

Macquarie Island Pest Eradication Program

Review of the impact of 2010 aerial baiting on non-target species

Final Report

Introduction

A Review of the impact of the Macquarie Island Pest Eradication Program's 2010 baiting on non-target species was commissioned by the Australian Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) for the Secretary of the Tasmanian Department of Primary Industries, Parks, Water and Environment (DPIPWE) and the First Assistant Secretary of the Heritage Division of SEWPaC.

Objectives and Scope

The objective of the Review as set out in its Terms of Reference ([Appendix 1](#)) was to:

- assess the impact of the aerial baiting program on bird species; and
- recommend measures that could be implemented to reduce the risk to these species.

The Review was carried out to:

1. Determine whether the baiting operation was conducted in accordance with the conditions of relevant permits/approvals, including those issued under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Agricultural and Veterinary Chemicals Code Act 1994*.
2. Determine what factors contributed to the deaths of bird species, particularly petrels, in 2010 and the extent to which these factors were considered in the original assessment.
3. Determine whether the deaths were due to primary or secondary poisoning.
4. Evaluate the current population sizes and status for petrels and other listed bird species at risk.
5. Provide guidance on additional measures that could be implemented to reduce the number of deaths.
6. Provide an assessment of possible future deaths of these species if these additional measures are implemented.
7. Consider the likely impact of projected deaths on populations of listed bird species for scenarios:
 - i. poisoning with new mitigation measures;
 - ii. the baiting/program being discontinued; and
 - iii. evaluate the recovery potential of non-targeted species.
8. Consider whether the positive impacts of the program on Macquarie Island will outweigh the negative impacts on listed bird species.
9. Make any other recommendations for improving program implementation, including for adaptive management.

This Report presents the findings and recommendations of the Review. The Report will be a key input into advice to be provided to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities and to the Tasmanian Minister for Environment, Parks and Heritage.

Summary of findings

1. The 2010 aerial baiting operation was generally conducted in accordance with the conditions of relevant permits/approvals, however some permit conditions on reporting and carcass collection need to be more explicitly stated.
2. The cause of bird deaths following the baiting operation was brodifacoum poisoning resulting from the presence of carcasses of poisoned bird and target species, the accessibility of these carcasses and the scavenging behaviour of the listed bird species.
3. The deaths of giant petrels and skuas were due to secondary poisoning. The deaths of kelp gulls and black ducks may have been caused by both primary and secondary poisoning but it was not possible to determine their relative contribution.
4. There are about 1829 breeding pairs of northern giant petrel; 2534 breeding pairs of southern giant petrels; and 1030 breeding skua pairs on Macquarie Island. Reported deaths following 2010 baiting as at 8 October 2010 included 276 northern giant petrels (7.5% of number in breeding population); 10 southern giant petrels (0.2%); and 91 skuas (4.4%).
5. The incidence of secondary poisoning following any future baiting operation could be significantly reduced by mitigation measures including systematically searching for and removing poisoned target and bird carcasses. This would require more people to be accommodated on Macquarie Island (about 10 more than in the 2010 baiting operation).
6. The Review team expects that the implementation of the additional mitigation measures would result in fewer deaths following a future baiting operation than would otherwise occur but the number of these deaths cannot be quantified.
7. Populations of the listed bird species which were poisoned following the 2010 baiting operation will be further reduced by any future baiting incorporating additional mitigation measures but they are likely to recover.
8. Whatever mitigation measures are put in place, some deaths of listed birds will follow any future baiting but no population is expected to become locally extinct through baiting. However, if the Eradication Program is not undertaken, catastrophic damage to the ecosystems of Macquarie Island will continue and some seabird breeding populations will likely become extinct on the Island.

Background

Eradication program

The terms of reference note that the eradication of rabbits and rodents from Macquarie Island is critical given their devastating cumulative impacts on native fauna, flora, geomorphology, natural landscape values and nutrient recycling impacts.

In 2007, the Australian and Tasmanian governments agreed to jointly fund the Macquarie Island Pest Eradication Program (the Eradication Program) to eradicate rabbits and rodents (the black rat and house mouse) from Macquarie Island. The

program is being delivered by the Tasmanian Parks and Wildlife Service, DPIPWE. A description of the Eradication Program and its environmental impact statement (EIS) are available at: www.parks.tas.gov.au/?base=12997.

The Eradication Program is led by a Steering Committee and advised by a Scientific and Technical Advisory Committee. A Macquarie Island Pest Eradication Plan, including an EIS and an Operational Plan guide the pest eradication.

