SHORT COMMUNICATION

Long-term protection of important seabird breeding colonies on Tasman Island through eradication of cats

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Abstract: A restoration programme was initiated in 2008 in response to high levels of seabird predation by feral cats (*Felis catus*) at Australia's largest fairy prion (*Pachyptila turtur*) colony on Tasman Island, Tasmania. The primary knockdown involved aerial baiting with para-aminopropiophenone (PAPP) in meat baits. The efficacy of baiting was lower than expected resulting in trapping and hunting commencing earlier than planned. Cats were successfully eradicated over two weeks. Key to the success of the programme was the identification of a narrow window of low prey availability for cats. Post-eradication monitoring of the two most common seabird species, fairy prions and short-tailed shearwaters (*Ardenna tenuirostris*), showed positive signs towards population recovery. Prion activity increased three-fold and shearwater breeding success increased.

Keywords: fairy prion; *Felis catus*; feral cat; *Pachyptila turtur*; para-aminopropiophenone (PAPP)

Introduction

Seabirds are subject to a range of threats at sea (fisheries competition and bycatch, climate change issues) and on shore (invasive species, habitat destruction, pollution, human disturbance) (Hilton & Cuthbert 2010; Mulder et al. 2011; Croxall et al. 2012), many of which require ongoing management. Invasive species are the greatest threat to threatened seabirds (Croxall et al. 2012), but fortunately programmes to eradicate invasive species can have immediate and long-term benefits to island-based fauna like seabirds (Cooper et al. 1995; Ratcliffe et al. 2010; Medina et al. 2011). Feral cats are responsible for at least 14% of global bird, mammal and reptile extinctions on islands (Medina et al. 2011) and successful programmes to eradicate feral cats on islands currently number over 100 (Island Conservation 2012).

Tasman Island has the largest fairy prion (*Pachyptila turtur*) colony in Australia (Marchant & Higgins 1990; Brothers et al. 2001). Domestic cats were introduced as pets for lighthouse staff and a feral population had established by 1913 (p. 37, *Weekly Courier*, 3 July 1913, Launceston, Tasmania). Similar to other seabird islands (Bonnaud et al. 2011), seabirds (prions) were the primary prey in the absence of other introduced mammals like rabbits or rodents, with an estimated 30 000 to 60 000 killed per year (Bryant & Shaw 2006).

Eradication programmes for cats usually require a series of different techniques starting with the least invasive method (Parkes et al. 2014). Poison baiting is commonly used as a primary knockdown followed by trapping and targeted removal of survivors by shooting. Poison baits need to be attractive and cats need to be hungry to consume a non-live food item.

Problems with using toxic baits include potential non-target impacts, secondary poisoning and animal welfare issues related to toxicoses. To help address these concerns, the Curiosity® cat bait (a small meat sausage) has been under development (Johnston et al. 2011). This product uses the toxin para-aminopropiophenone (PAPP), which is considered to result in a more humane death (Murphy et al. 2005) and a reduced risk of secondary poisoning (Wood et al. 1991; Eason et al. 2010). The PAPP is encapsulated in a hard plastic pellet of a size that is readily consumed by cats but rejected by some native mammal and bird species (Marks et al. 2006; Hetherington et al. 2007) thus increasing the product's target specificity. Managers of the Tasman Island eradication project were keen to support the development of this new feral cat control product: the Curiosity® cat bait required a research permit and this was the first time PAPP had been used for an eradication programme.

The aims of this communication are to describe the adaptive management and monitoring undertaken in the successful eradication of cats on Tasman Island, and the costs and ecological outcomes of this operation.

