

ATOLL RESEARCH BULLETIN

NO. 505

FERAL CATS IN PARADISE: FOCUS ON COCUS

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**DAVID ALGAR, G. JOHN ANGUS, ROB I. BRAZELL,
CHRISTINA GILBERT, AND DAVID J. TONKIN**

**ISSUED BY
NATIONAL MUSEUM OF NATURAL HISTORY
SMITHSONIAN INSTITUTION
WASHINGTON, D.C., U.S.A.
AUGUST 2003**

FERAL CATS IN PARADISE: FOCUS ON COCOS

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DAVID ALGAR,¹ G. JOHN ANGUS,¹ ROB I. BRAZELL,² CHRISTINA GILBERT,² and
DAVID J. TONKIN³

ABSTRACT

The Department of Conservation and Land Management was approached by the Shire Council of the Cocos (Keeling) Islands to provide a long-term solution to the feral cat problem on the islands. Researchers in the Department have developed a number of techniques and strategies to control feral cats. The project on the islands provided the opportunity to assess these procedures on a closed population in a wet tropical climate.

A control program resulted in the removal of approximately 90% of the feral/stray cats on the islands. It is anticipated that Shire officers that were trained in trapping techniques during the control program will remove the remaining individuals.

INTRODUCTION

The Cocos (Keeling) Islands were initially settled by Alexander Hare in 1826 and subsequently by the Clunies Ross family in 1827. These families brought with them a number of coconut plantation workers, predominantly of Malay origin. Today, 460 Cocos-Malay people live in the kampong (village) on Home Island while 150 people mostly from mainland Australia live on West Island. Pondokos (weekender shacks) used by the Home Islanders are present on the lagoon shore of South Island and on a number of the smaller islands.

¹Department of Conservation and Land Management, Science Division P.O. Box 51, Wanneroo, Western Australia 6065.

²Department of Conservation and Land Management, Central Forests Region, Mornington District, P.O. Box 809, Collie, Western Australia 6225.

³City of Subiaco Council, affiliated with the Shire of Cocos (Keeling) Islands, P.O. Box 270, Subiaco, Western Australia 6904.

The early settlers first introduced cats to the southern atoll and throughout the islands' history cats have arrived as domestic pets. Over the last two decades, the number of stray/feral cats present has concerned the community and a number of short-term control programs have been implemented (Garnett, 1992; Reid, 2000). These control campaigns have only reduced cat numbers over a limited period and the problem has persisted. A recent policy adopted by the Shire Council has restricted the importation of cats to sterilized animals only. The presence of feral/stray cats potentially poses health problems to the human population as cats are hosts and reservoirs for a number of diseases and parasites. The presence of feral/stray cats in residential areas has also presented a significant nuisance problem with cats calling and fighting through the night and urinating and defecating around the houses. The Cocos-Malay people were also concerned that cats were predators of their domestic chickens around the kampong and pondoks where chickens are allowed to range free.

Successful control of stray and feral cats would also benefit the proposed reintroduction of the endangered buff-banded rail (*Rallus philippensis andrewsi*) to several islands within the group (Garnett, 1993; Parks Australia, 1999; Garnett and Crowley, 2000; Reid, 2000). This species was once widespread on all the Cocos (Keeling) Islands but is now restricted to the cat-free North Keeling Island. The last record for this species, other than on North Keeling Island, was an individual killed by a cat on West Island in 1991 (Garnett, 1993).

Members of the Shire Council on behalf of the Island Community made an approach to the Department of Conservation and Land Management to provide a long-term solution to the cat problem on the islands. Feral cats are present on Home and West Islands and possibly occupy some or all of the chain of islands between the two.

Until recently, limited research has been conducted in Australia on control strategies for feral cats. The research and operational programs being conducted by the Department are providing innovative techniques and successful strategies for controlling feral cats. The program on the Cocos (Keeling) Islands offered the opportunity to expand the range of environmental conditions under which the current control techniques have been assessed. Two broad climatic regimes under which the techniques have not been tested are the wetter temperate and tropical climates. The Cocos (Keeling) Islands offered the opportunity to assess current procedures on a closed population in a wet tropical climate with rats and chickens as the principal prey species.

METHODOLOGY

Site Description

The Cocos (Keeling) Islands are a remote Australian External Territory located in the Indian Ocean. They lie 2,768 km northwest of Perth, 3,658 km almost due west of Darwin, 900 km west of Christmas Island and 1,000 km southwest of Java Head. The islands are two coral atolls only several meters above sea level which have developed on top of old volcanic seamounts. The inhabited southern atoll is 14 km long and 10 km across and comprises 26 islands. Some islands are linked together (or separated by very shallow water) at low tide,

while others are in deeper water and are accessible only by boat. The uninhabited northern atoll 26 km to the north comprises a single island, North Keeling Island, an area of 1.3 km² that is a seabird rookery of world-wide significance.

