Developing a community-based feral cat control program for Kangaroo Island.

David C. Paton,
Dept of Environmental Biology, University of Adelaide, Adelaide SA 5005

Introduction

Various methods have been used to eliminate or control feral cats from selected areas, often islands. These include poisoned baits, biological agents (e.g. feline panleucopaenia), shooting, trapping and exclusion fencing, often applied in combination (e.g. Veitch 1985, 1991; van Rensbury *et al*. 1987; Coman 1991; Newsome 1991; Bloomer & Bester 1992). These techniques can be labour- and area-intensive and have been effective for relatively small areas. In an Australian context recent work has concentrated on assessing various trapping, baiting and luring techniques (e.g. Risbey *et al*. 1997; Edwards *et al*. 1997; Short *et al.* 1997, 2002) with the view to developing methods of controlling feral cats over larger areas. The conclusion from these studies is that no one method is likely to be totally effective, that a variety of methods may be needed and that these methods need to be tailored for the environment in which control is sought (e.g. Veitch 1991; Short et al. 2002). For Kangaroo Island which is relatively well populated the use of poisoned baits and biological agents is unlikely to be acceptable to the community because of risks to non-target native fauna and companion animals such as dogs and cats. Furthermore rural and urban communities are increasingly sensitive to animal welfare issues and any method of control for feral cats will need to be humane. As a consequence only mechanical methods of control - trapping, shooting and fencing - are likely to remain as acceptable for controlling feral cats on Kangaroo Island.

Kangaroo Island differs from mainland Australia in having no rabbits or foxes. On mainland Australia, rabbits are a major component of the diets of feral cats (e.g. Jones & Coman 1981; Read & Bowen 2001). The ability to eliminate feral cats on the mainland is complicated by the presence of rabbits. In general cats are more prone to scavenge and hence enter traps or take baits when their normal foods, particularly rabbits, are in short supply (e.g. Newsome 1991; Paltridge *et al*. 1997; Molsher 2001; Short *et al*. 2002). Knowledge of the times when feral cats are most susceptible to trapping on Kangaroo Island may assist in developing more effective or efficient methods of control. This paper briefly summarizes information on the behaviour of feral cats on Kangaroo Island, particularly seasonal patterns to their susceptibility to attend baiting stations or to be trapped. This information was then used to develop and assess a community-based trapping program for the control of feral cats.

Ecology and behaviour of feral cats on Kangaroo Island.

Seventy-two feral cats were caught in treadle cage traps during 1992-1994 near Murrays Lagoon on Kangaroo Island. Body masses of the cats caught ranged form 2.25 to 5.5 kg for adult males and from 1.7 to 3.95 kg for adult females (Table 1). These weight ranges are similar to body masses of feral cats from other regions of Australia. Fifty-four of these cats were grey tabbies (either dark or light), eight were either ginger or ginger tabbies, four were black and two were mottled black and brown. One tortoise shell, two black-and-white and one grey cat were also caught.

Table 1: Summary of ages and body mass of radio-collared feral cats trapped and released at Murray's Lagoon, Kangaroo Island, 1992-1994.

Age & sex class	*n*	Body mass (kg) mean ± s.e.
Adult Male	27	3.77 ± 0.16
Adult Female	25	2.72 ± 0.12
Juvenile Male	10	2.03 ± 0.17
Juvenile Female	10	1.55 ± 0.10
Total	72	

Home ranges and activity patterns were determined for 30 radio-collared cats on Kangaroo Island. Home ranges varied widely from as little as 8 ha for juveniles to 526 ha for an adult male. Adults generally had larger home ranges than juveniles, while differences between males and females were small (Table 2). The main study area near Murrays Lagoon consisted of rural properties with moderate levels of remnant vegetation along roadways, fences and creek-lines. On most occasions radio-collared feral cats were located in native vegetation, and they tended to stick to these habitats (or the edges of them) when moving within their home ranges. Based on hourly checks on the positions of radio-tagged cats, individual cats were active at any time of the day or night but tended to be least active in the middle of the day. Feral cats on Kangaroo Island typically moved distances of around 600 m in an hour within their home ranges when active (maximum 2 km) and covered distances of around 8 km and up to 18 km while traversing their home ranges in a day. These movements were largely contained within a portion of the cat's home range on any one day and were not associated with patrolling the boundaries of their home ranges.