Baiting was scheduled to occur between early May and August 2010 and was to include two, whole-island applications of toxic (brodifacoum) cereal bait with a third application in areas of high risk (e.g. cliffs, coastlines) or with high rabbit density. Bait distribution was to be by helicopter and supplemented by hand-laying around buildings and caves.

The Eradication Program also provides for the elimination of individual rabbits which survive baiting by measures including hunting and fumigation but this was not undertaken in 2010 because the island-wide aerial baiting was not completed.

2010 Baiting operation

The Eradication Program provided for arrival at Macquarie Island in late April 2010 and for baiting to commence in late April or early May 2010. However, due to logistical issues the *Aurora Australis* did not arrive on Macquarie Island until 25 May 2010. Bait depot establishment was completed by 1 June but weather conditions did not allow baiting to commence until 5 June 2010. Adverse weather conditions permitted the aerial laying of baits on only five days and the last baiting occurred on 29 June. Baits were laid over only about ten per cent of Macquarie Island. The hand-laying of bait occurred in and around buildings as planned.

While it was anticipated that some bird deaths, including of listed species, would occur as a result of the baiting, an unexpectedly large number occurred. The *Macquarie Island Non Target Bird Mortality, Specifically in Relation to Giant Petrels – Interim Report* describes the chronology, location and impact of baiting ([Appendix 2](#)). On 21 September 2010 there was still evidence of dead and recently dying birds.

By 8 October 2010, the carcasses of 753 birds had been found. The actual number of non-target mortalities would have been higher as not all areas of Macquarie Island were intensively searched and some individuals may have died at sea.

Of particular concern is the recorded death of 276 northern giant petrels, whose Australian population is listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and rare under Tasmania's *Threatened Species Protection Act 1995* (TSP Act) and 10 southern giant petrels which are listed as endangered and vulnerable under the Commonwealth and Tasmanian Acts respectively. Breeding of northern giant petrels in Australia is limited to Macquarie Island. In Australian jurisdiction, southern giant petrels breed on Heard Island, Macquarie Island and the Australian Antarctic Territory. The global populations of the northern giant petrels and southern giant petrels are classified as 'of least concern' by IUCN.

Table 1: Recorded deaths of bird species (as at 8 October 2010) and their EPBC Act and TSP Act status (DPIPWE)

Non-Target Species	Deaths recorded	EPBC Act	TSP Act	IUCN
Northern giant petrel (<i>Macronectes halli</i>)	276	Vulnerable Marine Migratory	Rare	Least concern
Southern giant petrel (<i>Macronectes giganteus</i>)	10	Endangered Marine Migratory	Vulnerable	Least concern
Subantarctic skua (<i>Catharacta lonnbergi</i>)	91	Marine		Least concern
Kelp gull (<i>Larus dominicanus</i>)	356	Marine		Least concern
Black duck (<i>Anas superciliosa</i>)	19			Least concern
Mallard (<i>Anas platyrhynchos</i>) - Alien Species	1			
Total	753			

Review Process

Members of a Review team were appointed on the basis of their relevant experience and because they had not been involved in the design or implementation of the Eradication Program. The Review team comprised:

Paul Murphy (Chair)	Assistant Secretary, Natural and Indigenous Heritage Branch, Heritage Division, SEWPaC
Alex Schaap	General Manager, Biosecurity and Product Integrity, DPIPWE
Dr Geoff Tuck	Resource Modeller, CSIRO Marine and Atmospheric Research
Prof Mark Hindell	Institute for Marine and Antarctic Studies, University of Tasmania

The Review team convened on 22-23 September, and 1 and 12 October 2010 during which the following people were consulted:

- Keith Springer, Project Manager, Macquarie Island Pest Eradication Program (by phone 22 September)
- Dr Rosemary Gales, Section Head, Biodiversity Monitoring Section, Resource Management and Conservation Division, DPIPWE (23 September)
- Ian Hay, Australian Antarctic Division (AAD), Australian contact point for the Agreement on the Conservation of Albatrosses and Petrels (1 October 2010)
- Dr Dana Bergstrom, Principal Research Scientist (Terrestrial Ecologist) AAD (1 October 2010)
- Dr Ben Raymond, Senior Research Scientist (Computational Ecologist) AAD (1 October 2010)

Those listed in [Appendix 3](#) were also consulted.

The following section contains detailed findings against each of the nine matters specified as the scope of the Review in its Terms of Reference.

