

Eradication of feral cats on Rottnest Island, Western Australia

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Manuscript received August 2010; accepted May 2011

Abstract

Domestic cats were introduced to Rottnest Island both as pets and as predators of commensal pest animals such as the Black Rat and House Mouse at various times since European settlement. Historically, the Rottnest Island Authority has attempted to rid the island of all cats since the 1960s. It was suggested that cats maybe influencing the abundance of native fauna and if left uncontrolled, the cat population was likely to increase and could result in considerable damage to ground nesting birds and heavy predation pressure on Quokkas and reptile species.

The Department of Environment and Conservation was approached by the Rottnest Island Authority to assess feral cat numbers and control options on the island and if possible to eradicate the feral cat population. A feral cat monitoring and trapping campaign was conducted in November 2001 and 2002. Four cats were trapped and no further cat activity has been observed or cats sighted by Rottnest Island staff or the general public in the eight years subsequent to this program suggesting that eradication has been successfully achieved.

Keywords cat eradication, islands, cat trapping.

Introduction

Domestic cats, *Felis catus* (Linnaeus, 1758), have been introduced to Rottnest Island at various times since European settlement (King 1985). It is likely that they were introduced both as pets and as predators of commensal pest animals such as Black rats, *Rattus rattus* (Linnaeus, 1758) and House mice, *Mus musculus* (Linnaeus, 1758). Historically, the Rottnest Island Board (now the Rottnest Island Authority) has attempted to rid the island of all cats. It was proposed by the Board in 1965, that all cats, including domestic pets, be removed from the island by October 1965. "All wild cats would be exterminated by shooting and trapping" (West Australian Newspaper 1965). Fifteen years later in July 1980, in an effort to protect the island's bird populations, all domestic cats were removed from Rottnest Island. Approximately 20 residents had domestic pet cats at this time and the Board was still working on a solution to destroy all feral cats (West Australian Newspaper 1979, 1980).

By 1985, a small population of feral cats was present on the island but its size was unknown (King 1985). There were no data to suggest that cats were implicated in the decline of any fauna on Rottnest Island however, there was the possibility that cats were influencing the abundance of native fauna (op. cit.). If the cat population was left uncontrolled, it was likely to increase and could result in considerable damage to ground nesting birds and heavy predation pressure on Quokkas, *Setonix brachyurus* (Quoy & Gaimard, 1830), and reptile species (King 1985).

Techniques available for the control of feral cats prior to the 1990s were not particularly effective or economical. As such, long-term management options for the control of the cat population on the island at this time were to: – continue the prohibition of importation and/or the

keeping of domestic cats; maintain the occasional cage-trapping program; exclude cats from rubbish bins and the waste disposal site to reduce the source of supplementary food and the possibility of conducting localised baiting programs. The implementation of this on-going management strategy, excluding baiting, was reported to have reduced, but not eradicated, the feral cat population by 1997 with a small number of cats (possibly two or three) remaining (Pontre 1997). As part of the Rottnest Island Management Plan (1997–2002) control programs for feral cats were to continue to enable eradication of cats from the island (Pontre 1997).

Control of feral cats is recognised as one of the most important fauna conservation issues in Australia today and as a result, a national 'Threat Abatement Plan (TAP) for Predation by Feral Cats' has been developed (EA 1999; DEWHA 2008). Under the TAP the goal is to protect affected native species and ecological communities, and to prevent further species and ecological communities from becoming threatened. In particular, the first objective of the TAP is to: – prevent feral cats from occupying new areas in Australia and eradicate feral cats from high-conservation-value 'islands'

The Department of Environment and Conservation (DEC) has been developing control strategies for feral cats under the umbrella program 'Western Shield'. This research has led to the successful design and development of an effective trapping technique and a bait that is readily consumed by feral cats and can be used over broad-scale areas for their control. The Department was approached by the Rottnest Island Authority to assess feral cat numbers and control options on the island and if possible to eradicate the feral cat population. Researchers visited Rottnest Island in November 2001 and again in November 2002 to conduct a feral cat monitoring and trapping program. This paper describes the feral cat eradication campaign on the island.

Methods

Site Description

Rottneest Island is an 'A' Class reserve (Reserve A 16713), vested in the Rottneest Island Authority, gazetted for the purpose of public recreation. The island is located on the southern west coast of Western Australia at 32°00' S and 115°30' E. The island, an area of 1705 ha (Abbott & Burbidge 1995), lies in an approximate east-west orientation and is 11 km long and less than 5 km wide at its widest point.

