Solutions, and other appropriate organisations.
- Cat management programs for biodiversity are in place in prioritised areas.
- The abundance and/or impacts of feral cats are reduced in priority areas. To be measured through the recovery of threatened species in the area and a reduction in the abundance of feral cats (specific targets will be dependent upon the particular species and monitoring ability but should be identified in the relevant program plan).
- Consistent or complimentary legislation across all states and territories enabling effective control of feral cats.

Action	Priority and timeframe	Output	Outcome	Responsibility
2.1 Understand motivations and provide incentives for land managers to include feral cat management into standard land management for biodiversity	High priority, short term	Options for providing incentives to land managers	A greater proportion of land managers undertaking effective cat	Social scientists, social psychologists, and

Action	Priority and timeframe	Output	Outcome	Responsibility
outcomes		for cat control	management	governments
2.2 Provide information, in various media and through training, on best practice methods and standard operating procedures for controlling and monitoring feral cats	High priority, medium term	Training material is available to land managers on how to effectively control and monitor feral cats and their impacts	Land managers running management programs for feral cats can effectively design and adapt the program	Researchers in association with communications or education specialists to develop the material. Delivery by government, NGOs, NRM groups, Invasive Animals CRC or Centre for Invasive Species Solutions, and other appropriate organizations. Land managers for uptake.
2.3 Ensure areas prioritised for feral cat management across Australia maximise benefits to biodiversity at a local, regional and national level	Very high (for an initial reprioritisation) to medium priority, long term - ongoing	An understanding of how management programs provide effective threat abatement on all scales	A holistic approach to cat management for threat abatement	Governments in association with land managers conducting management programs and regional groups (e.g. NRM bodies)
2.4 Governments agree to consistent legislation that identifies feral cats as a pest, has requirements for control, and identifies control techniques that may be used	High priority - short term	Consistent legislation for feral cats	Land managers in all states and territories legally able to undertake effective control of feral cats	Governments

Objective 3 Develop or maintain alternative strategies for threatened species recovery

Objective 3 is focused on providing options where sustained control of cats using standard techniques is not possible or the degree of sustained control is insufficient to enable threatened species recovery. It is likely that any threatened species recovery program will need to incorporate a range of approaches to abate the threat. Also included in this objective is a consideration of the impact of disease transmission from feral cats to native animals and how this impact may be mitigated.

Action 3.1 Eradicate, or control, cats on offshore islands of high, or potentially high, biodiversity value

Action 3.1 emphasises the importance of islands in maintaining biodiversity. Cat eradication programs have been successful on a number of islands and similar programs are underway on at least two more large islands (Dirk Hartog Island and Christmas Island). These islands are or will become important refuges for reintroduced threatened species, or, in the case of Christmas Island have endemic species that are threatened. This action has the option for sustained control on off-shore islands. This is generally not cost-effective in the long-term but is included to acknowledge that there may be islands where, at the present time, it is not possible (for financial, resourcing or technical reasons) to completely eradicate feral cats. In these situations it may be worthwhile investing in a sustained control program where it enhances the survival of threatened species. Care should be taken to ensure that potential unintended consequences of cat eradication are considered for each island.

Action 3.2 Establish, enhance or maintain biosecurity measures for cat-free offshore islands to prevent incursions

Establishing or maintaining biosecurity measures for islands that do not have feral cats is critical. This may need to be reinforced through state or territory legislation. Action 2.2 addresses issues of provision of appropriate training and information to support and undertake biosecurity.

Action 3.3 Establish and maintain further fenced reserves ("mainland islands") for threatened species where it is identified cats cannot be controlled to the level required for threatened species recovery

Cats are present almost everywhere in the mainland Australian landscape so there are no natural mainland refuges that can be exploited for threatened species recovery. Instead, where a threatened species population is sufficiently threatened it may be possible to fence an area of habitat with a predator-proof fence. Action 3.3 recognizes predator-proof fencing as an important option for some of the most threatened species that are unlikely to survive without such action. Predator-proof fence designs are now standard but are expensive to build and require significant ongoing monitoring and maintenance. Note though that the ongoing monitoring and maintenance costs may be similar to other ongoing feral cat control methods. There may also be a requirement to manage overpopulation by some species confined to the fenced area.

Action 3.4 Research methods to understand thresholds of cat abundance required to improve survival rates for threatened species heavily preyed upon by feral cats. Research ways in which adaptation by threatened species may improve survival rates

Action 3.4 focuses on further research into alternatives to direct killing or complete exclusion of feral cats that can help threatened species populations to recover. Examples of alternatives may include research into how habitats can be manipulated (e.g. increase the structural complexity of vegetation, introducing plants containing toxins that native herbivores are tolerant to but will impact on feral cats preying upon those species), the use of guardian dogs (e.g. Marrema breed) or trained hunting dogs to protect threatened species populations, and the training or selection of traits within a species to make them more predator savvy. Directly linked to this action is Action 1.7 on understanding feral cat abundance and impact on threatened species in the landscape. As mentioned in Action 1.7, this research should be based on the understanding that some feral cats specializing in particular prey (e.g. Dickman & Newsome, 2014).

*Action 3.5 Continue research into cat diseases, including *Toxoplasma gondii* and sarcosporidiosis, their prevalence, ability to transmit to other species (including livestock and humans) their impacts, and ways to mitigate the impacts*

Cats in Australia carry a number of diseases that are transmissible to other species. The best known of these is toxoplasmosis, caused by a protozoan parasite called *Toxoplasma gondii*, of which felids are the only definitive host. In addition, other diseases including sarcosporidiosis are carried by cats, affect livestock and are important to understand. Action 3.5 acknowledges that the transmission of diseases from feral cats can have a deleterious impact on social and economic values, as well as biodiversity. While investigating diseases that also impact on livestock, and communicating the risk from feral cat-borne diseases to primary producers, it is also important to be mindful that the overall risk to the international disease-free reputation of Australian agricultural produce is not compromised. Through this action, the plan seeks to focus research into the impacts of these cat-borne diseases on other species including threatened species, other native animals, livestock and humans.

Performance Indicators

- Additional offshore islands cat-free or under sustained control programs.
- Implementation of effective biosecurity programs for all islands that are currently cat-free and at risk of a cat incursion.
- Further fenced reserves (“mainland islands”) created for threatened species most affected by predation.
- Research conducted into alternative ways to assist threatened species to avoid predation and published.
- Results of research into alternative ways to assist threatened species to avoid predation adopted by land managers as demonstrated through plans and reported techniques and outcomes.
- Cat borne diseases and their impact on other species, including native species and livestock, are better understood.
- The prevalence of cat borne diseases in native species is measured. Where there is a significant impact on a threatened species mitigation measures are instigated, and results measured and reported.
- The review by Moodie (1995) summarising the potential for biological control of feral cats including diseases is publicly available.