Detailed Findings of the Review

1. Determine whether the baiting operation was conducted in accordance with the conditions of relevant permits/approvals, including those issued under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Agricultural and Veterinary Chemicals Code Act 1994*

The pest eradication project was referred under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and determined to be not a controlled action if undertaken in a 'particular manner' which sets out how the referred pest eradication is to be undertaken ([Appendix 4](#)).

A permit to allow the use of a regulated chemical product for the control of European rabbits, black rats and house mice on Macquarie Island was issued by the Australian Pesticides and Veterinary Medicines Authority (APVMA) to the Tasmania Parks and Wildlife Service. The permit sets out conditions for the use of the approved poison bait (Pestoff 20R) in the Eradication Program ([Appendix 5](#)).

The Eradication Program also required a number of Tasmanian permits and approvals which are summarised in [Appendix 6](#).

The Review considered the conduct of the baiting operation and determined that it was generally in accordance with the conditions of relevant permits and approvals. Permit conditions for carcass collection and for reporting were, however, not clearly stated. Table 2 and Table 3 summarise the conduct of the aerial baiting against the relevant particular manner and permit conditions of the EPBC Act and the *Agricultural and Veterinary Chemicals Code Act 1994* approvals.

The SEWPaC Approvals and Wildlife Division and the Australian Pesticides and Veterinary Medicines Authority compliance teams also reviewed the matters and did not make any findings of non-compliance.

Table 2: EPBC 2009/5079 - Compliance with Particular Manner

Summary of EPBC Act measure	Program conduct
Measure 1	
The action is undertaken in accordance with the Macquarie Island Pest Eradication Plan – Part C: Environmental Impact Statement – August 2009.	Confirmed by project manager 30 September 2010
Measure 2	
Aerial baiting is undertaken during winter	Baiting occurred 5 June to 29 June 2010 (DPIPWE 2010a)
Green brodifacoum baits to be used	Confirmed by project manager 30 September 2010
Field staff located at Wandering Albatross breeding sites to remove baits	Confirmed by project manager 30 September 2010
Adherence to Pestoff 20R label requirements	Confirmed by project manager 30 September 2010
Measure 3 Not applicable	
Measure 4 Not applicable	

Summary of EPBC Act measure	Program conduct
Measure 5	
"Monitoring of mortality and cause of death of non target species must be undertaken from the commencement of aerial baiting until four weeks following the completion of aerial baiting."	Monitoring commenced 6 June 2010. 'Suspected Baited Wildlife Recording Data Sheets' entered from 9 June 2010 to 31 July 2010.

Table 3: APVMA Permit PER10895 - Compliance

Summary of APVMA permit requirement	Program conduct Comment
Permit in force from 1 May 2009 to 30 September 2011	Baiting occurred in June 2010 (DPIPWE 2010a)
Product to be used: Pestoff Rodent Bait 20R containing 0.02g.kg Brodifacoum as its only active constituent	Confirmed by project manager 30 September 2010
Only trained or experienced employees or persons under the direct supervision of Tasmania Parks and Wildlife to use product	Confirmed by project manager 30 September 2010
Permit conditions read by users/ product used in accordance with label	Label and permits covered with baiting team - Confirmed by project manager 30 September 2010
GPS used to log bait placement	TracMap GPS used to guide and log helicopter bait distribution. Confirmed by project manager 30 September 2010
Visible carcasses of target animals in accessible areas retrieved/disposed	Permit requirements for carcass collection require clarification. Retrieved on an <i>ad hoc</i> basis and following targeted searches (DPIPWE 2010a)
Non target species at risk of poisoning monitored for mortality and behaviour changes	Reported in 'Suspected Baited Wildlife Recording Data Sheets'
Any significant effects on non-target species to be reported to APVMA within 7 days	APVMA advise that such a report was not provided, however the review team considers that permit conditions for non-target mortality reports require clarification.
Monitoring and collation of data on behaviour and death of target species.	Monitored and collated in 'Suspected Baited Wildlife Recording Data Sheets'
Report on monitoring and efficacy of program, once completed, to be provided to APVMA	Monitored and collated in 'Suspected Baited Wildlife Recording Data Sheets'

Given the realisation that, regardless of implementation of mitigation strategies, some non-target species (including protected and threatened species) will be killed in any future aerial broadcast of baits, permits to "take" protected wildlife shall be required for any future baiting under Tasmania's *Nature Conservation Act 2002* and *Threatened Species Protection Act 1995*.