Undulating old dunes, now limestone and overlain by sand, cover the greater part of the island (Playford 1983). A chain of lakes dominate the north-eastern area. Many small swamps and soaks, located in the interdunal depressions, are scattered around the eastern half of the island. The serrated coastline consists of a succession of exposed headlands and sandy bays. There are also a number of sand blowouts that support little or no vegetation (Anon. 1978; Anon. 1983). The vegetation on the island has changed dramatically since settlement and today is described as predominately a low shrubland dominated by *Acanthocarpus preissii* (Anon. 1978; Anon. 1983; Pen & Green 1983; Rippey & Rowland 1995). Other plant communities present are described in more detail in the above references.

The climate of Rottneest Island is Mediterranean, with mild winters and hot summers, with February being the warmest month with an average maximum of 26.5 °C and minimum of 18.7 °C and July the coldest month with an average maximum of 17.2 °C and minimum of 11.6 °C. The average annual rainfall is 713 mm with January being the driest month and June the wettest with mean rainfalls of 6.8 and 156 mm per month respectively (Bureau of Meteorology).

Survey of Cat Activity and Control Options

Records of cat sightings by Rottneest Island Authority staff, maintenance personnel and residents have been documented since April 2001. These records suggested that perhaps up to five feral cats were present on the island at the time this program was implemented. Prior to control measures being put into operation, extensive, intensive searches, over a period of ten days, were conducted across the island looking for evidence of cat activity. These included locations at which cat activity had been reported to island rangers. All areas of sandy substrate, including access tracks/roads, beaches, interdunal areas and sand blowouts, where cat tracks could be observed were surveyed either on-foot or from a 4WD vehicle, in 2002 an All Terrain Vehicle was also used. The surveys for cat activity in 2002 also coincided with the annual maintenance of the island's extensive firebreak network. Ripping of firebreaks assisted in the detection of cat activity by removing vegetation and breaking compacted soil, such that cat tracks could be reliably detected. The location of fresh cat activity, its extent and the distances between sites provided a focus for control effort.

King (1985) suggested that baiting might provide a suitable method to control cats on Rottneest Island although at the time, there appeared to be considerable difficulty in getting feral cats to accept baits. With the

successful development of the feral cat bait (*Eradicat*®) containing the toxicant sodium monofluoroacetate (compound 1080), baiting is now recognised as the most effective method for controlling feral cats where there is no risk posed to non-target species populations (EA 1999; Algar & Burrows 2004; Algar *et al.* 2007). These baits have also been employed to successfully eradicate cats from Hermite Island in the Montebellos (Algar & Burbidge 2000; Algar *et al.* 2002) and on Faure Island in the eastern gulf of Shark Bay (Algar *et al.* 2010). On Rottneest Island however, broad-scale application of feral cat baits was discounted as a suitable control strategy for two reasons. Firstly, Quokkas were likely to consume multiple baits. Despite Quokkas being listed as highly tolerant to the toxin 1080, they have a high, yet variable LD₅₀ of between 10–40 mg/kg (King 1990). The current 1080 dose rate for cat baits is 4.5 mg 1080/bait and therefore, an individual Quokka would only need to consume 2–3 baits for there to be a potential risk. Secondly, research has suggested that the optimum time to conduct baiting programs and maximise their effectiveness is under cool, dry conditions in late autumn/winter (Algar & Burrows 2004; Algar *et al.* 2007). At this time rainfall, which will cause degradation of feral cat baits is less likely to occur than during the summer months, and the abundance and activity of all prey types, in particular predator-vulnerable young mammalian prey and reptiles, is at its lowest and bait degradation due to rainfall, ants and to hot, dry weather, is significantly reduced.

The timing of the program on Rottneest Island during the early summer, non-target bait risks and the fact that only a few cats appeared to be on the island suggested that a trapping program would be a more viable control strategy.

Trapping Program

Two trapping techniques were used; cage traps were deployed in residential areas where cats would be used to scavenging food scraps. Leg-hold traps were located at sites distant from of human habitation.

