Eradication of the Pacific Rat (*Rattus exulans*) from Adele Island Nature Reserve, Western Australia APVMA permit number – PER13966

Impact of the October 2013 Aerial baiting on non-target species

Figure 1. Aerial view of tidal inlet and channels on Adele Island.

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Summary

In October 2013, two aerial broadcasts of the rodent bait, Pestoff 20R with the active ingredient brodifacoum (0.02g/kg / 20 ppm), were applied to Adele Island to eradicate the invasive Pacific Rat. The average application of bait during the first drop was 37 kg/ha (20-21 Oct) and 7.2 kg/ha for the second drop (30-31 Oct). No rats were recorded on seven remote cameras set on the island from the 1st to the 22nd November. Forty deceased birds showed sign of brodifacoum poisoning. These included five Buff-banded Rails (*Gallirallus philippensis*), seven Silver Gulls (*Larus novaehollandiae*) and 28 Ruddy Turnstones (*Arenaria interpres*). All were recovered 9 to 12 days after the first bait drop. The Buff-banded Rails and Silver Gulls were assessed to be at high risk of primary and/or secondary poisoning. Ruddy Turnstones were assessed to be at risk from secondary poisoning by eating bait contaminated invertebrates. Planned mitigation measures to minimise bait from entering the intertidal zone in the inlet area of Adele Island following the first bait drop were unable to be implemented due to logistic constraints. Time lost due to engine failure on the bait spreader limited our ability to remove stray bait from the tidal channel leading into the inlet. Invertebrates in the intertidal zone probably consumed wet bait, resulting in the secondary poisoning of the Ruddy Turnstones. Whilst unfortunate, these non-target losses were minimal considering there may have been over 40 000 seabirds and shorebirds present. The Buff-banded Rails and Silver Gulls both breed locally. We expect these documented losses for these species will be rapidly made up by recruitment of new individuals into the breeding population.

1 Background

Adele Island is situated ~90 km north east of Cape Leveque, Dampier Peninsula, Western Australia at 15°31'30"S 123°09'30"E. The island is 294 ha in size and is a Class A Nature Reserve for the conservation of flora and fauna (Figure 1). It is an internationally significant seabird breeding island that supports large numbers of breeding species including Lesser and Greater Frigatebird, Brown, Masked and Red-footed Booby, Brown Noddy, and Bridled, Crested and Lesser Crested Terns. Eighty-two species of bird have been recorded on Adele Island. Twenty species of seabird, eight of the ten coastal waterbirds, and twenty-seven of the twenty-nine shorebird species recorded there are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as marine and/or migratory species. Adele Island has no known land-based native mammals or reptiles.

The Pacific Rat (*Rattus exulans*) was first recorded on Adele Island in 1891 (Walker 1892). It was probably introduced by traditional Indonesian fishers. Although not quantified, it is likely that the Pacific Rats have a negative impact on the biodiversity of Adele Island, especially on smaller species of seabirds and shorebirds. The impact of Pacific Rats on insular seabirds is well documented elsewhere (Jones, et al. 2008) and predation by exotic rats on Australian offshore islands of less than 1000 km² (100,000 ha) is listed as a key threatening process under the EPBC Act 1999.

The Australian Pesticides and Veterinary Medicines Authority (APVMA) issued the Department of Parks and Wildlife (DPaW; formerly Department of Environment and Conservation) with a permit (#13966) to aerial broadcast an anti-coagulant poison, brodifacoum (0.02g/kg), on Adele Island to eradicate the Pacific Rat in August 2013 (http://permits.apvma.gov.au/PER13966.PDF). The nature of the bait and the mode of delivery (aerial broadcasting) resulted in the potential for both primary and secondary poisoning of non-target species during the baiting of Adele Island.

2 Potential species at risk and mitigation strategies

The potential environmental hazard to non-target species from the proposed distribution of brodifacoum baits on Adele Island was assessed for the 82 species of bird recorded there. This risk assessment identified that a range of species were at risk of primary and/or secondary poisoning from the baiting operation but concluded that anticipated mortality was not likely to have a lasting effect on the non-target populations. A series of mitigation strategies were developed to further minimise non-target mortalities. This risk assessment and proposed mitigation strategies formed part of the permit application to the APVMA and the subsequent application for animal ethics approval lodged with the DPaW Animal Ethics Committee (Approved DEC AEC 2010/39).