2. Determine what factors contributed to the deaths of bird species, particularly petrels, in 2010 and the extent to which these factors were considered in the original assessment

While the cause of death of all birds was not established, most were examined and found to have evidence of haemorrhage consistent with brodifacoum poisoning (brodifacoum is the active ingredient of the bait Pestoff 20R). The Review found that the deaths of giant petrels and skuas resulted from secondary poisoning. Kelp gulls were likely to have been killed through both primary and secondary poisoning.

Key factors that contributed to bird deaths through secondary poisoning were the toxicity of poisoned carcasses, the availability of these carcasses and the presence and scavenging behaviour of the affected listed bird species.

The Eradication Program EIS assessed the risk of primary and secondary poisoning to non-target species. The assessment was based on known species behaviour, past pest eradication attempts on comparable islands and the results of trials using non-toxic baits.

The EIS concluded that there would likely be relatively few target carcasses available following the baiting operation because most rabbits would die in burrows. The EIS also noted that the reduced number of birds in winter, together with the tendency of giant petrels to feed more on coastal carrion than search for food inland, made it unlikely that the impact of the baiting would be significant, although some impact at an individual level could be expected (EIS pp. 47-52).

Based on the bird mortalities following the 2010 baiting operation, it is clear that if the Eradication Program continues it should be modified to include:

- i. systematic monitoring of baited and non-baited areas for target and non-target carcasses;
- ii. dedicated resources to remove carcasses; and
- iii. adaptive management mechanisms to address the deaths of non-target species during the baiting operation.

Toxicity of carcasses

It is evident that the many accessible carcasses contained levels of poison that were dangerous to birds. While not quantified, the toxicity of carcasses to birds is likely to have been variable and affected by the quantity of poison consumed by the food source prior to death. Brodifacoum poisoning does not take effect immediately after baits have been consumed. Target and non-target species which consumed brodifacoum by eating baits or by secondary ingestion potentially accumulated more than a lethal dose of the toxin before their behaviour was affected and they died.

The bait application rates may have contributed to the availability of baits in the environment and to the toxicity of carcasses. The Eradication Program provides for the bait to be applied on Macquarie Island at a rate (up to 44 kg/ha). This was in response to the very high density of rabbits on the Island, their capacity to consume a significant quantity of bait before they die and the need to ensure complete eradication of the three target species. The availability of the baits may have contributed to the incidence of primary poisoning of kelp gulls and black ducks.

Availability of carcasses

Poisoned carcasses of target species and birds were more available to scavenging by birds than expected following the baiting operation. While the evidence is that a very large percentage of rabbits died in burrows as expected following the baiting, a sufficient number of their poisoned carcasses and those of poisoned birds remained accessible for long enough to cause higher than expected mortalities.

Presence and behaviour of birds

The commencement of baiting was delayed until 5 June 2010 and the final baiting occurred on 29 June 2010. Poisoned carcasses were still accessible to scavengers in September 2010, when the numbers of skuas and giant petrels were increasing and the nest building behaviour of giant petrels had commenced.

Although baiting covered only about 10 per cent of Macquarie Island, giant petrels and skuas from around the Island were poisoned because these species disperse widely to feed. Carcasses of these species appeared around the Island following the 2010 baiting (DPIPWE 2010a).

Once poison entered the population of scavengers, it is likely to have cycled within their populations, causing secondary and tertiary fatalities. The persistence of baits in the environment contributed significantly to both primary and secondary poisoning and presents significant challenges in mitigating non-target mortality.

3. Determine whether the deaths were due to primary or secondary poisoning

It is not possible to precisely quantify the relative impacts of primary and secondary poisoning on non-target species as this was not able to be definitively established in the field. However, the known and observed behaviour of affected species during baiting trials and following the baiting operation strongly indicate that secondary poisoning caused the deaths of giant petrels and skuas, while the deaths of kelp gulls were probably a result of both primary and secondary poisoning. The cause of black duck deaths was not determined but both primary and secondary poisoning may have occurred.

The Review found that it is highly likely that giant petrel deaths occurred through secondary poisoning following scavenging of poisoned rabbit and bird carcasses. Northern giant petrels were observed feeding on dead rabbits following the 2010 baiting. Northern giant petrels were also observed engaging in cannibalism. Giant petrels showed no interest in non-toxic baits during 2007 trials. Following the trials, the risk to giant petrels from primary poisoning was assessed as non-existent to very low (EIS p. 52).