Methods

Tasman Island (43°14´ S 148°00´ E) is part of Tasman National Park, situated 500 m from the south-east tip of Tasman Peninsula (Fig. 1). The island holds significant breeding colonies of fairy prion (between 300 000 and 700 000 pairs) and relatively small populations of short-tailed shearwater (*Ardenna tenuirostris*) (7000 burrows) and sooty shearwater (*A. griseus*) (1000 burrows) (Brothers et al. 2001). There are no native terrestrial mammals present (Bryant & Shaw 2006). Dolerite cliffs and steep slopes rise nearly 300 m to a central plateau on the 120-ha (1.6 × 1 km) island (Fig. 2). The island's

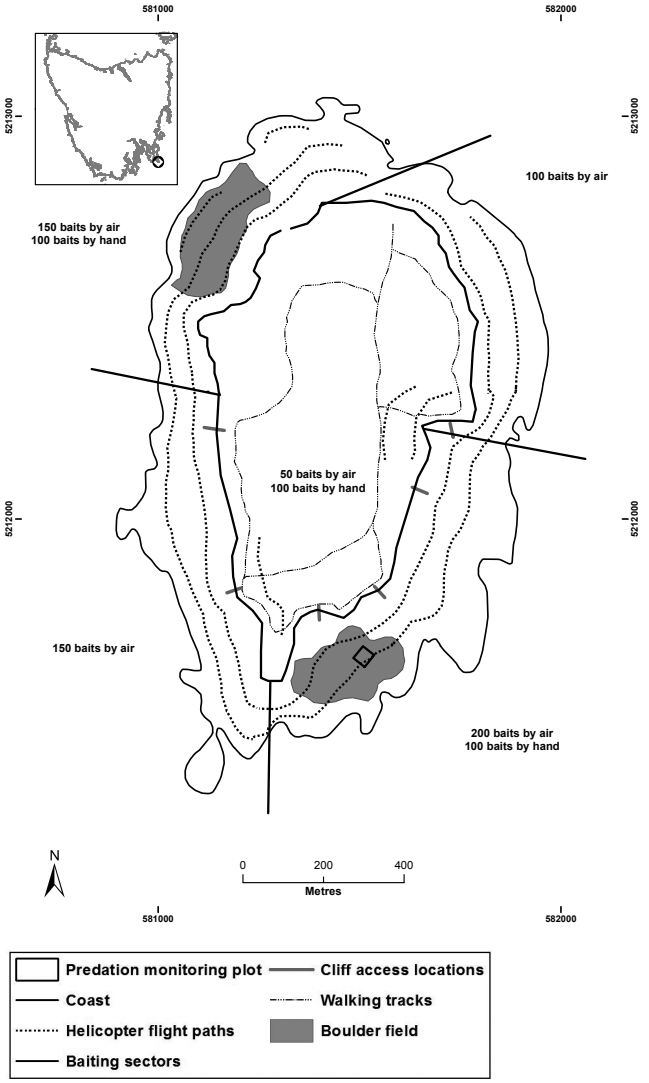


Figure 1. Tasman Island, south-east Tasmania, Australia: slope access points, boulder fields (main fairy prion habitat), tracks, bait application and helicopter flight paths.

vegetation is a mosaic of coastal scrub and native grassland (Harris & Kitchener 2005). Vertical cliffs are interspersed with vegetated slopes that are accessed via discrete narrow pathways in the cliffs.

An eradication feasibility study was completed in March 2009 (Saunders & Norbury 2009 unpubl. report) and recommended aerial baiting, followed by trapping, hunting, and surveillance using detector dogs. The seasonal presence of fairy prions was documented using camera traps to identify the time of lowest prion numbers and therefore the window of lowest prey availability to cats, which was considered the best time to bait. Four Scout Guard™ camera traps (model SG550VB-31) were deployed from January 2009 to May 2012 near caves used by prions and operated between 1800 and 0700 hours AEST, with a minimum interval of 5 min between images.

Baseline monitoring of short-tailed shearwaters began in December 2009 with two plots, measuring 10 × 10 m and 10 × 20 m respectively, and six 50-m transects being established. In December 2010, further transects were added (8 × 50 m, 2 × 100 m) (DPIPWE 2010 unpubl. operational works plan). The presence of incubating adult birds or pre-fledge chicks was assessed in plot areas and within one metre either side of transect lines by extending an arm with a 50-cm stick into each burrow to elicit a response from birds present. In the two plot areas this technique was used to determine breeding success.