Action	Priority and timeframe	Output	Outcome	Responsibility
3.1 Eradicate, or control, cats on offshore islands of high, or potentially high, biodiversity value	Very-high priority, long term	Cats eradicated or under sustained control on offshore islands	Cat-free islands where threatened species can be recovered	Island owners or managers, including governments where they are managers
3.2 Establish, enhance or maintain biosecurity measures for cat-free offshore islands to prevent incursions	Very high priority, short term	Cat-free offshore islands have biosecurity measures	Cat-free islands remain cat free	Island owners or managers and all visitors
3.3 Establish and maintain further fenced reserves (“mainland islands”) for threatened species where it is identified cats cannot be controlled to the level required for threatened species recovery	Very high priority, medium term	Fenced reserves created and maintained for key threatened species populations	Preventing localised extinctions. Threatened species recovery for species under greatest pressure by predation by feral cats	Government and non-government conservation land managers

Action	Priority and timeframe	Output	Outcome	Responsibility
3.4 Research methods to understand thresholds of cat abundance required to improve survival rates for threatened species heavily preyed upon by feral cats. Research ways in which adaptation by threatened species may improve survival rates.	High priority, long term - ongoing	Use of alternative methods (to cat management actions or exclusion fencing) for threatened species protection	More resilient populations of threatened species to the effects of cat predation	Researchers
3.5 Continue research into cat diseases, including <i>Toxoplasma gondii</i> and sarcosporidiosis, their prevalence, ability to transmit to other species (including livestock and humans) their impacts, and ways to mitigate the impacts.	High priority, medium term	An understanding of cat diseases and their impacts	Impact of disease transmission from feral cats is mitigated	Researchers and land managers

Objective 4 Increase public support for feral cat management and promote responsible cat ownership

Objective 4 is particularly important for a species that is also highly valued as a domestic companion by many in the community. To gain or maintain support from the community to manage feral cats it is important to have ongoing education campaigns to raise awareness and change attitudes (as necessary) about the impact of predation by feral cats on threatened species and ecological communities. One of the significant challenges to overcome with this type of education is engaging different audiences in the right way. It is also important that the messages are believable, the source trustworthy and an emphasis placed on the contribution from the individual being valuable. This message must also include the emphasis that the threat is from predation of threatened species by feral cats, rather than cats intrinsically being bad.

Action 4.1 Quantify the proportion of the domestic and stray cat population that transitions to the feral cat population

All cats are the same species and may transition from domestic to feral and vice versa. However, it is poorly known what the contribution of domestic and stray cats are to the feral cat population, and the degree to which this has a significant impact on the threat of predation on threatened species. This is particularly the case for more remote communities or places where domestic cats are actively encouraged to hunt (e.g. farms for rodent control). A clearer understanding of how many domestic and stray cats make the transition will inform public education about responsible ownership or the control of stray cats.

It is noted that for some Indigenous communities the definitions of what is a domestic, stray and feral cat may be different, and a different approach to the management of these cats may be needed. However, these communities may also be able to quantify the transition of cats from domestic to feral in their area if consulted appropriately.

Action 4.2 Promote to and seek engagement of the community in: an understanding of the threat to biodiversity posed by cats and support for their management; an understanding of the transitions between domestic, stray and feral cats, and the need for responsible ownership; and support for the containment of domestic cats where their roaming may impact on identified conservation areas

Action 4.2 focuses on gaining community support on three elements. Firstly, as outlined above, an understanding of the biodiversity impacts posed by cats. Secondly, an understanding that all cats may transition from domestic to feral and vice versa. Incorporated into this understanding is the concept of responsible ownership, including responsibility for stray cats. An element of the need for responsible ownership is to investigate what the effective motivators are to enhance responsible domestic cat ownership in the community. Thirdly, while many de-sexed domestic cats tend to be more passive, domestic cats do negatively impact on native animals (e.g. Grayson & Calver 2004; Dickman & Newsome 2014). The last element seeks support for expansion of 24-hour containment requirements for domestic cats, particularly close to identified conservation areas of significance. Introduction of containment requirements must be done in such a way (e.g. implemented over time) that it does not cause an unnecessary financial burden on those who cannot afford the containment options, or lead to dumping of domestic cats as an unintended consequence. As with all types of government regulation, education and enforcement should necessarily accompany any changes.

Beyond our more urban areas, containment may not be an option in some more remote communities due to a general lack of infrastructure or resources, or different cultural attitudes towards cat-keeping. It is also acknowledged that in some rural settings, domestic cats are kept or stray/feral cats allowed to remain because they prey on mice and rats. For people living, visiting or moving to offshore islands, an understanding of the biosecurity risks and requirements related to cats is also required.

It must be noted that the Australian Government does not have the jurisdiction to legislate to require the control of domestic cats (or feral cats) as this is the responsibility of state, territory and local governments. However, as domestic cats may be a source of cats entering into the feral population and recognizing that they have impacts on native wildlife as domestic cats it is important to identify actions that can contribute to reducing this problem.

Action 4.3 Promote and seek community engagement on the reduction of food and other resources to stray cats

Action 4.3 considers stray cats' exploitation of human resources. These include refuse from rubbish tips, food outlets and some small-holdings. Minimising or stopping the availability of food for both cats, and the mice and rats on which the stray cats prey, may slow the rate of population increase and this may lead to reduced numbers of feral cats. For example, effective fencing of community dumps may remove this food and shelter source. The deliberate feeding of stray cats should be discouraged on animal welfare grounds. The concept of trapping, neutering and releasing stray cats as a method of population control should also be discouraged on animal welfare grounds and because it is not effective, except where populations are truly isolated and all females are neutered. As noted above for domestic cats, the Australian Government does not have the jurisdiction to legislate with respect to stray cats.

Action 4.4 Develop specific communication campaigns to accompany the release of new broad-scale cat control techniques and other current/new cat control techniques and management programs

Action 4.4 builds on the requirement to gain community support for feral cat management. In particular, the release of new toxic baits for feral cats, even with restrictions on their availability and use, may be of concern to elements of the community. An effective communications campaign will be essential for the successful roll out of such products.

Across all of the actions in Objective 4 is the need for consideration of Indigenous peoples and their particular cultural values for and beliefs about feral cats. This is particularly the case in central and northern Australia

where the land tenure by Indigenous people is high. These areas often have a rich diversity of threatened species requiring protection from cat predation. Culturally appropriate communication and education materials will be required.

Performance indicators

- Measurable increase in community support and engagement for feral cat management. The increase to be measured from a baseline study by researchers and governments on commencement of the threat abatement plan.
- Increase in effective management for domestic cats by communities in all states and territories through confinement regulations.
- A measured and reported reduction in stray and feral cat abundances in areas around human habitation.

Action	Priority and timeframe	Output	Outcome	Responsibility
4.1 Quantify the proportion of the domestic and stray cat population that transitions to the feral cat population	Medium priority, short term	An understanding of the transition between domestic, stray and feral populations	Factors affecting the transition between domestic, stray and feral populations understood and addressed. Information for communities to understand the links between domestic and feral animals.	Researchers and governments
4.2 Promote to and seek engagement of the community in: - an understanding of the threat to biodiversity posed by cats and support for their management; - an understanding of the transitions between domestic, stray and feral cats, and the need for responsible ownership; - support for the containment of domestic cats where their roaming may impact on identified conservation areas	High priority, short term - ongoing	Further education materials developed and utilised	Community support for the control of feral cats. Community ownership and responsibility for domestic and stray cats.	Governments and community (including community leaders such as pest control officers, vets, NRM bodies)
4.3 Promote and seek community engagement on the reduction of food and other resources to stray cats	High priority, medium term	Education material developed and utilised	Reduced availability of resources for stray cats	Governments and community

Action	Priority and timeframe	Output	Outcome	Responsibility
4.4 Develop specific communication campaigns to accompany the release of new broad-scale cat control techniques and other current/new cat control techniques and management programs	High priority, short term	Communication campaign undertaken	Community understanding of the need for feral cat control and are supportive	Government

3 Duration, cost, implementation and evaluation of the plan

3.1 Duration

This plan reflects the fact that the threat abatement process is likely to be ongoing, as there is no likelihood of nationally eradicating all feral cats in the life of this plan. The plan lays out measures that should be taken in the next five years to reduce the impact from the key threatening process of predation by feral cats and from the additional threats that feral cats pose through indirect impacts such as disease transmission and ecological changes. Within the life of this threat abatement plan the focus necessarily must be on suppressing and managing the impacts of feral cats in targeted areas where they pose the greatest threat to biodiversity.