The Review found that skua deaths are highly likely to have been caused by secondary poisoning. Skuas were assessed in the EIS (p. 48) to be at low risk of primary and high risk of secondary poisoning as skuas showed no interest in baits in 2005 and 2007 trials and rabbits are known to be a primary prey species for skuas on Macquarie Island. Skuas were observed scavenging rabbit and kelp gull carcasses following the 2010 baiting operation.

It is not possible to determine whether kelp gulls died mainly as a result of primary or secondary poisoning but both may have occurred. Kelp gulls were observed scavenging carcasses following the 2010 baiting. They consumed non-toxic bait during 2005 trials and some primary poisoning was anticipated (EIS p. 48).

Black ducks as surface-feeding, mainly plant-eaters, probably died through primary poisoning, although it is also possible, but less likely, that secondary poisoning occurred from preying on aquatic invertebrates.

4. Evaluate the current population sizes and status for petrels and other listed bird species at risk

Current populations are summarised in Table 4 below, based on recent DPIPWE monitoring.

Table 4: Population of listed birds on Macquarie Island at risk of poisoning (DPIPWE 2010a)

Species	Population on Macquarie Island (annual breeding pairs) and year of estimate	2010 observed bird deaths as percentage of breeding population on Macquarie Island*	Global population of breeding pairs (Macquarie Island population as a per cent)	Population trend on Macquarie Island
Northern giant petrel	1829 (2010/11)	7.5%	11,800 (15.5%)	Moderately increasing
Southern giant petrel	2534 (2009/10)	0.2%	50,170 (5.0%)	Stable
Subantarctic skua	1030 (2009/10)	4.4%	-	Stable?
Kelp gull [#]	"hundreds"	Unable to be determined	-	Unknown. Population highly variable

* Approximate indicator of impact on population numbers only: many dead birds would not have been found; non-breeding individuals including juveniles are not counted in breeding populations; and some giant petrels may have had incorrect species assigned.

[#]Kelp gull numbers on Macquarie Island are highly variable but were still reported to occur in large numbers in October 2010.

5. Provide guidance on additional measures that could be implemented to reduce the number of deaths

The key measure to reduce bird deaths would be the removal of the carcasses of poisoned bird and target species from Macquarie Island following any further baiting, possibly supplemented by the provision of alternative food sources.

While a number of additional measures to mitigate bird deaths are suggested below, a Bird Technical Advisory Group could be established to provide further guidance on the conduct of any future baiting operation.

Bird Technical Advisory Group

A Bird Technical Advisory Group (BTAG) could be established to:

- develop bird mortality mitigation methods (including, but not limited to, bait application procedures, carcass collection, alternative food sources, administration of vitamin K and operational timing and responses to adverse weather conditions);
- identify the extent and timing of resources required for the project (new, dedicated resources and existing Eradication Program operational resources);
- prepare a detailed proposal for the adaptive management of carcass collection including:

- a. systematic monitoring, recording and documentation of the search operations and the location, identification, condition, and cause of death of bird and target carcasses
 - b. systematic, targeted and flexible searching protocols
 - c. carcass disposal protocols; and
- iv. provide advice and make recommendations to the Steering Committee on i-iii and any other recommendations to mitigate bird deaths (e.g. toxicant selection, use of rabbit calicivirus).

The BTAG should include operational, seabird and ecological experience and expertise and consult relevant experts as required.

The Steering Committee would then consider the advice from the BTAG and:

- i. establish a plan for bird mortality monitoring and mitigation including clear contingency planning;
- ii. establish a dedicated Mitigation Team on Macquarie Island to implement the plan. This team would sit alongside and work with the existing Eradication Team and report to the project manager. The Eradication Team would support the activities of the Mitigation Team whenever feasible and vice versa as long as a dedicated and systematic carcass collection program was maintained;
- iii. establish procedures for monitoring and regular and timely (including daily) reporting of non-target deaths to the Steering Committee; and
- iv. ensure that the BTAG is kept up to date on the operations on the Island and take advice during the operations from the BTAG in accordance with any adaptive management plan.

Toxicity of carcasses

Further technical advice has been sought from the Island Eradication Advisory Group on whether brodifacoum application rates could be reduced without compromising the success of the pest eradication. The Group has indicated that reducing the application rate was unlikely to significantly influence non-target mortality and would increase the risk of eradication failure.