A 'prototype' version of the Curiosity® cat bait (Scientec Research Pty) – a kangaroo and chicken meat sausage with a polymer toxicant pellet or 'hard-shelled delivery vehicle' (Marks et al. 2006) containing 78 mg PAPP and the marker dye Rhodamine B (RhB) – was permitted for use under an Australian Pesticides and Veterinary Medicines Authority Research Permit. The RhB dye was used to provide a rapid field assessment of bait uptake during post-mortem examinations and scat searches after baiting (Fisher et al. 1999). The product was known from previous captive and field studies to be palatable to feral cats (Johnston et al. 2011). On-site trials of non-toxic-bait consumption, using camera traps and direct observation, were undertaken in 2009 and 2010.

An area of 50 × 50 m was cleared of bird remains on each of 22 visits from March 2009 to May 2011 and the accumulated fairy-prion wing pairs collected and counted. An index of cat predation on prions was calculated from the accumulation of wing pairs. This rate was subsequently used as a measure of eradication success.

To measure baiting efficacy, 15 cats were trapped in cage traps, sedated, and fitted with VHF tracking collars (Titley Scientific, Ballina, NSW) 3 weeks before the aerial baiting operation. Sedation was undertaken by a registered veterinary surgeon using ketamine (5.5 mg kg^{-1}) mixed with midazolam (0.28 mg kg^{-1}) in a 50:50 mix for intramuscular delivery. This combination was chosen for its amnesic qualities (Kreeger & Arnemo 2007). Collared cats were tracked and located before and after the baiting operation to provide a measure of success for the initial knockdown phase of the eradication.

Bird observations were conducted by skilled observers before, during and after the baiting operation (1–7 May 2010) using Birdlife Australia's Bird Atlas methods for 2 ha/20 minute Habitat Search (Birdlife.org.au/projects/atlas-and-birdata/) in which all birds heard and seen within a 2-ha search grid over a period of 20 min were recorded. A second technique, the '1km Area Search', recorded all birds seen and heard over the entire island. To minimise potential for bait consumption by non-target species, specifically raptors and corvids, wallaby and possum carcasses were transported to the island to provide recognisable food items and a distraction from baits. Skilled bird observers were positioned on cliff tops to record bird behaviour during aerial baiting.

Baiting operations were timed to occur when cats' natural prey resource was lowest. Aerial bait application was undertaken by helicopter, with two operators dropping baits along predetermined transects. Ground-laid baits were placed at 40-m intervals on tracks and in boulder fields to target known areas of cat activity. The positions of ground-laid baits and helicopter flight paths were recorded by GPS devices.

Follow-up trapping began 3 days after the baiting operation and ran continuously for 27 days followed by another short trapping effort 2 weeks later. Up to 28 cage traps (Mascot Wireworks, NSW, Australia) (300 × 300 × 600 mm) baited with fried chicken were set and checked daily. Thirty rubber-padded leg-hold traps (Duke # 1.5, West Point, USA) were set in pairs as 'walk-throughs' and 'cubby sets' (Wood et al. 2002) and checked twice daily. A pair of traps was counted as one 'trap-set night'. Hunting occurred 10 days after baiting for 7 weeks, and involved searches using a 50W spotlight (Lightforce 240).