Potential impacts on the populations of Silver Gull (*Larus novaehollandiae*), Buff Banded Rail (*Gallirallus philippensis*), Nankeen Night Heron (*Nycticorax caledonicus*), Brown Quail (*Coturnix ypsilophora*) and Nankeen Kestrel (*Falco cenchroides*) on Adele Island were predicted as mitigation measures to reduce their exposure to the toxin were limited. A further 18 species of shorebird recorded on Adele Island were assessed to be at some risk of secondary poisoning by eating bait contaminated invertebrates along the beach and the intertidal zone. It was also apparent that Common Greenshank (*Tringa nebularia*) and Ruddy Turnstone (*Arenaria interpres*) may eat dead or dying rodents if they encountered them.

To minimise potential exposure and toxic effects to non-target species of the baiting program, the following mitigation measures were planned;

- Use of a less potent bait, Pestoff 20R Rodent Pellet Bait containing 0.02g/kg of brodifacoum and dyed green to deter birds,
- Removal of stray bait from the beach and tidal inlet to prevent invertebrates from feeding on the pellets,
- Baiting on the low tide to provide personnel the chance to remove stray bait from the beach and inlet,
- Use of an ATV (quad bike) to enable rapid inspection of the beach and inlet,
- Checking of the high tide mark on the beach the day after each baiting session for any washed-up bait,
- Hand broadcasting of bait on small islets within the tidal inlet to ensure accurate dispersal of bait; and
- Collection and disposal of dead rats and birds encountered.

3 Methods – eradication program

Two aerial applications of bait were approved, an initial drop of up to 32 kg of bait per ha, followed by a second distribution of up to 12 kg/ha. The minimum period between bait drops was eight days (http://permits.apvma.gov.au/PER13966.PDF). A quad bike was slung onto the island to patrol the ~8 km of beach around the outside of the island and the tidal inlet (~4 km of perimeter) for stray bait and carcases of dead rats and birds.

3.1 Operations schedule

The timetable for baiting and monitoring activities on Adele Island are summarised in Appendix 1. Briefly, the first bait drop occurred on the 20/21 October and the second on the 30/31 October. We left the island on the afternoon of the 22 October and returned on the 28 October, and then departed from Broome on the 1 November.

3.2 Remote camera monitoring

The success of the baiting program was monitored using seven trail cameras (Hyperfire HC600, Reconyx Inc., Holmen) baited with poison rodent bait blocks. These cameras were established around the outer perimeter of the island on the 22 October and checked on the 29 October. Due to the large number of false triggers during the heat of the day, the HC600 cameras were replaced on the 31 October with HC900 cameras. These newer model cameras were programmed to operate from 30 minutes before sunset to 30 minutes after sunrise (6:30 pm to 5:30 am) to reduce the number of false triggers. An additional camera was also deployed on this date. A handful of Pestoff 20R rodent pellet bait was added as an attractant in front of each camera. These eight cameras were collected on the 22 October. One camera failed to work.

4 Results and Discussion

4.1 Bait application rates

The mean application rates for the first and second bait drops were 37.0 kg/ha and 7.2 kg/ha, respectively. There was a 9-10 day interval between the two bait drops.

The first bait drop exceeded the maximum amount of 32 kg/ha set out in the APVMA permit. Operational problems were encountered with the engine on the bait spreader bucket. The engine operated normally on the ground, but it cut-out regularly once in flight, particularly as temperatures increased. All attempts to fix the motor in the field failed. It was necessary to repeat bait lines on which engine stoppages occurred as the pilot was not always able to accurately detect when it cut-out (see Figure 2 for multiple flight lines). This ensured there were no gaps in the distribution of bait on the island during the first bait drop so that all rats on the island were exposed to lethal dose of bait. Consequently, an additional 1470 kg of bait was applied to the island (mean 5 kg/ha). This over application during the first drop resulted in a proportionate decrease in the amount of bait applied during the second drop (7.2 kg/ha instead of 12 kg/ha) as we had a fixed amount of bait.

The engine problems increased the time required to bait the island from half a day to 1.5 days, which had flow-on logistical effects for bait removal operations from areas below the tide line. Bait was removed from the beaches on the 22 October but there was no time available to search and remove stray bait from the inlet or channels on the island following the first bait drop.