Table 2: Summary of home ranges determined for 30 feral cats on Kangaroo Island, 1992-1994. Areas of home ranges calculated using convex polygon method. Where home ranges have been determined on more than one occasion the largest home range was used in compiling this table.

Age & sex class	*n*	Home range average (ha)	Home range min – max (ha)
Adult Male	10	160	42 – 526
Adult Female	11	145	18 – 467
Juvenile Male	6	118	54 – 274
Juvenile Female	3	77	8 - 109

Of the seventy-two cats caught and radio-collared, 29 disappeared within a month. Many of these cats were probably transient and moving through the area, although some of these disappearances would have been due to faulty transmitters or battery failure, while others were known to have died (shot by farmers). Two cats radio-collared as juveniles were detected away from the study site, one 15 km and the other approximately 50 km away. Based on the numbers of feral cats that were resident, plus knowledge of their home range sizes and the level of overlap in home ranges, the density of feral cats at the Murrays Lagoon study site was estimated to be around 0.6 - 0.7 cats/ha.

Feral cats were 2 to 4 times more easily caught during winter and spring on Kangaroo Island than during summer and autumn. Trap success ranged from 3.9 to 7.5 cats per 100 trap-nights during winter and spring compared with 1.2 to 1.8 cats per 100 trap nights at other times of the year (Table 3). In winter and early spring, feral cats were also often seen at road kills and this suggests along with the increased trapping rate that feral cats were more willing to scavenge food during winter and that food is more likely to be limiting in winter.

Rosenberg's Goanna, Australian Ravens and Brush-tailed Possums were also caught frequently at various times in the year. Goannas, however, were not caught over winter and ravens were not caught over summer. Brush-tailed Possums were caught in all seasons and at higher rates (5 to 20 possums per 100 trap-nights) than feral cats particularly during summer and autumn.

Table 3: Number of trap nights and trap success for cats and frequently trapped non-target animals at Murrays Lagoon, 1992-1994. Rates are expressed as number of animals trapped per 100 trapping nights and have been corrected to account for traps being unavailable for part of the day because other animals had been caught.

Date	# trap nights	Trap success rate for different animals:			
		Cats	Possums	Ravens	Goannas
Summer					
1992-93	175	1.8	5.2	0.0	1.2
1993-94	383	1.2	20.2	0.0	0.3
Autumn					
1993	217	1.5	9.0	0.5	1.5
Winter					
1992	239	6.6	7.5	1.4	0.0
1993	1291	3.9	9.7	2.2	0.0
Spring					
1992	42	7.5	5.1	2.6	2.6
1993	445	5.0	9.0	0.5	0.5

Remotely-triggered cameras and or the use of raked patches were used to detect and identify the types of animals that might visit and so come in contact with a bait. In these studies baits (usually a type of meat - lamb, rabbit, roo, or fish) were placed in wire mesh and pegged to the ground and then, depending on the habitat, the surrounding sand for 1 m around the bait was raked to remove all tracks. These raked patches were re-examined at approximately 12 h intervals and any animal tracks left were recorded before the patches were raked again. This technique worked best in sandy areas during fine still weather and was not ideal for Kangaroo Island where there were few sandy areas. The second technique involved using remotely-triggered cameras to photograph animals attending baiting stations. In this case an infrared beam was established about 10 cm above the bait and when the beam was broken a photograph of the animal was taken.

These methods revealed that cats, and a variety of non-target fauna, particularly various mammals and birds, regularly visited meat baits on Kangaroo Island as well as at other sites on the mainland (Table 4). The frequency of visits however varied from location to location, but on Kangaroo Island the most frequent visitors were cats, brush-tailed possums, ravens and ants. Although macropods were often photographed the photos revealed that they were not necessarily visiting baits but just moving through the area and breaking the beam.

Table 4: Frequency of tracks of different animals around baits in different regions of South Australia. The table shows the proportion of baits that were visited at least once over a 24 hour period from five locations. The data for different bait types are pooled for this table. RD = Roxby Downs, KI = Kangaroo Island.