Availability of carcasses

While there were daily patrols of the isthmus area of the Island, the search for and removal of carcasses following the 2010 baiting operation was *ad hoc*, depending on resources not committed to other operational requirements and was disrupted by bad weather. Significant numbers of poisoned target and non-target species were accessible to scavenging giant petrels, skuas and kelp gulls following the baiting.

With sufficient additional effort and resourcing, the systematic removal of target and bird carcasses following any future baiting operation would be likely to reduce the number of deaths of listed species from secondary poisoning. While carcass removal is an unproven technique, advice including from the project manager and Ranger in Charge of Macquarie Island indicate that the collection of carcasses is practical if adequately planned and resourced and likely to reduce deaths through secondary poisoning.

A team of about ten people, dedicated to carcass detection and removal, would likely be needed for effective coverage of the Island. The actual number would need to be determined following advice of the Bird Technical Advisory Group discussed above. This could require about 50 people to be accommodated on Macquarie Island.

In addition, careful consideration should also be given to the use of dogs trained under the program to search for dead rabbits.

Presence and behaviour of birds

The provision of an alternative source of food to reduce secondary poisoning should be considered to further assist in reducing bird deaths. Elephant seal carcasses have been suggested as a food source warranting further investigation. Other suitable food could potentially be brought to the Island but biosecurity and logistical considerations would need to be addressed. It also was suggested that trials of alternative feeding of giant petrels could be conducted over summer 2010-2011 if this was considered a priority.

While the efficacy of providing an alternative food source in reducing bird mortalities cannot be quantified, the foraging of giant petrels across the Island and their habit of congregating at food sources may be exploited and if successful is likely to reduce scavenging on poisoned carcasses.

The possibility of rats exploiting alternative food sources would need to be addressed. The addition of vitamin K (an antidote to brodifacoum) to alternative food sources including its administration through hand feeding to avoid access by rats and ensure its availability to non-dominant birds could also be considered.

It is critical that the aerial baiting operation is completed in one season over the entire Island to avoid the need to re-apply baits and the additional bird mortalities that this would cause. Accordingly, baiting should commence as soon as practical after giant petrel chick-rearing finishes in April to maximise the number of days available for aerial baiting. Among other things, the need to avoid baiting when rabbits and rodents are still breeding and to avoid impacts on penguin colonies and albatross young would also need to be considered.

While there is considerable search bias, most dead skuas following the 2010 baiting were found in September 2010 after the return to the Island of greater numbers of this species.

Southern giant petrels arrive at breeding colonies from July. The northern giant petrel breeding season begins in August (DPIPWE 2010a). It is noted, however, that significant numbers of giant petrels remain on Macquarie Island over winter and that major food sources (elephant seals and penguin species) do not return until spring. Substantial further deaths among individuals present over winter in any future baiting operation may be unavoidable.

Kelp gulls are present all year and significant further deaths of these species in any future baiting operation may also be unavoidable.

6. Provide an assessment of possible future deaths of these species if these additional measures are implemented

While only about ten per cent of Macquarie Island was baited, a significantly larger proportion of the coast and adjacent slopes, which is primary habitat for listed birds, was baited. Even without additional mitigation measures, it is unlikely that the number of extra deaths following any future baiting would be directly proportional to the increase in the area baited.

There is evidence that birds from most/all of the island were exposed to poisoning in 2010 as carcasses were collected along the entire coastline and it is known that giant petrels and skuas cover large distances when foraging.

Further, as noted in 5 above, with sufficient effort and resources the systematic removal of poisoned carcasses during any future baiting operation would be expected to significantly reduce deaths arising from secondary poisoning.

7. Consider the likely impact of projected deaths on populations of listed bird species for scenarios:

- i. poisoning with new mitigation measures;**
- ii. the baiting/program being discontinued; and**
- iii. evaluate the recovery potential of non-targeted species**

It is likely that the populations of listed bird species will, in time, recover from the poisoning that occurred following the 2010 baiting operation and from mortalities associated with future baiting incorporating new mitigation measures. The impact on populations of the deaths associated with the 2010 and any new baiting cannot, however, be accurately quantified on the information available.

Without pest eradication, populations of birds including burrowing petrels, giant petrels, albatrosses and prions will remain vulnerable to impacts of vegetation degradation on Macquarie Island. The local extinction of breeding populations of some burrowing petrel and albatross species is likely.

Table 5 summarises the impacts on populations of listed species and key groups at risk from the presence of rabbits and rodents on Macquarie Island that would be likely to result from successful poisoning with new mitigation measures and the discontinuation of baiting.