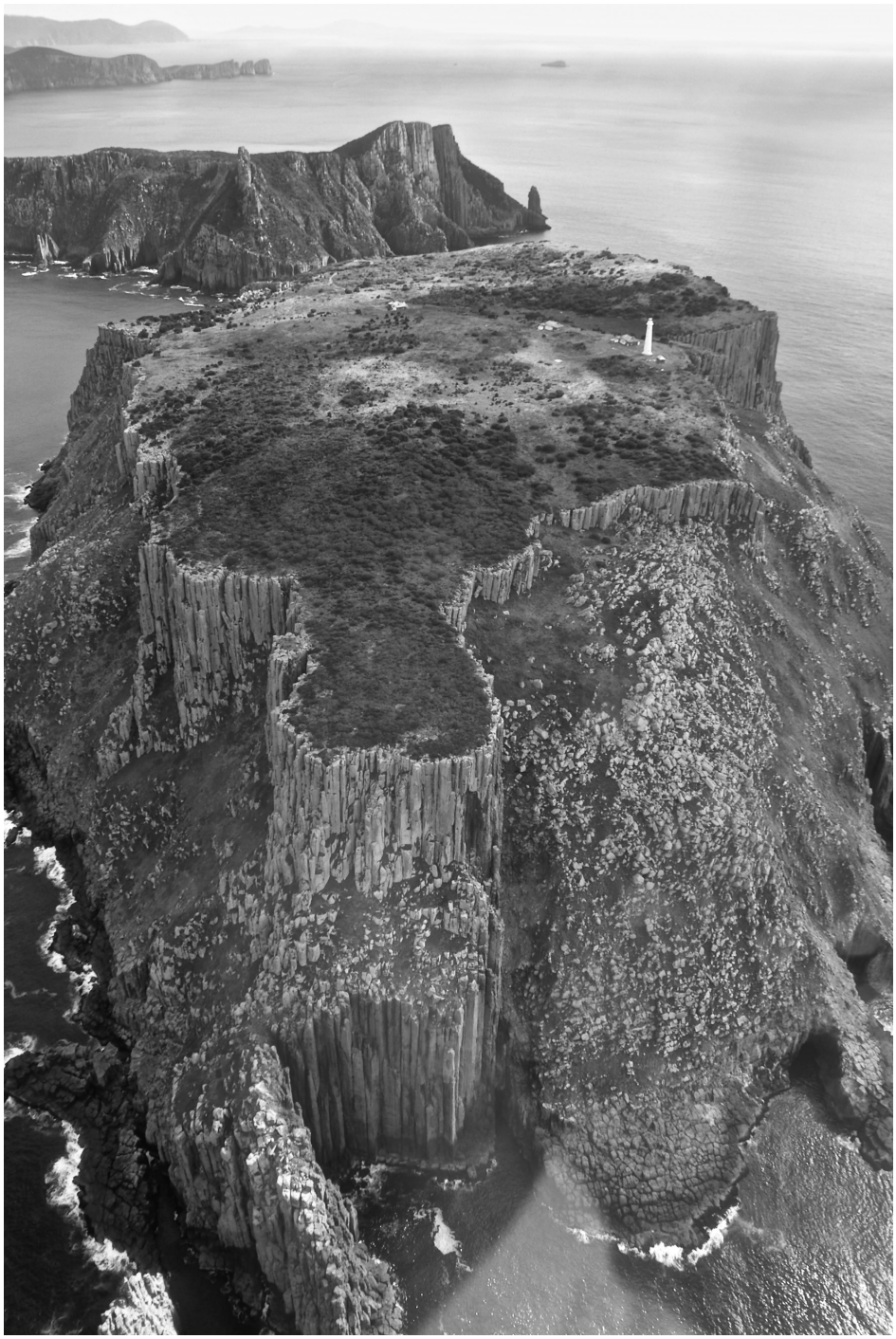


Figure 2. Tasman Island. Aerial view looking north (©Peter Marmion).

Radio-collared cats that were detected as 'likely dead' via telemetry mode on radio collars were recovered, and trapped cats were euthanased. Stomach contents were inspected to confirm bait remains and digestive tracts were visually checked for RhB staining or by locating RhB fluorescence in the mouth cavity under ultraviolet light in a darkened room (Fisher 1998).

Verification of eradication success occurred from late May 2010 to May 2011. Teams of two to four people and two detector dogs undertook monthly 4-day searches for cat sign across all accessible habitats and included spotlighting. Up to 23 camera traps were regularly reviewed.