Animal	RD urban	RD rural	Waitpinga	Coorong	KI
Cat	0.47	0.02	0.08	0.01	0.11
Dog/fox	0.21	0.01	0.13	0.23	
Rabbit	+	0.02	+	0.1	
Possum					0.12
Wallaby/roo		+	0.04	0.03	0.48
Wombat				0.09	
Echidna					0.01
Raven/kite	0.22	0.47	0.08	0.01	0.2
Small bird	+			0.07	0.01
Emu		+			
Lizard	0.04	0.03	0.13		0.08
Ants	nr	nr	0.58	0.02	0.16
# of baits	72	530	24	136	268

Seasonal patterns in visits to baiting stations on Kangaroo Island reflect the patterns shown for trapping rates, with cats being least prominent in summer and more prominent at other times of the year (Figure 1). For all times of the year both ravens and brush-tailed possums were more frequently detected than cats. The pattern was rather different at Roxby Downs on the South Australian mainland, where cats were only frequently detected at a baiting station in winter, with the numbers of Little Crows and birds of prey (collectively) visiting the baits being much higher than cats (Figure 2).

The remotely-triggered cameras also recorded the time when an animal was photographed and so diurnal patterns of visitation were also documented. Figure 3 shows the data for cameras set over baits on Kangaroo Island while Figure 4 shows the same type of data for Roxby Downs. On Kangaroo Island cats attended bait stations both during the night and to a lesser extent during the day. There was extensive temporal overlap in the visitation patterns of cats and non-target fauna (notably brush-tailed possums at night and goannas and ravens during the day) on Kangaroo Island. At Roxby Downs, the cats were only active at night and there was no overlap between cats and non-target fauna.

Figure 1: Seasonal patterns to the rates at which various animal attend baiting stations near Murrays Lagoon, Kangaroo Island.

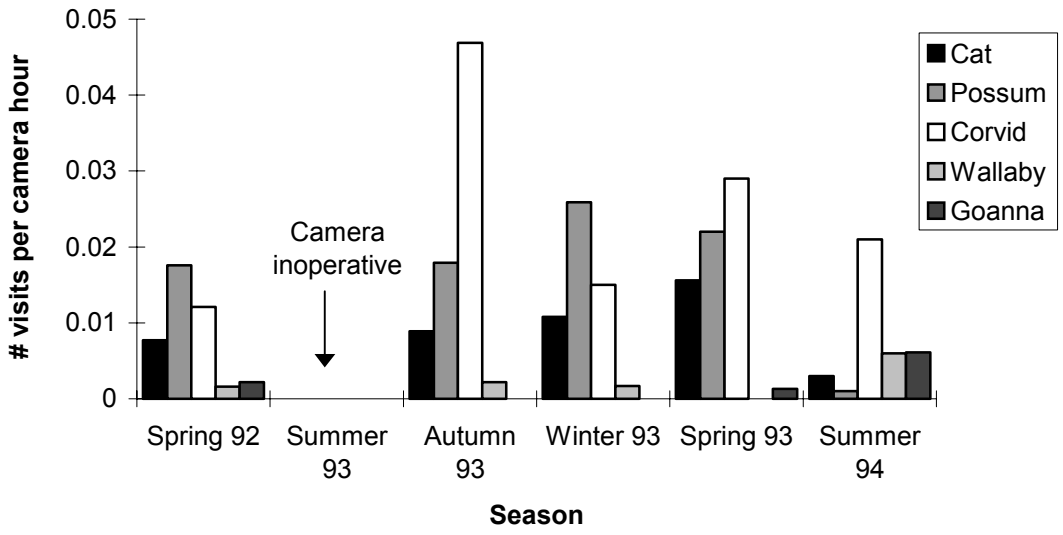


Figure 2: Seasonal patterns to the rates at which various animals attend baiting stations at Roxby Downs.