Table 5: Impact on populations following new poison mitigation measures and discontinuation of baiting - listed species poisoned in 2010 and other key groups

Species	i New mitigation measures	ii Baiting discontinued
Burrowing petrels	Increase in breeding population if eradication is successful. Potential re-colonisation of the Island of additional species.	Continued loss of breeding habitat and continued black rat predation. Potential extinction of populations of blue, grey, white-headed and soft-plumaged petrels
Albatrosses	Increase in breeding population if eradication is successful – subject however to impacts of fisheries related mortalities	Continued loss of breeding habitat. Potential extinction of populations of grey-headed and black-browed albatross

Species	i New mitigation measures	ii Baiting discontinued
Prions	Increase in breeding population if eradication successful	Continued loss of breeding habitat and continued black rat predation. Population decline.
Northern giant petrel	Some medium term decline followed by possible increase	Probable recovery to 2010 level and moderate increase (following 1994-2009 data trend). Will remain vulnerable to impacts of vegetation degradation on breeding success
Southern giant petrel	Some medium term decline followed by stabilisation	Probable recovery to 2010 level and then stable (following 1994-2009 data trend). Will remain vulnerable to vegetation degradation
Skua	Some short term decline through bait mortality, followed by partial recovery	Probable recovery from 2010 mortalities and then stable/small increase
Kelp gull	Significant short term decline followed by recovery	Rapid recovery of population

The Eradication Program (Justification and Overview p. 28) lists 22 bird species that are highly likely to benefit from an eradication operation ([Appendix 7](#)).

Giant Petrels

It is likely that giant petrel populations will recover from the impact of the 2010 baiting operation and from deaths associated with any revised baiting operation. As indicated under 4 above, about 7.5 per cent of the number of northern giant petrels in breeding pairs was reported to have been poisoned in 2010. On the same basis about 0.2 per cent of southern giant petrels were reported poisoned. However, of a small sample whose sex was determined following the 2010 baiting, some 90 per cent of poisoned giant petrels were males (which scavenge more on land). This would be likely to reduce the number of breeding pairs more than if an equal number of males and females had been killed. It is also noted that the population of northern giant petrels may have artificially benefited from the presence of rabbits on Macquarie Island.

The recovery potential of giant petrel populations has not been quantified given gaps in the demographic data. Petrels are long-lived, with strong site and partner fidelity and have low reproductive output. There is not likely to be substantial immigration of giant petrels from other subantarctic populations to Macquarie Island. Fledgling Macquarie Island giant petrels are at sea for a minimum of four years prior to returning to the Island and there is an unknown, but probably substantial, proportion of adult petrels that will not be present during the baiting program. These returning birds will likely provide an initial increase in breeding population size and as such provide a natural buffer to a major mortality event on the breeding island.

This relatively rapid initial rate of increase is expected to become tempered after four years or more as the smaller breeding population following the mortality event produce a smaller absolute number of juveniles and these, in their turn, enter the breeding population. As a caveat it should be noted that the general trends described may be masked or complicated by demographic stochasticity and the level of compensation exhibited by these populations (for example it is possible that males would breed earlier if more un-paired females were available).

The persistence of large numbers of giant petrels throughout winter, together with the persistence in the toxicity of the baits, makes mitigating the mortality of these birds challenging and hence a priority.

Skuas

Most of the skua population does not winter on the Island (DPIPWE 2010a). The skua population would be expected to recover from 2010 baiting and from a revised baiting operation conducted in winter. Numbers of skuas on Macquarie Island may be higher than normal due to the abundance of rabbits which are a food source. The eradication of rabbits may reduce their numbers over the long term. As indicated under 4 above, about 4.4 per cent of the number of skuas in breeding pairs was reported to have been poisoned in 2010

Kelp Gulls

Kelp gull mortalities are expected to be large following any future poisoning. As they may be subject to primary poisoning, mitigation measures may be of limited effectiveness. However, kelp gulls are a cosmopolitan species and effective colonisers and would be expected to re-establish populations on Macquarie Island.

8. Consider whether the positive impacts of the program on Macquarie Island will outweigh the negative impacts on listed bird species

The benefit of rabbit and rodent eradication on Macquarie Island on other listed species has been well established (e.g. DEH 2005, DEWHA 2009, Tasmania Parks and Wildlife Service 2006, EIS). Grazing by rabbits has caused extensive damage to the ecosystems of Macquarie Island. Black rats are documented as impacting endemic plant species.