The islands of the southern atoll are located at latitude 12° 12'S and longitude 96° 54'E. Climate is oceanic-equatorial and humid with a mean annual rainfall of approximately 2000 mm, high humidity (65-84%), and uniform temperatures year round (mean daily temperature: 25.8–27.5° C) (Falkland, 1994). The southeast trade winds dominate for most of the year but with periods of doldrums during the tropical cyclone season (November-April).

The total land area of all the islands of the southern atoll is 14 km². The reef islands of the Cocos (Keeling) Islands are described in detail by Woodroffe and McLean (1994) and summarized below. The smaller islands are less than a hundred meters wide, some are virtually vegetated sandbanks, and all are made up of coral clinker and sand thrown up from the surrounding reef. All the islands are flat, their highest points being sand hills on the ocean side. The sizes of the main islands in the group are indicated in Table 1 (from Woodroffe and McLean, 1994).

Table 1. The sizes of the main islands of the southern atoll

Island	Perimeter (km)	Area (km ²)
Pulu Panjang (West Is.)	38.5	6.23
Pulu Atas (South Is.)	28.5	3.63
Pulu Luar (Horsborough Is.)	4.4	1.04
Pulu Selma (Home Is.)	6.7	0.95
Pulu Tikus (Direction Is.)	3.4	0.34
Pulu Pandan	3.9	0.24
Pulu Wak Bangka	2.4	0.22
Pulu Siput	2.2	0.10
Pulu Ampang	1.8	0.06
Pulu Kembang	1.6	0.04
Pulu Labu	1.3	0.04
Pulu Blekok	1.1	0.03
Pulu Blan	0.8	0.03
Pulu Blan Madar	0.7	0.03
Pulu Wa-idas	0.7	0.02
Pulu Kelapa Satu	0.5	0.02
Pulu Beras (Prison Is.)	0.4	0.02
Pulu Maria	0.7	0.01

The majority of islands in the atoll have a conglomerate platform on the ocean side, although there are extensive sandy/shingle areas on South and Horsburgh Islands. The ocean side of West Island is predominantly sand. The lagoon side of the islands is either sandy beaches or intertidal sands with variable areas of coral shingle. On a number of islands sandy spits extend into the lagoon.

The vegetation on the southern atoll is dominated by groves of coconut palms. This coconut woodland has ceased to be cleared and has become largely overgrown and penetrable with difficulty. The understory is mostly coconut seedlings with some shrubs, grasses or other perennials or a dense mat of decaying palm fronds and coconuts. These woodlands are fringed on the lagoon shore by shrub land of *Pemphis acidula* and on the ocean shores by cabbage bush (*Scaevola taccada*) and clumps of octopus bush (*Argusia argentea*) (Williams, 1994; Woodroffe and McLean, 1994).

There are no native mammal species on the atoll; however, a number of species have been introduced. Two species of introduced rats, the brown rat (*Rattus norvegicus*) and black rat (*R. rattus*), are present on the islands (Wood Jones, 1909). Rats arrived on the Cocos before the settlers. Rats that survived the shipwreck of the Mauritius in 1825 colonized an island the Cocos Malay call Pulu Tikus (Rat Island, now known as Direction Island) (Wood Jones, 1909; Bunce, 1988). Subsequent shipwrecks and dispersal of rats have enabled the animals to spread to all the islands in the southern atoll. Two bird species have also been introduced and become established on the southern atoll (Carter, 1994). "Feral chicken", domestic chicken that have become semi-wild, occur on most if not all islands in the southern group. The green junglefowl (*Gallus varius*) of Java was also introduced to West Island.

The Control Program

The first stage in providing a long-term solution to the cat problem on the islands was to sterilize domestic pets and thus prevent young animals entering the overall cat population. Prior to implementing the control program, the Shire of Cocos contracted a veterinary surgeon to sterilize those domestic cats that the owners wished to retain. The sterilized cats were sprayed with a red marker to enable identification and release of pets should they be captured during the trapping program. The sex, age and the owners of sterilized cats were recorded.

A public awareness and education program was conducted upon our arrival outlining the program and method of operation. Talks were given to children in primary and high schools and a presentation was provided to shire councillors. Once the control campaign had been initiated, there was an ongoing commitment to inform the shire and members of the general public of the program's progress.

The control program commenced on November 5, 2000 and was conducted over a 40-day period. The majority of cats were reported to be on the inhabited Home and West Islands and therefore these two islands were the focus of the control program. The other 24 islands in the southern atoll were systematically examined for evidence of cat activity. The extensive searches conducted revealed that South Island was the only other island in the group that cats occupied. The cat population on this island was localized and relatively small, probably less than 10 animals.