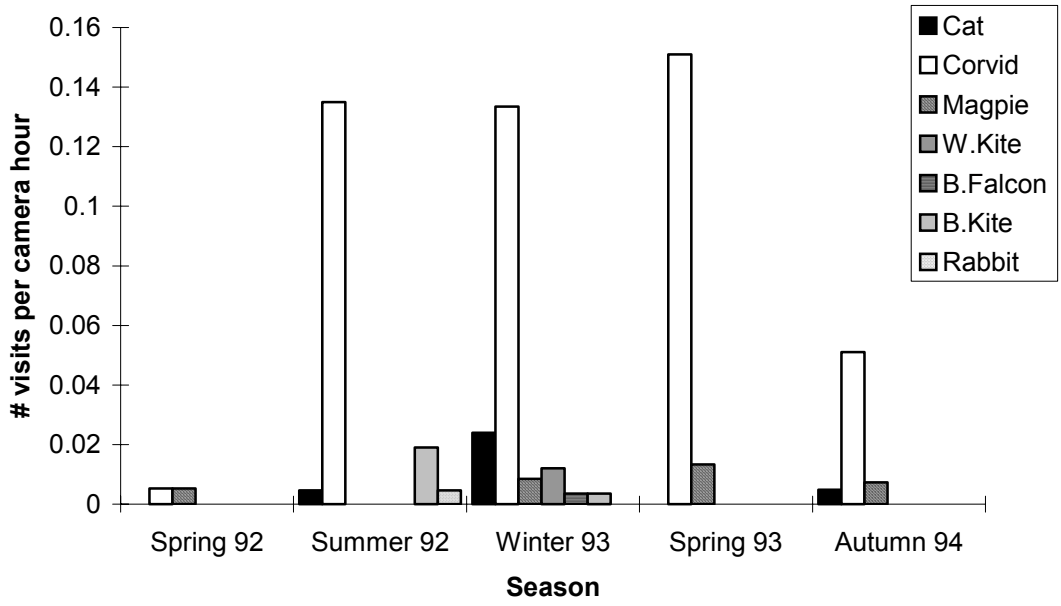


Figure 3: Diurnal patterns of visitation to baiting stations at Murrays Lagoon, Kangaroo Island in Spring.