Threat abatement plans have a statutory review point within five years but have a formal life of ten years. Dependent on the degree of implementation and success of that implementation some or many of the objectives and actions in this plan may be valid for the full ten years.

3.2 Investment in the plan

Investment in many of the threat abatement plan actions will be determined by the level of resources that stakeholders commit to management of the problem. The Commonwealth is committed, via the EPBC Act, to *implement the threat abatement plan to the extent to which it applies in Commonwealth areas*. However, it should be noted that the Australian Government is unable to provide funding to cover all actions in this threat abatement plan across all of Australia and requires the financial and implementation support from stakeholders. Partnerships amongst and between governments, non-government organisations, community groups and individuals will be key to successfully delivering significant reductions in the threats posed by feral cats.

Outlined below are some estimates of costs of implementation of the actions within the plan. These have been placed in this section instead of against each objective because it is difficult to fully cost the implementation of each action because of unknown variables. In particular, research or field project costs are going to be highly variable dependent on the subject and location. A more remote location, or one with difficult access, will cost more than an accessible site. Other actions are contingent on particular prior actions (e.g. identification of high priority sites) and cannot be accurately costed until the prior action is undertaken. What is presented here are estimates of different elements to actions within the plan to provide a guide to governments, researchers, land managers, island owners, community and others when considering what actions they may be able to implement. Anyone looking to implement an action is strongly recommended to undertake their own budget exercise for their particular circumstances and outcomes sought.

Action	Costs anticipated or known at the time of TAP development for action items	Estimated total cost across TAP
Baiting for feral cats Bait development – new bait Field baiting (including permits, preparation, bait cost, aerial delivery, ground staff and monitoring)	\$3 million for a variation on existing baits suitable for new areas. \$6 million to develop a new bait. \$30,000–40,000 to aerial bait 200km ² . Note costs will not scale exactly by area.	\$1 million – Curiosity available \$3 million – modified Curiosity bait – Hisstory - for northern Australia Annual cost of \$1.5-\$2 million to bait 1 million hectares.
Grooming trap development	\$1 million to fully develop.	

Action	Costs anticipated or known at the time of TAP development for action items	Estimated total cost across TAP
Other current control methods Ground shooting Trapping	\$5,000–10,000 per week for ground shooting at a single site using professional shooters. Use of volunteer shooters (e.g. SSAA National) would cost considerably less than this. \$3,000-4,000 per week for a single trap line.	Annual cost of \$250,000 – \$800,000 for 8 weeks of control at 10 sites across Australia. Less if volunteers are utilised.
Exclusion fencing	\$12,500 per kilometre for material costs (Moesby & Read, 2006). Requires installation costs to be included. \$25,000 per year per enclosure for ongoing maintenance and monitoring (Moseby & Read, 2006).	\$625,000 for material costs for fences around 5 areas of 10 km ² . \$625,000 for ongoing maintenance of these 5 areas for 5 years.
Island eradications	This could range from \$4 per hectare for a smaller uninhabited island such as Faure Island to \$50-\$100 per hectare for larger, inhabited such as Kangaroo Island.	Per island: \$18,000 for small, uninhabited to \$22-44 million for large, inhabited.
Island Biosecurity Ranging from signage to a quarantine officer	\$500 – signs per island \$60,000 per year – part time quarantine officer. A quarantine officer may be able to cover multiple smaller islands where they are in a group.	\$300,000 quarantine officer salary for one island or island group over 5 years.
Social research Including community attitudes, incentives for control.	\$200,000 per six-month project involving community engagement.	\$600,000 across 3 actions.
Research projects Includes research into new tools, attractants, ecological modifiers, diseases, biocontrols, monitoring techniques Development and registration of cat control devices.	\$250,000 per year per researcher, including field costs \$15,000 per year to monitor internationally for new diseases.	To be determined for each project.
Prioritisation of cat control areas	\$100,000 for an initial broad prioritisation across all of Australia.	\$100,000 + additional for finer scale prioritisation.
Community education general promotion of feral cat issues promotion of stray cat issues campaign for releases of new control techniques	\$200,000 per state/territory for general promotion per year. This amount may decline as material can be reused and education levels rise. \$100,000 per state/territory for stray cat issues per year. This amount may decline as material can be reused and education levels rise. \$200,000 per state/territory for releases of new tools per release.	\$1.2 million per state/territory over 5 years for general education.
Training materials Including materials using different media and courses	1. \$10,000 to \$100,000 to develop different materials 2. \$2,000 to \$200,000 for delivery	1. \$500,000 over 5 years 2. \$300,000 over 5 years

This threat abatement plan provides a framework for undertaking targeted priority actions. Budgetary and other constraints may affect the achievement of the objectives of this plan, and as knowledge changes, proposed actions may need to be modified over the life of the plan. Australian Government funds may be available to implement key national environmental priorities, such as relevant actions listed in this plan and actions identified in regional natural resource management plans.

3.2 Implementing the plan

The Department of the Environment will work with other Australian Government agencies, state and territory governments, industry and community groups, to facilitate the implementation of the plan. There are many different stakeholder interests and perspectives to take into account in managing cats. For example, Indigenous communities' views need to be fully considered. It will be important to consult and involve the full range of stakeholders in implementing the actions in this plan.

The Australian Government will implement the plan as it applies to Commonwealth land.

The Department of the Environment, via the Threatened Species Commissioner's Office, will establish a Feral Cat Taskforce. The Taskforce will bring together government officials and key stakeholders to ensure effective implementation, monitoring and reporting on progress towards the goals of the threat abatement plan and targets related to feral cat predation.

It is acknowledged that many of the actions in this threat abatement plan are rated as very high or high priority, reflecting the need to tackle the problem of predation by feral cats from multiple angles. Everyone implementing the plan will need to identify the specific actions that can be tackled first in their area — either land jurisdiction or area of expertise.

3.3 Planning links

This threat abatement plan will tie in with other complementary planning processes and strategies for threat abatement and threatened species recovery. These will include other threat abatement plans where there is a clear overlap in issues (for example the *Threat abatement plan for predation by the European red fox* (DEWHA 2008c), recovery plans and the Threatened Species Strategy. The intersection between recovery plans and threat abatement plans is where there are threats to a native species which need to be addressed on a broader scale than on an individual species level or group-of-species level (where there are regional recovery plans). An example of this is the development of broad-scale baits for feral cats.

This threat abatement plan can also provide the basis to develop targets or a source of justification for funding of scientific research or management actions.

3.4 Evaluating implementation of the plan

It may be difficult to assess directly the effectiveness of the plan in abating the impacts of feral cats on Australia's biodiversity. However, performance indicators have been provided against each of the objectives to provide an indication of the level of threat abatement that has been achieved.

