



**Australian Government**

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**Department of the Environment, Water, Heritage and the Arts**

**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 dorreae</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