In November 2001, 30 wire cage traps (60x20x20 cm) with treadle plates were located in the settlement area. Further to these, cages were also placed at the nursery (1 cage), university house – Wadjemup Hill (2 cages), ranger's house – Wadjemup Hill (2 cages) and immediately outside the waste disposal site (2 cages) (see Fig. 1). The majority of these traps were left in position over a five-day period, providing 145 trap-nights. In November 2002 five cage traps were placed at various locations around the perimeter of the waste disposal site. These traps were operated for a total of 15 trap-nights. All traps were baited with either fresh pilchards or non-toxic *Eradicat*® feral cat baits and sprayed with an ant deterrent compound (Coopex®) at a concentration of 12.5 gl⁻¹ Coopex, as per the manufacturer's instructions.

Cage traps can be ineffective for trapping feral cats (Friend & Algar 1993; Lee 1994; EA. 1999). A more effective technique to trap feral cats utilises padded leg-hold traps, Victor 'Soft Catch'® traps No. 3 (Woodstream Corp., Lititz, Pa.; U.S.A.), a Felid Attracting Phonic (FAP) that produces a sound of a cat call, and a blended mixture of faeces and urine. The trapping methodology is described in detail in Algar *et al.* (2010).

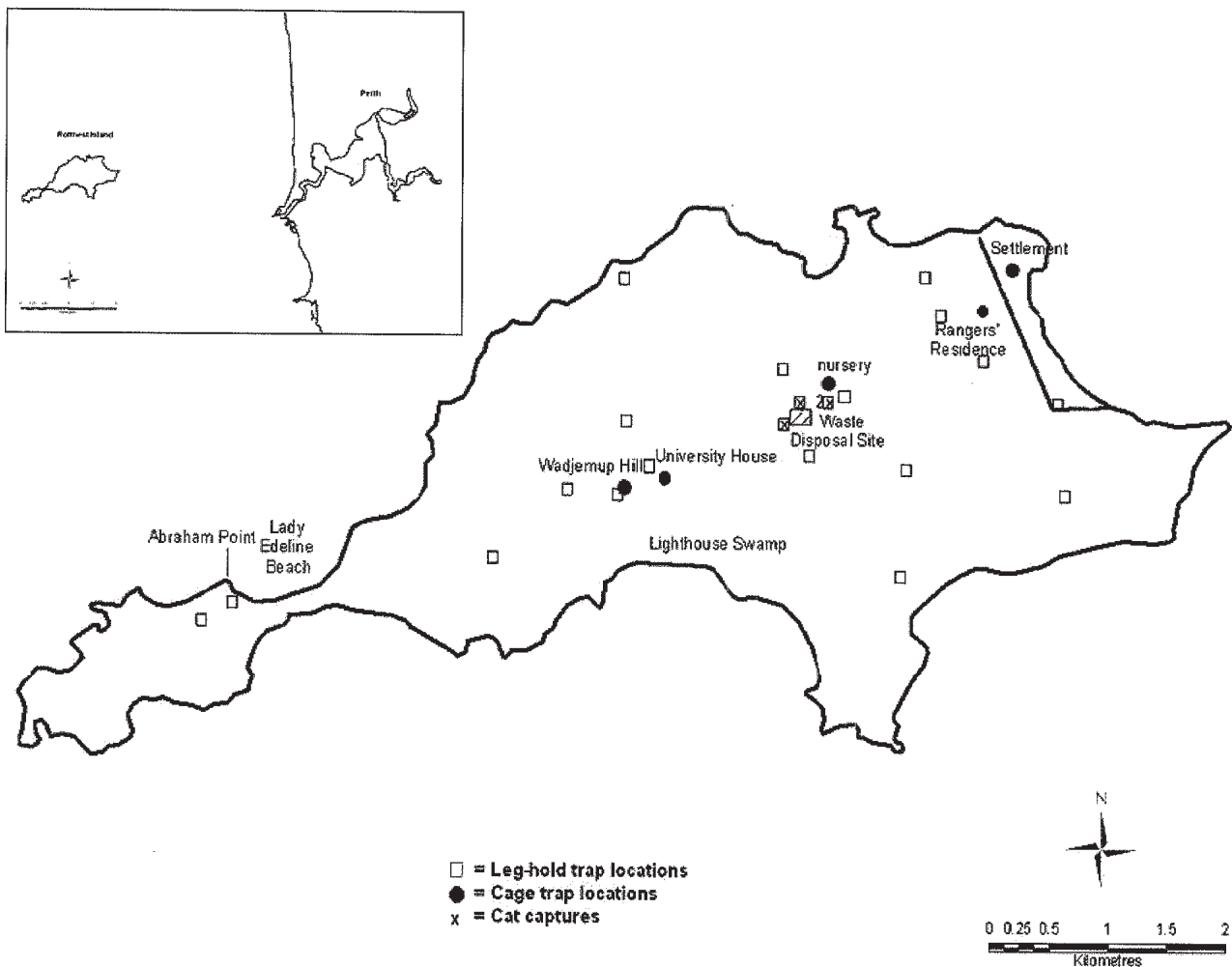


Figure 1. Leg-hold trap, cage trap and cat capture locations

To prevent the potential risk of capturing Quokkas and causing them injury, the leg-hold traps were located in areas from which Quokkas were excluded. Existing fenced rehabilitation enclosures that excluded Quokkas were used where available. Where existing enclosures were not available, or they did not exclude Quokkas, small enclosures (approximately 2x2x1 m), manufactured on-site with rabbit netting and star pickets, were employed. In 2001, 21 trap sites were located strategically around the island (see Fig. 1). All traps were left in position for a minimum of five days, providing a total of 162 trap nights. In 2002, three trap sites were located around the waste disposal site over a three day period. The traps were routinely checked at first light each day.

Necropsies and Analyses

Trapped cats were destroyed using a 0.22 calibre rifle. All animals captured were sexed and weighed; a broad estimation of age (as either kitten, juvenile or adult) was recorded using weight as a proxy for age. The pregnancy status of females was determined by examining the uterine tissue for embryos. Stomach contents were collected for diet analysis. Samples of brain, muscle, spleen, blood and faeces were collected to determine the incidence of diseases and parasites in the population that are potentially harmful to both humans and native fauna.

Results

Cat Monitoring Program