Measurements in the improvement of threatened species populations or conditions can be monitored particularly where the primary threat is feral cat predation. However, in many situations, feral cat management is only an element of a complete recovery plan so being able to accurately assess impact of feral cat control may be difficult. Individual feral cat control programs with comprehensive monitoring may be able to see a recovery in the threatened species populations.

3.5 Threatened species adversely impacted by feral cats

Appendix A lists threatened species that are known to, or may, be adversely affected by predation by feral cats. The threatened species included are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or, in the case of mammals, identified as being threatened by feral cat predation in *The Action Plan for Australian Mammals 2012* (Woinarski et al. 2014). Information for species listed under the EPBC Act is available from the Species Profile and Threats Database: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>.

Appendix A: Species affected by feral cats

Table A1 outlines the various statuses of mammals which may be affected by feral cats and the relative risk of feral cat predation on those species. These species were determined from *The Action Plan for Australian Mammals 2012* (Woinarski et al. 2014) and from profiles which identified predation by feral cats as a threatening process in the Australian Government's Species Profile and Threats Database (SPRAT) (Department of the Environment, 2015). The Action Plan status is the conservation status assigned to a species by Woinarski et al. (2014) and has been based on the International Union for Conservation of Nature's (IUCN) Red List criteria. The overall threat rating considers both the severity and extent of feral cat predation and has been developed from *The Action Plan for Australian Mammals 2012* (Woinarski et al. 2014). For example, the threat is considered to be high risk where there may be a moderate consequence over the entire range, a severe consequence across a large extent of the range, or a catastrophic consequence across a moderate extent of the range (Woinarski *pers. comm.* March 2015). The number of other threats and those which are an equal or greater threat to feral cat predation are also from Woinarski et al. (2014).

Table A1: Threatened mammal species that may be adversely affected by feral cats.

Scientific Name	Common Name(s)	EPBC Act Status	Action Plan Status	IUCN Red List Status	Overall Threat Rating of feral cat predation	Number of other threats	Other threats which are of equal or greater risk than feral cat predation
<i>Bettongia lesueur lesueur</i>	Burrowing Bettong (Shark Bay), Boodie	Vulnerable	Near Threatened (Conservation dependent)	Near threatened ¹	Moderate	6	Climate change/severe weather events (moderate); predation by European red foxes (moderate) ² ; predation by black rats (moderate) ² ; novel disease (moderate) ² .
<i>Bettongia penicillata ogilbyi</i>	Woylie	Endangered	Critically endangered	Critically endangered ¹	High - very high	6	Predation by European red foxes (high - very high); inappropriate fire regimes in presence of cats and foxes (high)
<i>Burramys parvus</i>	Mountain Pygmy-possum	Endangered	Critically endangered	Critically endangered	Very high	7	Inappropriate fire regimes (very high); predation by European red foxes (very high); habitat loss and fragmentation (very high)
<i>Conilurus penicillatus</i>	Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma	Vulnerable	Vulnerable	Near threatened	High - very high	6	Inappropriate fire regimes (high); habitat loss and fragmentation (high)

¹ IUCN Red List Status provides the status at species level and is taken to include the subspecies (a separate assessment at the subspecies level has not been completed at this stage).

² This threat rating is based on the introduction and establishment of the pest species to islands within the range of the mammal species. At present, the pest species has either been eradicated, is not present, or has not established in large enough numbers to threaten the mammal within its current range.

Scientific Name	Common Name(s)	EPBC Act Status	Action Plan Status	IUCN Red List Status	Overall Threat Rating of feral cat predation	Number of other threats	Other threats which are of equal or greater risk than feral cat predation
<i>Crocidura trichura</i>	Christmas Island Shrew	Endangered	Critically endangered (Possibly Extinct)	Critically endangered	Very high	8	Novel disease (extreme)
<i>Dasyercus cristicauda</i>	Crest-tailed Mulgara	Vulnerable	Near Threatened	Least Concern	High	4	Predation by European red foxes (high); habitat change due to livestock and feral herbivores (high)
<i>Dasyuroides byrnei</i>	Kowari	Vulnerable	Vulnerable	Vulnerable	High	9	Predation by dingoes/wild dogs (high); climate change (high)
<i>Dasyurus geoffroi</i>	Chuditch, Western Quoll	Vulnerable	Near Threatened (Conservation dependent)	Near threatened	Moderate	6	Predation by European red foxes (very high); consumption of toxic feral cat baits (very high);
<i>Dasyurus hallucatus</i>	Northern Quoll	Endangered	Endangered	Near threatened	High	9	Inappropriate fire regimes (high); poisoning by cane toads (very high)
<i>Dasyurus maculatus gracilis</i>	Spotted-tailed Quoll or Yarri (North Queensland subspecies)	Endangered	Endangered	Near threatened ¹	Moderate	7	Habitat loss and fragmentation (moderate); climate change/severe weather events over several decades (very high); poisoning associated with control of non-native predators (moderate); predation by wild dogs (moderate)
<i>Dasyurus maculatus maculatus</i> (SE mainland population)	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (south-eastern mainland population)	Endangered	Vulnerable	Near threatened ¹	Moderate	10	Inappropriate fire regimes (moderate); predation by European red foxes (very high); predation by dingoes/wild dogs (high); habitat loss and fragmentation (moderate);
<i>Dasyurus maculatus maculatus</i> (Tasmanian population)	Spotted-tail Quoll, Spot-tailed Quoll, Tiger Quoll (Tasmanian population)	Vulnerable	Vulnerable	Near threatened ¹	Moderate	9	Habitat loss and fragmentation (high); timber production (high)

Scientific Name	Common Name(s)	EPBC Act Status	Action Plan Status	IUCN Red List Status	Overall Threat Rating of feral cat predation	Number of other threats	Other threats which are of equal or greater risk than feral cat predation
<i>Hipposideros semoni</i>	Semon's Leaf-nosed Bat, Greater Wart-nosed Horseshoe-bat	Endangered	Near Threatened	Data deficient	Minor	5	Disturbance at roost sites (minor); destruction or reduced accessibility of roost sites (minor); extensive, frequent and intense fires (minor); habitat change due to pastoralism (minor); habitat loss and fragmentation (minor)
<i>Isoodon auratus auratus</i>	Golden Bandicoot (mainland)	Vulnerable	Vulnerable	Vulnerable ¹	Moderate	4	Inappropriate fire regimes (moderate)
<i>Isoodon obesulus nauticus</i>	Southern Brown Bandicoot (Nuyts Archipelago)	Vulnerable	Near Threatened	Least Concern ¹	Moderate - high	10	Predation by European red foxes (high); habitat loss and fragmentation (high)
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (Eastern)	Endangered	Near Threatened	Least Concern ¹	Moderate - high	10	Predation by European red foxes (high); habitat loss and fragmentation (high)
<i>Lagorchestes hirsutus</i> unnamed subsp.	Mala, Rufous Hare-Wallaby (central mainland form)	Endangered	Endangered	Vulnerable ¹	Moderate (extreme if species introduced on islands ²)	5	Inappropriate fire regimes (very high); predation by foxes (extreme) ² ; predation by black rats (very high - extreme) ² ; novel disease (moderate - very high) ²
<i>Lagostrophus fasciatus fasciatus</i>	Banded Hare-wallaby, Merrnine, Marnine, Munning	Vulnerable	Vulnerable	Endangered ¹	Moderate (extreme if species introduced on islands)	3	Predation by European red foxes (moderate); climate change/severe weather events (very high); novel disease (moderate)
<i>Leporillus conditor</i>	Wopilkara, Greater Stick-nest Rat	Vulnerable	Near Threatened (Conservation dependent)	Vulnerable	Moderate ²	3	Predation by European red foxes (moderate)
<i>Macrotis lagotis</i>	Greater Bilby	Vulnerable	Vulnerable	Vulnerable	Very high - extreme	5	Predation by European red foxes (extreme);
<i>Mesembriomys macrurus</i>	Golden-backed Tree-rat, Koorrawal	Vulnerable	Near Threatened	Least Concern	Moderate	2	Inappropriate fire regimes (high)
<i>Myrmecobius fasciatus</i>	Numbat	Vulnerable	Endangered	Endangered	Very high	4	Predation by European red foxes (very high - extreme); Predation by raptors (high - very high)
<i>Notomys aquilo</i>	Northern Hopping-mouse, Woorrentinta	Vulnerable	Vulnerable	Endangered	Very high	2	Inappropriate fire regimes (very high)