4.2 Bait and carcase searches and removal/disposal

During patrols conducted on 22 October (1 day after the first bait drop), over 100 dead Boobies (mostly Brown) of various stages of decomposition were observed. As it was toward the end of the Booby nesting season, most were fledglings that had probably died from starvation. Mummified carcases of a small number of other species of bird were observed, along with a dead adult Green Turtle. There was no indication that any of these observed carcases were a result of the baiting program.

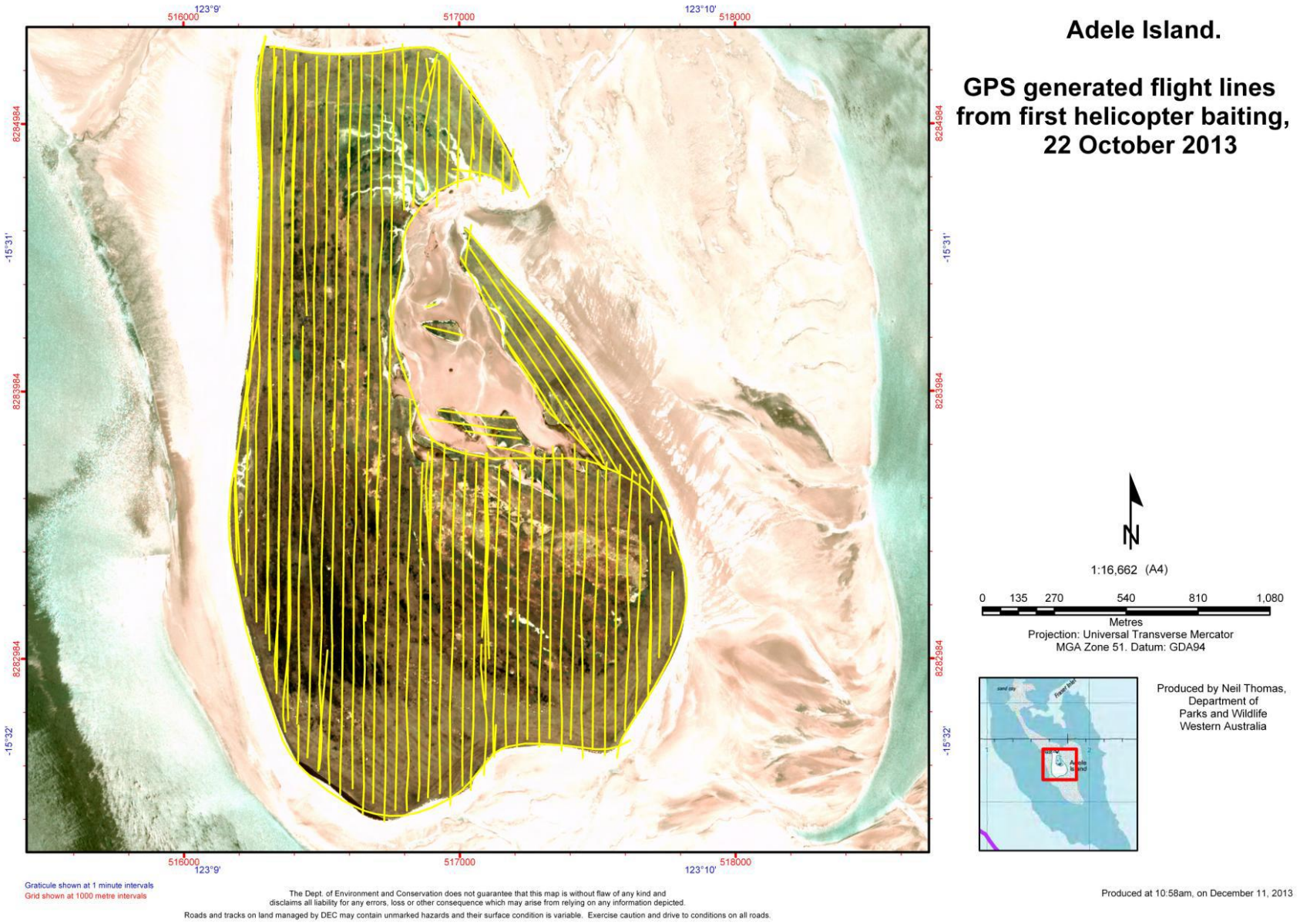

Figure 2. GPS generated flight lines for the first application of bait on Adele Island on the 20-21 October 2013