Expenditure and effort (including office and field time, transport, personnel, spotlighting, sign searching and detector dogs) were recorded. Staff costs were based on an average salary of A$220 per day.

Results

Camera traps revealed fairy prion activity (and therefore cat prey availability) was lowest from late April to late June (Fig. 3) and shearwaters were known to be absent from May to September. To coincide with low presence of seabirds (cat prey), the island was baited on 3 May 2010. In the three days after baiting, four dead VHF-collared cats were retrieved that had ingested Curiosity® bait as evidenced from the presence

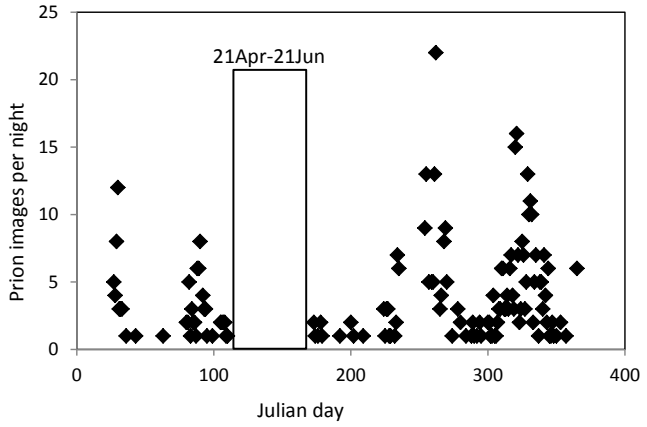


Figure 3. Plot of prion activity, Tasman Island, for 2009, in Julian days. Box indicates period of no prion activity. Black diamonds represent number of images of prions recorded per night.

of RhB. The VHF signal from one collared cat was not detected following baiting and the cat was presumed dead. The remaining 10 collared cats were deemed alive. The number of collared cats killed from baiting was lower than expected. As a consequence, trapping commenced 3 days after baiting (earlier than planned) and all remaining cats were caught within 2 weeks. Trapping effort totalled 1285 trap nights: 503 cage-trap and 782 leg-hold trap-set nights (Fig. 4). Twenty-eight cats were captured post-baiting (20 cage trap, 7 leg-hold, 1 by hand). The last image of a cat was recorded on 10 May 2010, 5 days before the putative last cat was trapped. Of cats trapped, 25 (89%) showed evidence of RhB staining indicating a high level of bait consumption. Had the bait worked as intended, the efficacy of the primary knockdown could have been at a similar level.

Cameras recorded forest ravens (*Corvus tasmanicus*) taking three baits and one RhB-stained faecal 'dropping' of a forest raven was found. No scavenging bird species were found dead in the 14 days after baiting or subsequently during monthly site visits. Raptor species recorded prior to, during,