Scientific Name	Common Name(s)	EPBC Act Status	Action Plan Status	IUCN Red List Status	Overall Threat Rating of feral cat predation	Number of other threats	Other threats which are of equal or greater risk than feral cat predation
<i>Notomys fuscus</i>	Dusky Hopping-mouse, Wilkiniti	Vulnerable	Vulnerable	Vulnerable	High - very high	4	Habitat change due to livestock and feral herbivores (high - very high)
<i>Notoryctes caurinus</i>	Kakarratul, Northern Marsupial Mole	Endangered	Least Concern	Data deficient	Moderate	5	Predation by European red foxes (moderate); predation by dingoes/wild dogs (moderate)
<i>Notoryctes typhlops</i>	Itjaritjari, Southern Marsupial Mole, Yitjarritjarri	Endangered	Least Concern	Data deficient	Moderate	5	Predation by European red foxes (moderate); predation by dingoes/wild dogs (moderate)
<i>Onychogalea fraenata</i>	Bridled Nail-tail Wallaby	Endangered	Vulnerable	Endangered	Very high	10	Predation by European red foxes (very high); climate change/severe weather events (very high); predation by dingoes/wild dogs (very high); habitat loss and fragmentation (very high); Habitat degradation and resource depletion due to livestock and feral herbivores (very high)
<i>Parantechinus apicalis</i>	Dibbler	Endangered	Endangered	Endangered	High	4	Inappropriate fire regimes (high); predation by European red foxes (high); habitat degradation due to <i>Phytophthora cinnamomi</i> (high)
<i>Perameles bougainville bougainville</i>	Western Barred Bandicoot (Shark Bay)	Endangered	Vulnerable	Endangered	Moderate (extreme if species introduced on islands ²)	3	Predation by European red foxes (moderate); climate change/severe weather events (high); novel disease (moderate)
<i>Perameles gunnii gunnii</i>	Eastern Barred Bandicoot (Tasmania)	Vulnerable	Vulnerable	Near threatened ¹	Very high	10	Novel disease (very high)
<i>Perameles gunnii</i> unnamed subsp.	Eastern Barred Bandicoot (Mainland)	Endangered	Endangered	Near threatened ¹	Very high	10	Predation by European red foxes (extreme); loss of genetic diversity (very high)
<i>Petaurus gracilis</i>	Mahogany Glider	Endangered	Endangered	Endangered	Minor	7	Inappropriate fire regimes (high - very high); habitat loss and fragmentation (very high); barbed wire fencing entanglement (minor); vehicle mortality (minor); predation by wild dogs (minor); habitat change due to livestock (minor); habitat change due to weeds (minor)

Scientific Name	Common Name(s)	EPBC Act Status	Action Plan Status	IUCN Red List Status	Overall Threat Rating of feral cat predation	Number of other threats	Other threats which are of equal or greater risk than feral cat predation
<i>Petrogale lateralis</i> MacDonnell Ranges race	Warru, Black-footed Rock-wallaby (MacDonnell Ranges race)	Vulnerable	Vulnerable	Near threatened ¹	High	6	Inappropriate fire regimes (high); predation by European red foxes (extreme); habitat degradation due to weeds (high)
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	Vulnerable	Vulnerable	Near threatened	Minor	7	Predation by European red foxes (very high); habitat change due to livestock and feral herbivores (high); predation by wild dogs (minor); Small subpopulation size (minor); habitat degradation and resource depletion due to native herbivores (minor); habitat loss and fragmentation (minor); inappropriate fire regimes (minor)
<i>Petrogale persephone</i>	Proserpine Rock-wallaby	Endangered	Endangered	Endangered	Moderate	6	Predation by wild dogs (moderate); habitat loss and fragmentation (high)
<i>Petrogale xanthopus xanthopus</i>	Yellow-footed Rock-wallaby (SA and NSW)	Vulnerable	Near Threatened	Near threatened	High	5	Predation by European red foxes (extreme); habitat change due to livestock and feral herbivores (high)
<i>Phascogale calura</i>	Red-tailed Phascogale	Endangered	Near Threatened	Near threatened	Very high	4	Habitat loss and fragmentation (very high); climate change/severe weather events (very high)
<i>Phascogale pirata</i>	Northern Brush-tailed Phascogale	Vulnerable	Vulnerable	Vulnerable	High	7	Inappropriate fire regimes (high); poisoning by cane toads (high); climate change (high)
<i>Potorous gilbertii</i>	Gilbert's Potoroo	Critically Endangered	Critically endangered	Critically endangered	High - very high	2	Inappropriate fire regimes (extreme); predation by European red foxes (high - very high)
<i>Potorous longipes</i>	Long-footed Potoroo	Endangered	Vulnerable	Endangered	High	6	Inappropriate fire regimes (high); predation by European red foxes (very high); predation by dingoes/wild dogs (high)
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE mainland)	Vulnerable	Near Threatened	Least Concern ¹	High	7	Inappropriate fire regimes (very high); predation by European red foxes (very high); predation by dingoes/wild dogs (high); habitat loss and fragmentation (very high)

Scientific Name	Common Name(s)	EPBC Act Status	Action Plan Status	IUCN Red List Status	Overall Threat Rating of feral cat predation	Number of other threats	Other threats which are of equal or greater risk than feral cat predation
<i>Pseudantechinus mimulus</i>	Carpentarian Antechinus	Vulnerable	Near Threatened	Endangered	Moderate	4	Inappropriate fire regimes (high)
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum, Ngwayir	Vulnerable	Critically endangered	Vulnerable	Very high - extreme	6	Inappropriate fire regimes (very high); predation by European red foxes (very high - extreme); climate change/severe weather events (very high - extreme)
<i>Pseudomys fieldi</i>	Shark Bay Mouse, Djoongari, Alice Springs Mouse	Vulnerable	Vulnerable	Vulnerable	Moderate (very high if cats establish on islands ²)	4	Predation by European red foxes (moderate) ² ; predation by black rats (moderate) ²
<i>Pseudomys fumeus</i>	Konoom, Smoky Mouse	Endangered	Vulnerable	Endangered	Very high	7	Nil
<i>Pseudomys novaehollandiae</i>	New Holland Mouse, Pookila	Vulnerable	Vulnerable	Vulnerable	Very high	7	Inappropriate fire regimes (very high)
<i>Pseudomys oralis</i>	Hastings River Mouse, Koontoo	Endangered	Vulnerable	Vulnerable	High	6	Predation by European red foxes (high); disjunct, genetically distinct populations (moderate)
<i>Pseudomys pilligaensis</i>	Pilliga Mouse, Poolkoo	Vulnerable	Least Concern	Data deficient	Unknown	Unknown	Unknown
<i>Pseudomys shortridgei</i>	Dayang, Heath Rat	Vulnerable	Near Threatened	Near threatened	High	6	Inappropriate fire regimes (high); habitat loss and fragmentation (moderate - high)
<i>Rhinolophus philippinensis</i> (large form)	Greater Large-eared Horseshoe Bat	Endangered	Near Threatened	Least Concern	Minor	6	Inappropriate fire regimes (minor); habitat loss and fragmentation (minor); destruction or reduced accessibility of roost sites (minor); disturbance at roost sites (minor); habitat change due to pastoralism (minor)
<i>Sminthopsis aitkeni</i>	Kangaroo Island Dunnart	Endangered	Endangered	Critically endangered	Very high	3	Inappropriate fire regimes (very high)
<i>Sminthopsis butleri</i>	Butler's Dunnart	Vulnerable	Vulnerable	Vulnerable	Moderate	4	Inappropriate fire regimes (moderate - high); habitat loss and fragmentation (moderate); poisoning by cane toads (moderate)