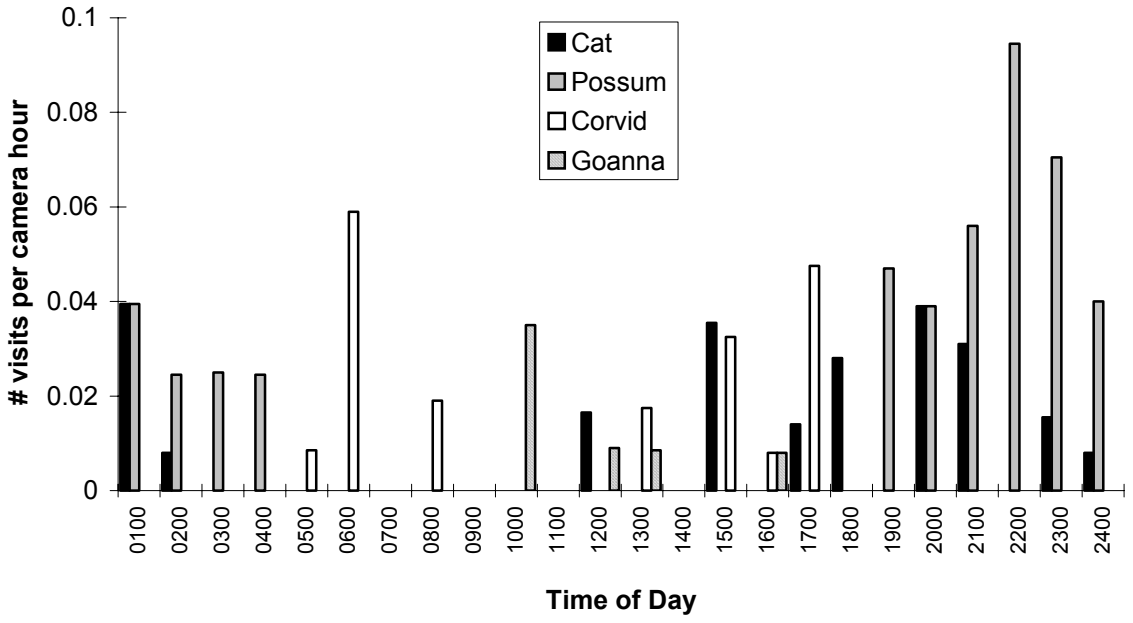
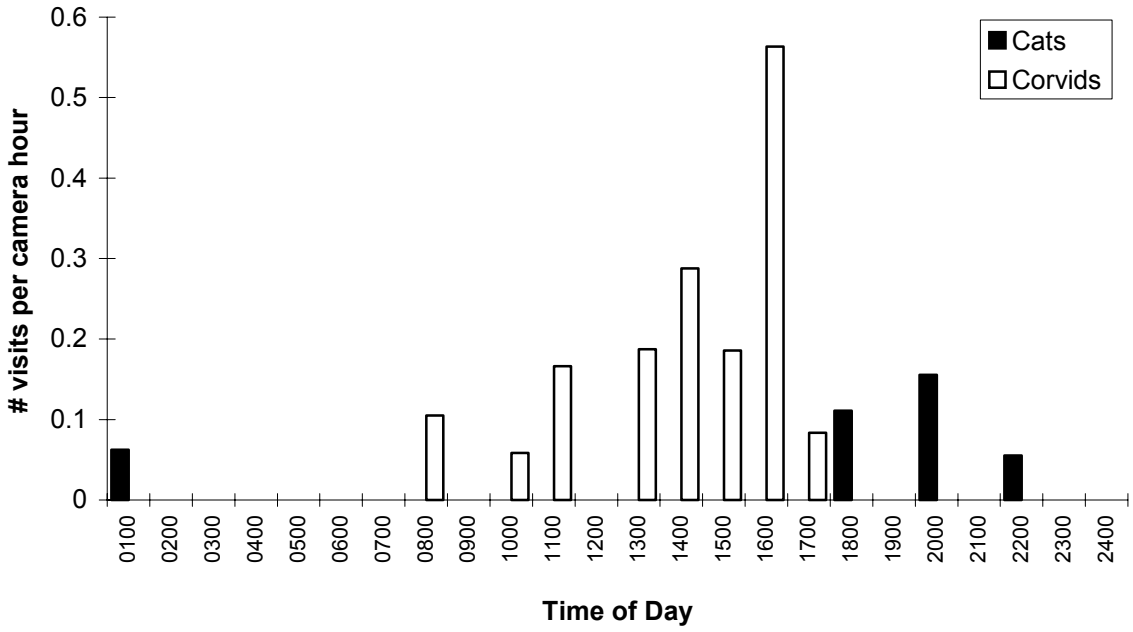


Figure 4: Diurnal patterns of visitation to baiting stations at Roxby Downs during winter.



Developing and assessing a community-based feral cat trapping program

Based on the above information, baiting and or trapping feral cats as a control technique is likely to be most cost effective if conducted during winter and early spring. Furthermore any traps or baits that are used should probably be placed on the edges of remnant native vegetation since these areas are used extensively by feral cats when they are moving around their home ranges. In developing a control program there is a clear need to consider the potential impact of any technique on the large numbers of non-target native animals that might take baits or be trapped. Furthermore controlling feral cats in areas that are relatively heavily populated with people is likely to be problematic, since techniques of eliminating feral cats will place companion animals such as dogs and cats also at risk. Given these concerns and the need for any control program to be humane, use of poisoned baits is unlikely to be acceptable to the community at large and so some alternative, selective and humane program needs to be developed. The only logical technique that is currently available is trapping, since this allows non-target fauna (including domestic cats) to be released while any feral cats can be humanely killed. From 1995 to 1997 a trial trapping program was established in the Emu Bay region of Kangaroo Island using the local community to determine if this had the potential to reduce feral cat populations from agricultural areas on Kangaroo Island. Funds from the Wildlife Conservation Fund and the Nature Foundation of South Australia were used to employ someone living in the local community to establish and manage this program over a period of 2-3 years. The program involved property owners setting and checking up to three treadle-operated cage traps each per day with the traps set on their own properties or in scrub along roads adjacent to their properties during the winter months. Participants were not required to operate traps at other times of the year when cats were less likely to be trapped.

There were two components to assessing the effectiveness of this project. The first involved collecting information that would indicate that the numbers of feral cats in the trapping area had declined, and the second involved assessing the ability of the community to implement an effective program.