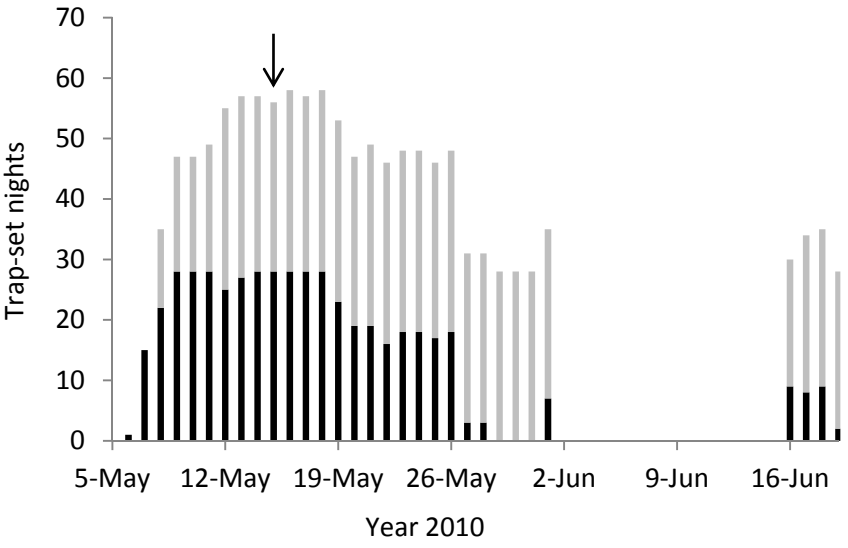
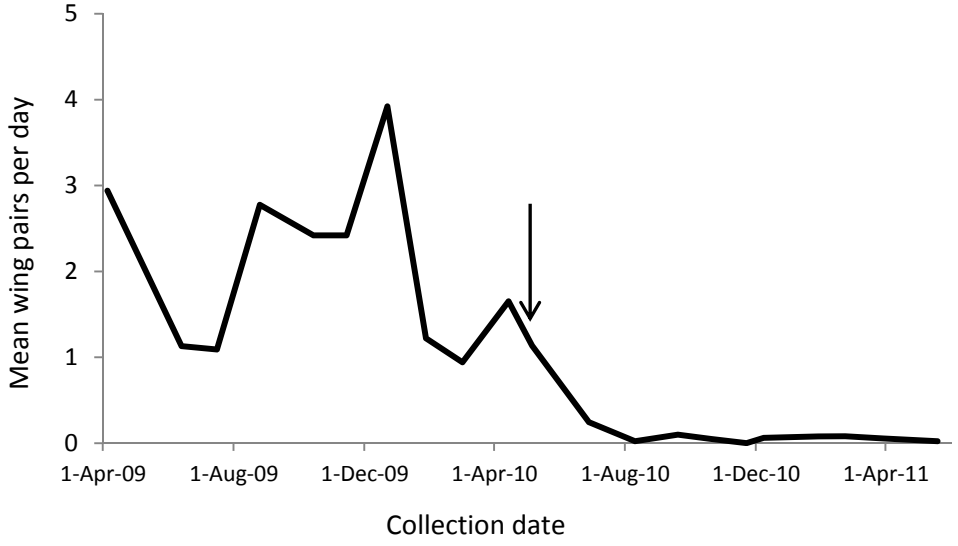


Figure 4. Tasman Island cat eradication: number of trap nights 2010; arrow indicates last cat caught. Cage trap nights represented by black bars, leg-hold trap-set nights by grey bars.

Figure 5. Fairy prion wing pairs collected from a 50 × 50 m plot, Tasman Island, April 2009 to May 2010; arrow indicates bait drop for cat eradication.



or for the survey period after baiting operations included wedge-tailed eagle (*Aquila audax fleayi*), white-bellied sea eagle (*Haliaeetus leucogaster*), brown goshawk (*Accipiter fasciatus*), brown falcon (*Falco berigora*), peregrine falcon (*F. peregrinus*), Australian hobby (*F. longipennis*) and southern boobook (*Ninox novaeseelandiae*) (Johnston et al. 2010 unpubl. report): none were reported taking baits or dead, or were recorded at mammal carcasses.

A total of 868 wing pairs were collected from the predation monitoring plot (98% fairy prions, 2% shearwaters). This number decreased rapidly after baiting, decreasing from an accumulation rate of four per day to less than 0.1 after August 2010 (Fig. 5).

During the one-year verification phase (13 May 2010 to 19 May 2011), spotlighting for sign of remaining cats was undertaken on 45 nights totalling 210 h. Eye-shine was reported on 31 May 2010 in the north-west and, within an hour, four staff and two dogs searched this area for several hours to attempt to verify the species responsible. No conclusive evidence of cat presence was found. Subsequently, three hunters were sent to the island in mid-June. Extra cameras were deployed to the area and thorough searches made. Thermal imaging equipment was used across the accessible parts of the island for three nights in May 2010 but no evidence of cats was found. For the verification phase, over 450 h of intensive searching for sign of cat activity were undertaken with no fresh cat scats found. Detector dogs worked for 211 h, recovering one recently dead cat (presumed poisoned) and two mummified (> 1 year) carcasses.