Scientific Name	Common Name(s)	EPBC Act Status	Action Plan Status	IUCN Red List Status	Overall Threat Rating of feral cat predation	Number of other threats	Other threats which are of equal or greater risk than feral cat predation
<i>Sminthopsis douglasi</i>	Julia Creek Dunnart	Endangered	Near Threatened	Near threatened	Very high	4	Nil
<i>Sminthopsis psammophila</i>	Sandhill Dunnart	Endangered	Vulnerable	Endangered	Very high	3	Inappropriate fire regimes (very high); predation by European red foxes (very high)
<i>Xeromys myoides</i>	Water Mouse, False Water Rat, Yirrkoo	Vulnerable	Vulnerable	Vulnerable	Moderate	12	Habitat loss and fragmentation (moderate); habitat degradation due altered hydrology (moderate)
<i>Zyomys maini</i>	Arnhem Rock-rat, Arnhem Land Rock-rat, Kodjper	Vulnerable	Vulnerable	Near threatened	High	3	Inappropriate fire regimes (very high)
<i>Zyomys palatalis</i>	Carpentarian Rock-rat, Aywalirroomoo	Endangered	Critically endangered	Critically endangered	Very high	4	Inappropriate fire regimes (very high); climate change (very high)
<i>Zyomys pedunculatus</i>	Central Rock-rat, Antina	Endangered	Critically endangered	Critically endangered	Very high	4	Inappropriate fire regimes (very high)
<i>Antechinus bellus</i>	Fawn Antechinus	Not listed	Vulnerable	Least Concern	High	4	Inappropriate fire regimes (Very high); poisoning by cane toads (high)
<i>Antechinus godmani</i>	Atherton Antechinus	Not listed	Near threatened	Near threatened	High	3	Climate change in the near future (high)
<i>Bettongia gaimardi</i>	Tasmanian Bettong, Eastern Bettong	Not listed	Vulnerable	Near threatened	High	4	Nil
<i>Bettongia tropica</i>	Northern Bettong	Not listed	Endangered	Endangered	High - very high	8	Climate change/severe weather event (high - very high); small, relictual subpopulations (high); habitat change due to changed fire regimes (high); predation by European red foxes if establish in range in the future (extreme)
<i>Dasyurus viverrinus</i>	Eastern Quoll	Not listed	Endangered	Near threatened	High	7	Novel disease if one establishes on Bruny Island; climate change (high) Fancourt et al. (2015a); predation by European red foxes if establish on Bruny Island as well as Tasmania main island (very high); 1080 poisoning if foxes establish on Bruny Island. Fancourt et al. (2015a)
<i>Hipposideros inornatus</i>	Arnhem Leaf-nosed Bat	Not listed	Endangered	Vulnerable	Minor	3	Inappropriate fire regimes (high); disturbance at roost sites (moderate);

Scientific Name	Common Name(s)	EPBC Act Status	Action Plan Status	IUCN Red List Status	Overall Threat Rating of feral cat predation	Number of other threats	Other threats which are of equal or greater risk than feral cat predation
							Destruction or reduced accessibility of roost sites (moderate)
<i>Lagorchestes conspicillatus</i>	Spectacled Hare-wallaby	Not listed	Near threatened	Least Concern	Moderate	5	Predation by European red foxes (moderate); novel disease (moderate)
<i>Macropus parma</i>	Parma Wallaby	Not listed	Near threatened	Near threatened	Moderate	4	Inappropriate fire regimes (high); predation by European red foxes (high)
<i>Mastacomys fuscus</i>	Broad-toothed Rat, Tooarrana	Not listed	Near threatened	Near threatened	High	8	Inappropriate fire regimes (high); predation by European red foxes (high); climate change/severe weather events (high)
<i>Mesembriomys gouldii</i>	Black-footed Tree-rat, Djintamoonga	Not listed	Vulnerable	Near threatened	High	7	Inappropriate fire regimes (very high)
<i>Notomys cervinus</i>	Fawn Hopping-mouse, Ooarri	Not listed	Near threatened	Vulnerable	High	4	Nil
<i>Petaurus australis</i>	Yellow-bellied Glider	Not listed	Near threatened	Least Concern	Moderate	5	Inappropriate fire regimes (moderate); habitat loss and fragmentation (high); timber production (moderate)
<i>Petrogale burbidgei</i>	Warabi	Not listed	Near threatened	Near threatened	High	3	Inappropriate fire regimes (high)
<i>Petrogale coenensis</i>	Cape York Rock-wallaby	Not listed	Endangered	Near threatened	Moderate	2	Nil
<i>Petrogale concinna</i>	Nabarlek	Not listed	Near threatened	Data deficient	High	5	Inappropriate fire regimes (high)
<i>Petrogale godmani</i>	Godman's Rock-wallaby	Not listed	Near threatened	Least Concern	High	4	Habitat change due to livestock and feral herbivores (high)
<i>Petrogale purpureicollis</i>	Purple-necked Rock-wallaby	Not listed	Near threatened	Least Concern	High	4	Habitat change due to livestock and feral herbivores (high)
<i>Petrogale sharmani</i>	Mount Claro Rock Wallaby, Sharman's Rock Wallaby	Not listed	Vulnerable	Near threatened	Moderate	4	Habitat change due to livestock and feral herbivores (moderate)
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Not listed	Near threatened	Near threatened	High	7	Nil
<i>Pseudomys australis</i>	Plains Rat, Palyoora	Not listed	Vulnerable	Vulnerable	Very high	3	Predation by European red foxes (very high)
<i>Pseudomys calabyi</i>	Pinti	Not listed	Near threatened	Vulnerable	High	4	Inappropriate fire regimes (very high)

Scientific Name	Common Name(s)	EPBC Act Status	Action Plan Status	IUCN Red List Status	Overall Threat Rating of feral cat predation	Number of other threats	Other threats which are of equal or greater risk than feral cat predation
<i>Pseudomys occidentalis</i>	Western Mouse, Walyadji	<i>Not listed</i>	Near threatened	Least Concern	High	3	Habitat loss and fragmentation (high); climate change/severe weather events (high)
<i>Pteropus natalis</i>	Christmas Island Flying-fox	<i>Not listed</i>	Critically endangered	Vulnerable	High	6	Novel disease (high)
<i>Sminthopsis archeri</i>	Chestnut Dunnart	<i>Not listed</i>	Near threatened	Data deficient	High	3	Nil
<i>Sminthopsis bindi</i>	Kakadu Dunnart	<i>Not listed</i>	Near threatened	Least Concern	High - very high	4	Inappropriate fire regimes (high)
<i>Wyulda squamicaudata</i>	Scaly-tailed Possum	<i>Not listed</i>	Near threatened	Data deficient	High	2	Inappropriate fire regimes (very high)

Table A2 outlines the threatened bird, reptile, amphibian and migratory/marine species which may be affected by predation by feral cats. These species were determined from profiles in the Australian Government's Species Profile and Threats Database (SPRAT) (Department of the Environment, 2015) that identified predation by feral cats as a threatening process. Note: species listed as marine or migratory are only threatened by feral cats when on shore. This includes predation of juveniles from on shore nests.