The initial program involved selecting an area of around 20 km^2 and enlisting the help of most of the property owners within this area in the trapping program. The Emu Bay region was eventually chosen because of the degree of community interest in managing the feral cat population. Each participant was then provided with 1, 2 or 3 cat traps depending on their anticipated ability to set and check the traps on a regular basis. All participants also received a logbook in which they were required to record the dates when the traps were set, what was caught in each trap and the amount of time they spent setting and checking traps. All traps were set following guidelines provided to the participants that met the requirements of the University of Adelaide's Animal Ethics Committee. This required all traps to be placed in sheltered areas and given additional protection with Hessian when needed. When traps were set, participants were required to check traps at dawn and dusk. Information on the animals (cats, possums, ravens etc) that were caught in the traps was recorded in the logbook. Except for cats, all other wildlife was released. Any feral cats that were caught, however, were destroyed humanely. Most were promptly transported in the trap to the local vet to be put down. (This was one of the requirements of the University of Adelaide's Animal Ethics Committee that had approved this work). When required the project officer assisted participants by transporting cats to the local vet. Where possible additional information on the cats, including sex of the cat, its body mass and its general condition were recorded.

Participants were also required to record information on the numbers of animals including feral cats that they saw along sections of road during the period of their trapping to provide some statistics on whether the numbers of cats in the area were declining. This task was not particularly onerous and only required people to record information when they actually drove

that section of the road as part of other activities. The logbook included tables where this information could be recorded.

The project officer maintained regular contact with the participants through the 3-4 month trapping season and encouraged them to fill in the logbook and keep good records. At the end of the season logbooks were collected and all data collated.

Three indicators were considered suitable for assessing the effectiveness of the trapping program:
(1) a reduction in the numbers of cats being caught as the season progressed;
(2) a reduction in the average body mass of the cats being caught (smaller body masses infer younger animals that were expected to move into vacant areas); and
(3) a reduction in the number of cats being sighted along the sections of road being surveyed.

In due course a fourth variable - the incidence of sarcosporidiosis in sheep meat - should also decline if feral cats were being effectively eliminated. However this was unlikely to be expressed until several years after the cats had been removed.

The other area that was assessed during this project was the commitment required by volunteers who operated traps. This consisted of each participant recording the amount of time they spent per day setting and checking traps. This information provides some basis for assessing the cost-effectiveness of the voluntary trapping program against other methods of control.

In 1995 the numbers of feral cats caught progressively declined across the trapping season (Table 5). The body masses of feral cats in this year also declined across the trapping season although few cats were caught from the end of July onwards (Table 5).

In 1996, no feral cats were caught within the study area in June and July and only 2 feral cats were caught in August 1996 (Table 5). However few traps were set in June because most participants had not seen any feral cats on or near their properties in the preceding months. Moderate and comparable levels of trapping took place in July, August and September, however, with only two cats being caught. The body masses of the two cats caught in 1996 were both 3.8 kg.

In 1997, moderate numbers of feral cats were caught over the study site with capture rates declining in September (Table 1). The majority of the cats caught in 1997 were small cats in their first year of life with the average body masses being substantially lower than those recorded in 1995 and 1996 (Table 1). These data are consistent with young cats dispersing into the area from outside areas during the winter of 1997.

Ten participants were actively involved in the trapping program when it commenced in 1995, but the numbers declined to six in 1996 and 1997. The amount of time that each committed to the trapping program also declined over the three years with the average number of hours spent per participant averaging 49.5 hours in 1995, 26.2 hours in 1996 and 17.0 hours in 1997. On average, participants spent 13 minutes per night that traps were set and took an average of 2-5 minutes per trap per day to check and re-bait and reset traps (depending on whether animals were caught and if traps needed to be re-baited). All participants recorded their trap success but only 2 of the 10 participants in the first year collected any data on the numbers of cats and other animals seen along roads in the vicinity of their property, and then irregularly.

Table 5: Capture rates and body masses of feral cats caught as part of a community-based control program at Emu Bay, Kangaroo Island during winters 1995, 1996 and 1997.