In 2001, evidence of fresh cat activity other than when a cat was captured, was recorded on 11 occasions during searches. All but one of these areas of cat activity was within 2 km of the site of capture of the three cats. The track activity along Lady Edeline Beach to Abraham Point (see Fig. 1) was less than 5 km from the capture sites. This area of activity was observed only once and despite intensive searches along this and other beaches and interdunal swales in the area, no further evidence of cat activity was recorded during the program.

No evidence of cat activity was observed or reported following the capture of the three cats (see below) until April 2002. Feral cat activity was reported to island rangers at three locations during 2002, twice within the settlement and once at Lighthouse Swamp (see Fig. 1 for location) (B Daw, pers. comm.). Searches of these locations in November 2002 failed to detect the presence of feral cats. Tracks of what appeared to be a single cat were noted on three successive mornings in November 2002, that activity was confined to the waste disposal site proper and within a several hundred-metre radius.

Following capture of this cat, no further cat activity was observed. In the eight years subsequent to this

program, no further cat activity has been observed or cats sighted by Rottneest Island staff or the general public (R Caccianiga pers. comm.).

Trapping Program

Three cats (2 male and 1 female) were captured in 2001 and a further cat (female) was trapped in 2002; all were caught in leg-hold traps. Examination of uterine tissue for scarring indicated that neither female cat had carried a litter in at least the previous year. Details of the cats captured, in terms of sex, weight, coat colour and age, are presented in Table 1. Captures ROT 01–03 were in rehabilitation enclosures either side of the waste disposal site, with ROT 02 and ROT 03 being trapped at the same location. ROT 04 was captured in a small enclosure, manufactured on-site located at the waste disposal site gate. The capture locations are shown in Figure 1.

The trapping program in 2001 also resulted in the capture of two non-target species: 37 Quokkas and two King Skinks, *Egernia kingii* (Gray, 1839). All but one of these captures occurred in cage traps. One Quokka was captured in a leg-hold trap, within the rehabilitation enclosure immediately north of the refuse site. The animal was released with a slight oedema to the limb held and the trap set decommissioned. In 2002, three quokkas were captured in cage traps and released without injury. A Ring-necked Pheasant, *Phasianus colchicus* (Linnaeus, 1758), and an Australian Raven, *Corvus coronoides* (Vigors & Horsfield, 1827), were captured in the same leg-hold trap on two consecutive days. Both animals received lacerations to the held limbs and were destroyed.

Of the four cats trapped, three had dietary items in their stomachs. The stomach volume and contents of captured cats are described in Table 2.