4.2.1 Carcases retrieved from the 29 October to 1 November.

Only six dead rats were located and buried. Forty-five freshly dead birds belonging to seven species were recovered and autopsied (Table 1). The Brown Booby, Common Greenshank, Brown Noddy and Pied Cormorants showed no sign of haemorrhage (n=5; Table 1). These five individuals were in poor condition indicating they died from starvation or other factors. The other forty individuals consisting of Buff-banded rails, Silver Gulls and Ruddy Turnstones were all found to have evidence of haemorrhage consistent with brodifacoum poisoning upon field necropsy (Table 1). Liver samples were taken from a sub-sample of 20 dead birds (with and without signs of haemorrhage) and stored in 100% ethanol for future analysis of brodifacoum residues if required (Table 1). Dead birds were disposed of via deep burial.

The number of deaths in the Ruddy Turnstones per day appeared to decline over the four-day period, whereas deaths in Silver Gulls were highest on the last day (Table 2). Silver Gulls apparently died from secondary poisoning, with rat hair found in the stomach of a necropsied bird. Buff-banded rails are likely to have succumbed to primary poisoning by feeding directly on the bait. Twenty-seven of the twenty-eight dead Ruddy Turnstones were found in the inlet area on Adele Island. This shorebird was observed feeding in the inlet and tidal channels at low tide. It is likely that they were exposed to contaminated invertebrates that had eaten wet bait. We had hoped to avoid exposing shorebirds to lethal doses of brodifacoum by removing stray bait from below the tide line in the inlet. Due to the time over-run for the baiting operation this was not possible following the first application of bait. The large 7 m tides probably contributed to washing bait from the channels into the inlet, where it ingested by invertebrates that were subsequently eaten by the Ruddy Turnstones.

No deaths were recorded in the other high risk species, Brown Quails or Nankeen Night Herons. Nankeen Night Herons were known to feed on rats on Adele Island placing them at risk of secondary poisoning. This was a species that a local naturalist from Broome claimed that the baiting operation would exterminate (pers. comm. Richard Costin). These two species are cryptic, so it is possible that deaths may have gone undetected. The fact we found dead Buff-banded Rails, an equally cryptic species on Adele Island, suggests we would have at least detected the presence of dead Nankeen Night Herons if significant numbers of this species had succumbed to brodifacoum poisoning. Another high risk species, Nankeen Kestrel, was not present on the island during the baiting operation.

Table 1. Summary of birds found dead during the Adele Island rat eradication program.

Scientific Name	Common Name	Number autopsied	No. with sign of brodifacoum poisoning	No. of liver samples collected
Sula leucogaster	Brown Booby	1	0	0
Tringa nebularia	Common Greenshank	1	0	1
Anous stolidus	Brown Noddy	1	0	1
Phalacrocorax varius	Australian Pied Cormorant	2	0	2
Gallirallus philippensis	Buff-banded Rail	5	5	4
Chroicocephalus novaehollandiae	Silver Gull	7	7	6
Arenaria interpres	Ruddy Turnstone	28	28	6
Total		**45**	**40**	**20**

Table 2. Daily records of birds showing signs of brodifacoum poisoning from the 29 October to the 1 November.

Date	Buff-banded Rail	Ruddy Turnstone	Silver Gull
29 October	3	15	1
30 October	2	6	
31 October	-	5	1
1 November	-	2	5
Total	**5**	**28**	**7**

4.3 Follow-up monitoring

4.3.1 Seabird and shorebird survey 22 November

Dr. Rohan Clarke and his seabird team of eight others from Monash University arrived at Adele Island on the 22 November to complete comprehensive surveys of the birds on the island to complement previous surveys undertaken in April and November 2012 and April 2013 (Clarke et al 2012a & b, 2013). Unfortunately, Tropical Cyclone Alessia intervened and they had to abandon their planned three-day survey after one day. They did manage to complete the shorebird counts on the high tide and collect the eight remote cameras that we deployed on the 1 November. Although their planned survey was cut short, with a team of nine they managed to complete an entire circumnavigation of the island on foot along the high tide line, walk to and from all remote camera locations and briefly inspect all of the major seabird breeding colonies on the island. During this time, they recorded just one suspected poisoned shorebird, a Pacific Golden Plover (*Pluvialis fulva*). This bird was too decomposed to examine. They also reported the presence of live Nankeen Night Herons, although their coverage of the island was limited (pers. comm. Rohan Clarke). Fifty-five individuals were recorded during the November 2012 survey (Clarke et al 2012b).