Date	Cats/100 trap nights (n trap nights)	Mean body mass (kg)	Range in body mass (kg)	# cats measured
June 1995	7.1 (170)	3.6	3.0 - 5.6	9
July 1995	2.4 (464)	3.3	3.0 - 3.9	6
Aug 1995	0.4 (248)	3.0	3.0	2
Sep 1995	0.3 (291)			
June 96	0.0 (3)			
July 96	0.0 (149)			
Aug 96	1.1 (177)	3.8	3.8	2
Sep 96	0.0 (90)			
June 97	3.4 (89)	3.3	2.0 - 5.0	7
July 97	5.8 (138)	2.4	2.0 - 2.9	4
Aug 97	4.9 (184)	2.7	1.5 - 3.5	7
Sep 97	3.0 (133)	1.9	1.4 - 2.5	4

The trapping program at Emu Bay appeared to eliminate feral cats from the study area during the first year. Based on estimates of the home ranges and population densities of feral cats near Murrays Lagoon on Kangaroo Island, 12 -14 feral cats would be expected to occupy an area of 20 km^2. In all 17 feral cats were trapped and removed from the study area in 1995. In 1996 when the trapping was scheduled to re-commence most participants were reluctant to be involved because no cats had been seen in the study area.

By the end of 1996 only two adult cats had been caught both on the periphery of the study area, suggesting that the trapping program of the previous year had been successful and that there had been little re-colonization of the area during 1995-96. In the third year 22 cats were caught, but these were primarily young first year cats that weighed less than 3 kg. These patterns are entirely consistent with an effective trapping program. Low recruitment during 1995-96 was a little surprising since new cats were anticipated to fill the vacant territories in the study area. Perhaps poor breeding during the spring of 1995 in adjacent areas meant that there were very few cats searching for territories in the following year. The same did not apply for 1997 when a large number of relatively young cats were caught and removed from the study area. Given that little or no attempt was made to eliminate cats from areas immediately outside the study area, arrivals of new cats in the study area were expected. However, if a strategy of trapping progressively further and further away from a core area could be implemented then community-based trapping programs would appear to be able to eliminate feral cats from core agricultural areas on Kangaroo Island and/or at least keep the numbers of cats at low levels. Furthermore lower levels of sarcosporidiosis were found in sheep taken from at least one property within the study area in 1998 compared with 1995. Although many factors may influence levels of sarcosporidiosis in sheep, one benefit of eliminating feral cats from an area should be a marked reduction in the incidence of sarcosporidiosis in sheep that are born and fattened in those areas.

Two other community-based trapping programs were commenced in other areas on Kangaroo Island, but neither of these were maintained long enough to assess the effectiveness of intensive trapping on cat numbers in these additional areas. In part these

replicate programs struggled because the community participants were less committed than those living at Emu Bay.

Several factors impinge on the effectiveness of trapping programs on Kangaroo Island. First and foremost the traps caught more possums and ravens than they caught cats. This added not only to the time required to check and set traps but also meant that the trap was inoperable as far as catching cats was concerned until non-target animals were released. Thus the number of effective traps nights is much lower than indicated in Table 5. Alternative trapping systems perhaps using singing decoy birds and soft jaw traps may prevent excessive captures of non-target animals, and so be more effective.

Second, when few cats were present the enthusiasm of community participants waned and so eliminating the last few hard to catch cats may be difficult. As with many community-based conservation programs a few keen participants contributed most of the time and effort to implementing the trapping program. Although most participants were keen to set and check traps, few if any were keen on collecting information on the numbers of cats seen in an area or along a road. Similar attitudes to recording information occur in other community-based conservation programs, with volunteers preferring 'hands on' field activities to data collection and note taking. During the second and third years of the program information about their local observations were collected orally. Even then few participants were consistently observant and the one lesson from this study is that effective monitoring programs of community projects may need to be done by professional people.

Additional ways of increasing the success of the trapping program, like concentrating animal carcasses in a small area to concentrate cat activity were not tested in this study partly because so few cats were present on the main study area during 1996. However, implementing such actions may improve the effectiveness of trapping and lead to more efficient trapping programs.