Activity data for fairy prions were compared over three breeding seasons. The mean number of prion images recorded per night increased three-fold from 0.63 in 2009–10 when cats were present to 1.90 in 2011–12, and similarly the mean number of prions recorded per night nearly trebled (0.86 to 2.34). The number of nights per year that prions were recorded as present increased 43% during this period. Breeding success of short-tailed shearwaters was estimated over 4 years (2009–10 to 2012–13) and results indicated a positive response to the removal of cats with respect to breeding success (13% to 63%). On transects, incubating adults increased from 43 in 171 burrows to 97 in 253 burrows.

A total of 30 trips were made to the island between December 2008 and May 2011. Field- and office-staff time totalled 526 days; volunteers contributed 77 days. Salaries were $115,720 over 2.4 years and operational costs $167,500 (eradication plan, transport, eradication and monitoring equipment, field allowances, bait, dogs and staff training) giving a total project cost of $283,220.

Discussion

Similar to other cat eradication programmes (Nogales et al. 2004; Campbell et al. 2011; Parkes et al. 2014) a mix of techniques was used. It is unlikely that all cats in a population will consume poison baits. The addition of other methods targeting remaining animals allows for adaptability within a programme. The Tasman Island eradication was the first to use the toxin PAPP for a primary knockdown. Curiosity® feral cat bait was selected for the low hazard that its use presented to non-target species through rejection of the hard-shelled delivery vehicle (Marks et. al. 2006; Hetherington et al. 2007; Forster 2009) and its suitability for aerial baiting.

Though well planned, the project encountered unforseen issues with the bait. Curiosity® is a complex bait product, comprising toxicant encapsulated in an acid-soluble polymer pellet inserted into a meat sausage. Though extensive testing had occurred during its development, the product failed to meet expectations for this project (Johnston et al. 2010 unpubl. report). Subsequent tests showed there was premature degradation of the polymer shell at a specific site on the pellets, likely due to incomplete mixing of the degradable pellet compounds. In hindsight, the bait product should have been more thoroughly tested with specific reference to confirming the longevity of the toxicant pellet following its insertion into the meat attractant.

When it was clear the bait was not functioning as intended, programme managers reassessed the situation. Given that sufficient trained staff and equipment were present, it was decided to deploy traps immediately across the island. Leg-hold traps were placed in the narrow access points and tracks (see Wood et al. 2002), which were known through camera trapping to be well used. The availability of several control methods to kill or capture cats allowed immediate adaptation to unforeseen circumstances; the eradication programme continued and was ultimately successful. The pre-operational planning and on-ground works resulted in cats being well-habituated to tracks and cage traps by the time of knockdown. The short window of low prey availability was clearly identified and targeted so that cats were receptive to eating baits (Short et al. 1997; Twyford et al. 2000; Algar et al. 2007) and those remaining potentially easier to trap with food lures.

The increase in fairy prion activity indicated a very positive response to the removal of cats. It is possible, however, that part of the increase in activity recorded by camera traps may have been birds spending longer preening or interacting before entering burrows (Prince & Copestake 1990; SR pers. obs.) with cats absent. For short-tailed shearwaters, although initial indications of recovery are very positive, 3 years is considered too short for conclusive results, given this long-lived species does not begin breeding until between 5 and 8 years (Serventy 1967). Further, breeding success in seabirds can show large inter-annual variation (Veit et al. 1997; Chambers et al. 2011; DPIPWE website http://dpipwe.tas.gov.au/wildlife-management) and this variation can bias the interpretation of short-term results such as this study.

The Tasman Island cat eradication was a small but significant project for Tasmania, contributing to the ecological restoration and long-term protection of important seabird colonies. The programme supported the development of a new toxin and bait product, and although the knockdown from baiting was lower than expected, thorough planning and adaptive management ensured success.

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