4.3.2 Remote cameras

No rats were detected on the seven remote cameras that were operating on the island between the 1 and 22 November. The last live rat detected was at 3:42 am on the 31 October (10/11 days following the first bait drop). Two of the cameras detected live Buff-banded Rails. The last dates for these detections were the 18 and the 21 November, respectively. These records were between 28 and 31 days following the first application of bait.

5 Conclusion

Although there were at least 40 non-target bird deaths as a result of the rat baiting operation, these losses were minimal considering there were over 33 000 seabird and coastal waterbirds and over 17 000 shorebirds present on Adele Island at a similar time to the baiting operation in the previous year (Clarke et al 2012b).

Counts conducted three weeks after the baiting program, reported 1290 Ruddy Turnstones and 312 Silver Gulls (pers. comm. Rohan Clarke). Similar numbers of Ruddy Turnstones (1807) and Silver Gulls (393) were recorded in November 2012 by Clarke et al (2012b), suggesting the baiting program had little impact on the local populations of these species.

The baiting operation was expected to have an impact on or in the worst-case scenario, cause the short-term extirpation of the Buff-banded Rail population on Adele Island. There were no accurate estimates of the population size of this cryptic species prior to baiting but the deaths of at least five birds may have caused a considerable decline in the population size on the island. Two separate remote cameras captured images of live Rails roughly a month after the baiting, indicating they have survived, and their population should recover through recruitment. We found no evidence to support claims by a Broome naturalist that the baiting program would eliminate Nankeen Night Herons from the island.

6 References

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Appendix 1. Schedule of rat baiting and monitoring activities undertaken on Adele Island 18 October - 2 November 2013

Date	***Program activity***
18th Oct	• Vessel loaded Broome, left at 4:00 pm
19th Oct	• Vessel (1:00 pm) and helicopter (2:15 pm) arrive Adele Island • Commenced slinging equipment to island
20th Oct	• Slinging of bait and equipment to island from 5:30 am • Baiting commenced at 3:15 pm and completed ~1/3 of the island by 5:00 pm (problems with engine on spreader)
21st Oct	• Baiting completed (7:00 am to 5:00 pm). Continued engine problems – took most of the day to complete a <3 hour operation • No time to patrol beach and inlet for stray bait
22nd Oct	• Helicopter returned to mainland (5:30 am departure) • Beach patrol on quad bike commenced at 5:45 am • Seven remote cameras set for monitoring of rats • Stray bait detected on ~1.5 km of beach, removed by hand raking with lawn rakes • A 20 m wide and 2.6 km long gap in bait distribution discovered on western side of island. Two people and quad bike diverted from bait removal to hand spread 35 kg of bait into the gap (5.2 ha gap, hand baited @ 6.7 kg/ha). • Shore parties returned to vessel at 1:30 pm on the falling tide • No time available for crews to remove bait from the inlet or channels (see Figure 1). • Baiting party left the island at 3:30 pm to undertake surveys of Northern Quolls in Talbot Bay.
28th Oct	Returned to Adele Island at night
29th Oct	• Remote cameras collected and checked • Island patrols for dead rats and birds on the quad bike and on foot (5 people from 6:00 am to 4:00 pm) • Hand broadcasting of bait on islets in the inlet. Hand broadcasting of 65 kg of bait in the gap on the western edge (rate 12.5 kg/ha).

30th Oct	• Helicopter arrived at 7:30 am • Slinging of bait to island • Broadcast of second drop of bait began at 10:30 am – bait spreader engine was very problematic, all attempts to fix it failed. Took entire day to bait the island returning at 5:00 pm. Should have taken <3 hours to complete. • Patrols for dead rats and birds • Stray bait removed from channels
31st Oct	• Wind storm at 7:30 am with 50 knot winds • Final perimeter run around the outside of the island to complete baiting after storm at 8:30 am. • Equipment slung back to the vessel • All available staff removing bait from channels in the morning • A crew of four remained on the island until 7:30 pm to remove bait from inlet and channels. Bait checks on the beach • Patrols for dead rats and birds
1st Nov	• Early morning patrols for dead birds and rats • Further clean-up of tide washed baits from the inlet and channels (7:30 to 9:30 am) • Vessel steamed from Adele Island at 10:30am.