Vegetation is considered likely to return to a more natural state if rabbits are removed. This has been demonstrated by vegetation regrowth within rabbit exclusion plots on Macquarie Island and by studies of vegetation after the introduction of myxomatosis. A number of examples worldwide have demonstrated significant benefits to island ecosystems as a result of pest eradication programs. Successful rodent eradication programs have occurred on other sub-Antarctic islands including New Zealand's Campbell Island (11,300 ha) (EIS). Macquarie Island has an area of 12,780 ha.

The Review did not re-evaluate pest control options for Macquarie Island which was outside its Terms of Reference. Pest eradication, rather than suppression, is the management objective for the Island. The management plan for Macquarie Island identifies the eradication of rabbits, rats and mice as the highest priority for management. An assessment of the population status and threats to ten seabird species listed as threatened under the EPBC Act indicated that on Macquarie Island, the integrated eradication of feral pests - rabbits and rodents - must be given highest priority to assist effective conservation of all burrowing petrel species on the island (DEH 2005, DEWHA 2009).

The impact of rabbits on the vegetation of Macquarie Island is affecting the success of the burrowing seabirds. Predation by black rat is identified as a threat to at least nine bird species that breed on Macquarie Island. House mice might also have a significant

impact on vegetation and invertebrate populations and predate burrowing seabird eggs.

It is highly likely that the positive impacts of a successful modified baiting operation will, overall, outweigh the negative impacts on listed bird species. Published studies, the EIS, and subsequent advice from experts are clear that without pest eradication, the Macquarie Island ecosystem including populations of birds such as burrowing petrels, giant petrels, albatrosses and prions remain vulnerable to impacts of vegetation degradation and rat predation (e.g. DPIPWE 2010c). The eventual loss of breeding populations of some burrowing petrel and albatross species is likely if no eradication or long term suppression of pests occurs.

The persistence of breeding populations of black-browed and grey-headed albatrosses and blue, grey, white-headed and soft-plumaged petrels on Macquarie Island are threatened by rodent predation and ecological damage caused by rabbits.

The eradication of rabbits is likely to provide positive outcomes for giant-petrel populations in the long-term. While breeding populations have been stable or moderately increasing, the rabbit population is having an increasing impact on their breeding habitat and may reduce breeding success in the long term. Negative impacts on seabird breeding habitat include increased fragility of the breeding slopes, significant erosion to the coastal escarpment and widespread loss of vegetation due to rabbit grazing (DPIPWE 2010b pp. 16-17, 161).

The program is unlikely to have a significant effect on numbers of skuas or kelp gulls on Macquarie Island in the long term. Skua numbers on the Island currently may be inflated due to the presence of rabbits which are a food source. An increase in the population of burrowing petrels as a result of pest eradication may provide an alternative food source.

If rabbits and rodents are not eradicated, the local extinction of a number of burrowing petrel and perhaps eventually albatross populations from the Island is likely. Whilst northern giant petrels are likely to be substantially impacted by any future baiting, their extinction on Macquarie Island would seem extremely unlikely. Additionally, the effect of 2010 baiting on the southern giant petrels population was slight and a substantial impact on their population from further baiting is unlikely.

All experts consulted by the Review in session were of the view that, despite the risk of bird mortalities, the Eradication Program should be continued to address the severe and continuing degradation of Macquarie Island ecosystems and impacts on bird populations.

9. Make any other recommendations for improving program implementation, including for adaptive management.

The Review encourages continued monitoring/modelling of impacted populations following the 2010 and any further baiting operation to inform adaptive management of population changes that result directly or indirectly from the Eradication Program.

Agencies should consider whether changes to existing approvals and permits are required.

Any future baiting operations and the proposed carcass collection operation should report on an agreed and regular basis to the Steering Committee and governments.

The single most important matter for the Steering Committee is to seek to ensure that any future baiting is completed in one season to maximise the chance of pest eradication and avoid additional bird deaths from any subsequent baiting - nothing should be done to prejudice this outcome except in the most extenuating of circumstances.

Appendices

Appendix 1: Terms of Reference

Appendix 2: *Macquarie Island Non Target Bird Mortality, Specifically in Relation to Giant Petrels – Interim Report*

Appendix 3: Organisations and individuals consulted

Appendix 4: EPBC 2009/5079 referral decision

Appendix 5: AGVET Permit PER10895

Appendix 6: Annotated table of permits required by the Eradication Program

Appendix 7: Species expected to attain long term benefits from a successful eradication program

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