Analyses of the samples collected to determine the incidence of diseases and parasites in the population

Table 1

Capture records of trapped cats (K = Kitten, J = Juvenile, A = Adult)

Date	Sample No.	Sex	Weight (kg)	Coat colour	Age (K/J/A)
20/11/01	ROT 01	Male	3.50	Black/white	A
22/11/01	ROT 02	Female	2.65	Black/white	A
23/11/01	ROT 03	Male	3.85	Black	A
20/11/02	ROT 04	Female	3.10	Black/white	A

Table 2

Stomach volume and contents of trapped cats

Sample No.	Approximate stomach volume (%)	Stomach content
ROT 01	10	1x <i>Egernia kingii</i>
ROT 03	60	2x <i>Mus musculus</i> , 2x <i>Phasianus colchicus</i> runners
ROT 04	70	1x <i>Mus musculus</i> , cooked chicken bones and meat

Table 3

Serum immunoglobulin titres for *Toxoplasmosis* in captured cats

Cat Number	Serum immunoglobulin titre (IgD)
ROT 01	1/256
ROT 02	1/128
ROT 03	1/128

were only conducted on cats captured in 2001. Results of the analyses indicated that all three cats had been exposed to *Toxoplasmosis*, serum immunoglobulin titres are given in Table 3 (where > 1/64 is considered positive and < 1/24 is considered a cross-reaction). No tissue cysts were detected in any of the cats, however the cat tapeworm (*Taenia taeniaformis*) was present in the stomach of cats ROT 02 and 04.

Discussion

Results from this program and the fact that no cats have been observed or trapped since its completion suggest that cats have been successfully eradicated from Rottneest Island.

The three cats captured in 2001 all had stumpy tails, which implies a high degree of relatedness. The cat trapped by Authority staff, earlier in 2001 also had a stumpy tail (B Daw pers. comm.). The coat phenotype of the cat trapped in 2002 suggested it was a close relative of the three individuals captured during 2001 and was not likely to be a recent introduction. Inbreeding often brings about an increased frequency of homozygosity and causes a reduction in survival and reproduction (Ishida *et al.* 2000) which could explain the absence of kittens and sub-adult cats on the island. The low density of cats on Rottneest in November 2001 and the apparent close relatedness of these animals suggest that previous control efforts by the Authority were successful in diminishing the viability of the feral population. The lack of genetic input from a domestic population and the dramatic reduction of the feral population left it inbred and invigorated. Very few individuals were captured in the previous decade and a population of only four individuals was present on the island in 2001. Given the capacity of cats to produce up to eight kittens in a litter and conceive potentially twice in a year, the removal of so few individuals would not have kept pace with recruitment by a viable population.

Records of cats captured during previous trapping programs are summarised in Table 4. This shows a decline in the number of cats caught over the years. A total of 63 cats was captured during these various exercises and of these animals, 81% were trapped in the general vicinity of the waste disposal site. All four cats trapped during this campaign were also captured in the general vicinity of the waste disposal site which indicates that this area is a focus of cat activity on the island.

It is always possible that individual cats will re-establish on the island. The most likely route of reinvasion is from domestic cats straying from pleasure craft moored around the island. Evidence suggests that if any cats do stray onto the island they will eventually

Table 4

Location of cat captures on Rottnest Island. Of the total number of trapped cats those captured at the waste disposal site are indicated in parentheses

Year	No. cats captured
1986	39 (31)
1987	2 (2)
1988	3 (2)
1989	4 (3)
1992	2 (2)
1993	4 (3)
1994	5 (5)
1995	2 (2)
1996	1 (0)
2001	1 (1)

locate at the waste disposal site or the settlement where they will be able to scavenge food. Cats that do stray onto the island will be highly visible, invariably solitary and therefore easily removed. Removal of these animals should employ the trapping methodology adopted in this program. Cats are very inquisitive about other individuals in their area and this is likely to be more so if they are recent strays onto the island. The communication instincts of cats are principally reliant on audio and olfactory stimuli and the trapping technique uses lures based on these traits. As shown by this exercise, placement of traps in enclosures prevented the capture of non-target species but did not hinder access by cats. The employment of enclosures where capture of non-target species is an issue may also provide an invaluable tool in cat control strategies elsewhere.

Acknowledgements: The authors would like to thank Claire Wright (former Manager of Conservation and Heritage) for organising and supporting this exercise. Thanks are also extended to Chas Hansen (former Environment Officer) for his invaluable assistance and hospitality during our stay on the island. We are also grateful to Brad Daw (former Senior Ranger) and the other Rangers: – Sally-Ann Gudge, Dave Tunnecliffe and Paul Finlay for their help during the program. We would also like to thank Peter Adams (Division of Veterinary and Biomedical Sciences, Murdoch University) for performing the disease analyses. The figure was drawn by Steffi Hilmer (DEC).

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