Table A2: Threatened species other than mammals that may be adversely affected by feral cats

Species type	Scientific Name	Common Name(s)	EPBC Act Status	IUCN Red List Status
Bird	<i>Accipiter hiogaster natalis</i>	Christmas Island Goshawk	Endangered	Least concern ¹
	<i>Amytornis barbatus barbatus</i>	Grey Grasswren (Bulloo)	Vulnerable	Least concern ¹
	<i>Amytornis modestus</i>	Thick-billed Grasswren	Vulnerable	Not listed
	<i>Botaurus poiciloptilus</i>	Australasian Bittern	Endangered	Endangered
	<i>Cacatua pastinator pastinator</i>	Muir's Corella (southern), Western Long-billed Corella (southern)	Vulnerable	Least concern ¹
	<i>Calonectris leucomelas</i>	Streaked Shearwater	Migratory	Least concern
	<i>Cinlosoma punctatum anachoreta</i>	Spotted Quail-thrush (Mt Lofty Ranges)	Critically Endangered	Least concern ¹
	<i>Cyanoramphus cookii</i>	Norfolk Island Parakeet, Tasman Parrot	Endangered	Near threatened
	<i>Cyclopsitta diophthalma coxeni</i>	Coxen's Fig-Parrot	Endangered	Least concern ¹
	<i>Dasyornis brachypterus</i>	Eastern Bristlebird	Endangered	Endangered
	<i>Epthianura crocea macgregori</i>	Yellow Chat (Dawson)	Critically Endangered	Least concern ¹
	<i>Epthianura crocea tunneyi</i>	Yellow Chat (Alligator Rivers)	Endangered	Least concern ¹
	<i>Fregata andrewsi</i>	Christmas Island Frigatebird, Andrew's Frigatebird	Vulnerable	Critically endangered
	<i>Gallirallus philippensis andrewsi</i>	Buff-banded Rail (Cocos (Keeling) Islands)	Endangered	Least concern ¹
	<i>Gallirallus sylvestris</i>	Lord Howe Woodhen	Vulnerable	Endangered
	<i>Geophaps scripta scripta</i>	Squatter Pigeon (southern)	Vulnerable	Least concern ¹
	<i>Geophaps smithii blaaui</i>	Partridge Pigeon (western)	Vulnerable	Vulnerable ¹
	<i>Hylacola pyrrhopygia parkeri</i>	Chestnut-rumped Heathwren (Mt Lofty Ranges)	Endangered	Least concern ¹
	<i>Lathamus discolor</i>	Swift Parrot	Endangered	Endangered
	<i>Leipoa ocellata</i>	Malleefowl	Vulnerable	Vulnerable
<i>Lichenostomus melanops cassidix</i>	Helmeted Honeyeater, Yellow-tufted Honeyeater (Helmeted)	Critically Endangered	Least concern ¹	
<i>Malurus coronatus coronatus</i>	Purple-crowned Fairy-wren (western)	Vulnerable	Least concern ¹	

¹IUCN Red List Status provides the status at species level and is taken to include the subspecies (a separate assessment at the subspecies level has not been completed at this stage).

Species type	Scientific Name	Common Name(s)	EPBC Act Status	IUCN Red List Status
	<i>Malurus leucopterus leucopterus</i>	White-winged Fairy-wren (Dirk Hartog Island), Dirk Hartog Black-and-White Fairy-wren	Vulnerable	Least concern ¹
	<i>Neochmia ruficauda ruficauda</i>	Star Finch (eastern), Star Finch (southern)	Endangered	Least concern ¹
	<i>Neophema chrysogaster</i>	Orange-bellied Parrot	Critically Endangered	Critically endangered
	<i>Ninox natalis</i>	Christmas Island Hawk-Owl, Moluccan Hawkowl	Vulnerable	Vulnerable
	<i>Ninox novaeseelandiae undulata</i>	Southern Boobook (Norfolk Island), Norfolk Island Boobook Owl	Endangered	Least concern ¹
	<i>Pachycephala pectoralis xanthoprocta</i>	Golden Whistler (Norfolk Island)	Vulnerable	Least concern ¹
	<i>Pachycephala rufogularis</i>	Red-lored Whistler	Vulnerable	Vulnerable
	<i>Pachyptila turtur subantarctica</i>	Fairy Prion (southern)	Vulnerable	Least concern ¹
	<i>Pardalotus quadragintus</i>	Forty-spotted Pardalote	Endangered	Endangered
	<i>Petroica multicolor multicolor</i>	Pacific Robin (Norfolk Island)	Vulnerable	Least concern ¹
	<i>Pezoporus flaviventris</i>	Western Ground Parrot, Kyloring	Critically Endangered	Not listed
	<i>Pezoporus occidentalis</i>	Night Parrot	Endangered	Endangered
	<i>Phaethon lepturus fulvus</i>	White-tailed Tropicbird (Christmas Island)	Endangered	Least concern ¹
	<i>Pterodroma leucoptera leucoptera</i>	Gould's Petrel	Endangered	Vulnerable ¹
	<i>Sternula nereis nereis</i>	Australian Fairy Tern	Vulnerable	Vulnerable ¹
	<i>Stipiturus malachurus intermedius</i>	Southern Emu-wren (Fleurieu Peninsula), Mount Lofty Southern Emu-wren	Endangered	Least concern ¹
	<i>Stipiturus mallee</i>	Mallee Emu-wren	Endangered	Endangered
	<i>Turnix melanogaster</i>	Black-breasted Button-quail	Vulnerable	Near threatened
Reptile	<i>Anomalopus mackayi</i>	Five-clawed Worm-skink, Long-legged Worm-skink	Vulnerable	Vulnerable
	<i>Aprasia rostrata</i>	Ningaloo Worm Lizard, Monte Bello Worm-lizard	Vulnerable	Vulnerable
	<i>Bellatorias obiri</i>	Arnhem Land Egernia	Endangered	Not assessed
	<i>Christinus guentheri</i>	Lord Howe Island Gecko, Lord Howe Island Southern Gecko	Vulnerable	Vulnerable
	<i>Cryptoblepharus egeriae</i>	Christmas Island blue-tailed skink	Critically Endangered	Not assessed
	<i>Cyclodomorphus praealtus</i>	Alpine She-oak Skink	Endangered	Not assessed
	<i>Delma impar</i>	Striped Legless Lizard	Vulnerable	Vulnerable
	<i>Emoia nativitatis</i>	Christmas Island forest skink, Christmas Island whiptail skink	Critically endangered	Critically endangered
	<i>Eretmochelys imbricata</i>	Hawksbill Turtle	Vulnerable	Critically endangered
	<i>Eulamprus leuraensis</i>	Blue Mountains Water Skink	Endangered	Endangered
	<i>Eulamprus tympanum marnieae</i>	Corangamite Water Skink	Endangered	Not assessed