In summary, the community-based trapping program at Emu Bay appeared to eliminate feral cats and the rate of subsequent re-colonization was slow over the next 1-2 years, suggesting that feral cat populations could potentially be eliminated from the island. Community-based trapping programs per se, however, are unlikely on their own to be truly effective because not all participants will be equally diligent in running effective trapping programs. However, such programs clearly have a key role to play in these more heavily populated areas and can contribute positively to the management of feral cat populations.

Acknowledgments

Lynn Pedler, Rachel Paltridge, and Hafiz Stewart assisted with the behavioural studies on feral cats reported in this paper. Natasha Kearslake and Jo Chivel also provided valuable assistance by managing the community-based feral cat trapping programs between 1995 and 1997, and communicating with and encouraging all of the participants. Greg Johnnson humanely destroyed any feral cats that were transported to his veterinary practice as part of this project. NPWS staff, particularly Anthony Maguire, on Kangaroo Island also provided assistance and encouragement at all times. Emma Crossfield kindly provided technical and editorial assistance with the production of this paper. The financial support of the Australian Nature Conservation Agency, the Wildlife Conservation Fund and Nature Foundation of South Australia is gratefully acknowledged. The research summarized in this paper operated under permits provided by the NPWS of South Australia and with approvals from the University of Adelaide's Animal Ethics Committee and was only possible due to the generosity and concern for the environment of the Kangaroo Island community.

References

Bloomer, J.P. & Bester, M.N. 1992. Control of feral cast on sub-antarctic Marion Island, Indian Ocean. *Biological Conservation* 60: 211-219.

Coman, B.J. 1991. The ecology and control of feral cats in Australia. In C. Potter (ed.) *The Impact of Cats on Native Wildlife. Proceedings of a Workshop 8-9 May 1991*. Pp 70-74. Endangered Species Unit, ANCA, Canberra.

Edwards, G., Piddington, K.C. & Paltridge, R.M. 1997. Field evaluation of olfactory lures for feral cats (Felis catus L.) in central Australia. *Wildlife Research* 24: 173-183.

Jones, E. & Coman, B.J. 1981. Ecology of the feral cat, *Felis catus* (L.) in southeastern Australia, I. Diet. *Australian Wildlife Research* 8: 537-547.

Molsher, R.L. 2001. Trapping and demographics of feral cats (Felis catus) in central new South Wales. Wildlife Research 28: 631-636.

Newsome, A. 1991. Feral cats:an overview. In C. Potter (ed.) *The Impact of Cats on Native Wildlife. Proceedings of a Workshop 8-9 May 1991*. Pp 7-13. Endangered Species Unit, ANCA, Canberra.

Paltridge, R., Gibson, D. & Edwards, G. 1997. Diet of the feral cat (*Felis catus*) in central Australia. *Wildlife Research* 24: 67-76.

Read, J.L. & Bowen, Z. 2001. Population dynamics, diet and aspects of the biology of feral cats and foxes in arid South Australia. *Wildlife Research* 28: 195-204

Risbey, D.A., Calver, M. & Short, J. 1997. Control of feral cats for nature conservation. I. Field tests of four baiting methods. *Wildlife Research* 24: 319-326.

Short, J., Turner, B., Risbey, D.A. & Carnamah, R. 1997. Control of feral cats for nature conservation. II. Population reduction by poisoning. *Wildlife Research* 24: 703-714.

Short, J., Turner, B. & Risbey, D.A. 2002. Control of feral cats for nature conservation. III. Trapping. *Wildlife Research* 29:475-487

Van Rensbury, P.J.J, Skinner, J.D., & van Aarde, R.D. 1987. Effects of feline panleucopaenia on the population characteristics of feral cats on Marion Island. *Journal of Applied Ecology* 24 :63-73.

Veitch, C.R. 1985. Methods of eradicating feral cats form offshore islands in New Zealand. In P.J.Moors (ed.) *Conservation of Island Birds. Case Studies for the Management of Threatened Island Species*. Pp 125-141. International Council for Bird Preservation Technical Publication.

Veitch, C.R. 1991. Cta eradication: the New Zealand perspective. In C. Potter (ed.) *The Impact of Cats on Native Wildlife. Proceedings of a Workshop 8-9 May 1991*. Pp 82-89. Endangered Species Unit, ANCA, Canberra.