S ³ species type	Scientific Name	Common Name(s)	EPBC Act Status	IUCN Red List Status
	<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	Vulnerable	Vulnerable
	<i>Lepidodactylus listeri</i>	Christmas Island Gecko, Lister's Gecko	Critically Endangered	Vulnerable
	<i>Liasis olivaceus barroni</i>	Olive Python (Pilbara subspecies)	Vulnerable	Not assessed
	<i>Liopholis guthega</i>	Guthega Skink	Endangered	Not assessed
	<i>Liopholis kintorei</i>	Great Desert Skink, Tjakura, Warrarna, Mulyamiji	Vulnerable	Vulnerable
	<i>Oligosoma lichenigera</i>	Lord Howe Island Skink	Vulnerable	Vulnerable
	<i>Ramphotyphlops exocoeti</i>	Christmas Island Blind Snake	Vulnerable	Vulnerable
	<i>Rheodytes leukops</i>	Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver	Vulnerable	Vulnerable
	<i>Tympanocryptis pinguicollis</i>	Grassland Earless Dragon	Endangered	Vulnerable
	<i>Uvidicolus sphyrurus</i>	Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko	Vulnerable	Lower risk/Near threatened
Amphibian	<i>Heleioporus australiacus</i>	Giant Burrowing Frog	Vulnerable	Vulnerable
	<i>Litoria aurea</i>	Green and Golden Bell Frog	Vulnerable	Vulnerable
	<i>Litoria castanea</i>	Yellow-spotted Tree Frog, Yellow-spotted Bell Frog	Endangered	Critically endangered
	<i>Philoria frosti</i>	Baw Baw Frog	Endangered	Critically endangered
Migratory/ Marine	<i>Amaurornis moluccana</i>	Pale-vented Bush-hen, Bush hen	Marine	Least Concern
	<i>Anous minutus</i>	Black Noddy	Marine	Not assessed
	<i>Anous stolidus</i>	Common Noddy	Migratory: CAMBA; JAMBA. Marine	Least Concern
	<i>Apus pacificus</i>	Fork-tailed Swift	Migratory: CAMBA; JAMBA; ROKAMBA. Marine	Least Concern
	<i>Ardenna grisea</i>	Sooty Shearwater	Migratory: CAMBA; JAMBA. Marine	Near threatened
	<i>Ardenna pacifica</i>	Wedge-tailed Shearwater	Migratory: JAMBA. Marine	Least Concern
	<i>Ardenna tenuirostris</i>	Short-tailed Shearwater	Migratory: JAMBA; ROKAMBA. Marine	Least Concern
	<i>Calonectris leucomelas</i>	Streaked Shearwater	Migratory: CAMBA; JAMBA; ROKAMBA. Marine	Least Concern
	<i>Cuculus saturatus</i>	Oriental Cuckoo	Migratory: CAMBA; JAMBA; ROKAMBA. Marine	Not assessed
	<i>Esacus magnirostris</i>	Beach Stone-curlew	Marine	Near threatened

Species type	Scientific Name	Common Name(s)	EPBC Act Status	IUCN Red List Status
	<i>Gygis alba</i>	White Tern	Marine	Least Concern
	<i>Monarcha melanopsis</i>	Black-faced Monarch	Migratory: Bonn. Marine	Least Concern
	<i>Onychoprion fuscata</i>	Sooty tern	Marine	Least Concern
	<i>Phaethon rubricauda</i>	Red-tailed Tropicbird	Marine	Least Concern
	<i>Procellaria aequinoctialis</i>	White-chinned Petrel	Migratory: Bonn. Marine	Vulnerable
	<i>Procelsterna cerulea</i>	Grey Ternlet	Marine	Least Concern
	<i>Pterodroma nigripennis</i>	Black-winged Petrel	Marine	Least Concern
	<i>Puffinus assimilis</i>	Little Shearwater	Marine	Least Concern
	<i>Sternula albifrons</i>	Little Tern	Migratory: CAMBA; JAMBA; ROKAMBA. Marine	Least Concern

Definitions:

Migratory species

Migratory bird species are those species which migrate to Australia and/or its external territories, or pass through or over Australian waters during annual migrations and require conservation. Under the EPBC Act, migratory bird species are taken to be those species which are: listed on the Appendices of the Bonn Convention, in the Annexes to Australia's bilateral migratory bird agreements; or any other relevant international agreement. The listing of the species as migratory under the EPBC Act makes it an offence to kill, injure, take, trade, keep or move that species without a permit.

Bonn Convention

The Bonn Convention, also referred to as the Convention on the Conservation of Migratory Species (CMS), lists threatened species that cyclically and predictably cross one or more national jurisdictional boundaries (migratory species) and where concerted conservation efforts and effective management of those species is required by range States. Australia is a Party to the Bonn Convention and implements requirements for species listed under its Appendices under the EPBC Act.

Bilateral migratory bird agreements

Australia's bilateral migratory bird agreements provide for the protection and conservation of migratory birds and their important habitats, protection from take or trade except under limited circumstances, the exchange of information, and building cooperative relationships. The following agreements are currently in place:

- CAMBA agreement: China-Australia Migratory Bird Agreement
- JAMBA agreement: Japan-Australia Migratory Bird Agreement, and
- ROKAMBA agreement: Republic of Korea-Australia Migratory Bird Agreement.

The annexes to JAMBA, CAMBA and ROKAMBA identify species known to be regular and predictable migrants between the agreement countries. JAMBA also refers to endangered bird species of each country, but none of these species are regular migrants between Australia and Japan.

Marine species

Under the EPBC Act, a listed marine species is a species that occurs naturally in a Commonwealth marine area and requires long-term conservation. Its listing under the EPBC Act makes it an offence to kill, injure, take,

trade, keep or move that species in a Commonwealth area without a permit and without notification of the action having occurred

Glossary

Critically endangered	Under the EPBC Act, a native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	Under the EPBC Act, a native species is eligible to be included in the endangered category at a particular time if, at that time, (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Endemic	A species that is present in a particular place.
Eradicate	To remove all animals from a population, with no prospect for any moving into the area.
Exclosure/exclusion (fencing)	An area that is fenced to protect the native species within and to prevent the entry of introduced predators.
Feral	An introduced animal, formerly in domestication, with an established, self-supporting population in the wild.
Invasive species	A species occurring as a result of human activities beyond its accepted normal distribution and which threatens valued environmental, agricultural or personal resources by the damage it causes (Beeton et al. 2006).
Key threatening process	Under the EPBC Act, a process that threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.
Performance indicator	A criterion or measure that provides information on the extent to which a policy, program or initiative is achieving its outcomes.
Threat abatement plan	Under the EPBC Act, a plan providing for the research, management and any other actions necessary to reduce the impact of a listed key threatening process on affected species and ecological communities.
Threatened species	A species under the EPBC Act listed as critically endangered, endangered, vulnerable or conservation dependent.
Vulnerable	Under the EPBC Act, a native species is eligible to be included in the vulnerable category at a particular time if, at that time, (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

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