Department researchers have developed a series of techniques that have proven highly successful in controlling feral cats. A bait has been developed to control feral cats. It is similar to a chipolata sausage, approximately 25 g wet-weight, and is composed of minced kangaroo

meat, chicken fat and flavor enhancers that are highly attractive to feral cats. Toxic baits contain the poison 1080 (sodium monofluoroacetate).

A trapping technique, using lures that mimic signals employed in communication between cats, has also been developed. Cats are very inquisitive about other cats in their areas; their communication traits are principally reliant on audio and olfactory stimuli. The trapping technique uses padded leg-hold traps, Victor 'Soft Catch'[®] traps No. 3 (Woodstream Corp., Lititz, Pa., USA.), a Felid Attracting Phonic (FAP) that produces a sound of a cat call, and a blended mixture of feces and urine (pongo). Each trap site consists of a channel slightly wider than the width of one trap which is cleared into a bush to create a one-way (blind) trap set. Two traps, one in front of the other, are positioned at the entrance of the blind set at each trap site. Cats are lured to a trap set initially by the audio signal produced by the FAP. The FAP consists of a 36 x 25 mm printed circuit board with a microprocessor data-driven voice read only memory (ROM). As cats approach the trap sets they are further enticed into the traps by the smell of pongo. These techniques, along with cage traps baited with fish or nontoxic sausage baits and shooting with a 0.22 caliber rifle or 12-gauge shotgun, provided the options during the control program. A number of cats were also captured by hand; these animals were usually kittens (under 500 g in weight) in the kampong.

The use of individual techniques varied for each island because of their size and the extent of human inhabitation. On Home Island a toxic baiting program could not be conducted because of legislative regulations and health and safety protocols. Cage trapping was the principal control measure used on the island. Initially the traps were provided to individual households and the villagers trapped the cats for us. The enthusiastic response to this program enabled traps to be located across the majority of houses in the kampong. Between 20-25 traps were employed daily in the kampong. Following the removal of the majority of cats from the kampong, the cage traps were strategically located across the rest of the island. Shooting of cats was employed in areas distant from the kampong. To remove those cats that were wary of entering cage traps, a number of leg-hold traps were strategically set in areas where cats were observed. Setting these traps in the village was conducted with the consent of the householder and all inhabitants of that house were shown its location. Leg-hold traps were also set outside the kampong. The leg-hold traps were either baited with pongo or a food lure and the traps were set at dusk and removed at dawn.

The much larger West Island with a smaller, localized residential area and South Island inhabited only on the weekends provided the opportunity to assess baiting options as a measure of cat control. Preliminary trials with nontoxic baits placed on the ground resulted in all baits being removed overnight by nontarget species. Land crabs (*Cardisoma carnifex*) which dominate the forest floor, hermit crabs (*Coenobita perlata*) along the coastal areas and chickens were responsible for removing the baits. A subsequent trial using 30 cm wooden skewers to elevate the baits above the ground prevented land crabs from taking baits but over three-quarters of the baits were still taken by hermit crabs and chickens. Further trials were abandoned and the option of using baits to control cats was dismissed. Later in the control program, it was discovered that attaching several baits to a string tied to a stake angled into the ground overcame the problem. The baits were suspended approximately 30 cm above the ground and were not taken by nontarget species but were highly attractive to cats. Unfortunately at this stage we did not have sufficient equipment to use this technique in a

baiting program but it did provide a very successful method for trapping cats towards the end of the control program.

West Island with its smaller localized residential area also enabled a greater flexibility in the use of control options. Cage trapping was conducted around the houses and leg-hold traps were located outside the residential area across the island. Leg-hold traps with the FAP/pongo lure were positioned at 500 m intervals along all road accesses on the island. The network of roads on the island provided 20 km of accesses along which 46 traps were located. All traps were left in position for a minimum of 20 days. A further 10 trap sets employing the suspended sausage lures were strategically located to remove those cats wary of the FAP/pongo lures.

Controlling cats on South Island was abandoned following the preliminary bait trials. South Island could only be accessed easily at certain points at high tide, which posed immense difficulty in being able to examine traps on a daily basis. The time involved in travelling to and from the island also meant that more critical efforts on the other islands could not be undertaken. Our focus was concentrated on Home and West Islands where the cat populations were much greater and posed more significant problems to the people.

Captured cats were humanely dispatched according to approved ethical procedures and the carcasses disposed of according to local government guidelines. For each individual animal, sex was determined, weight recorded and a broad estimation of age (as either kitten, subadult or adult) was determined according to their weight. The pregnancy status and litter size of females was recorded by examining the uterine tissue for the presence of fetuses or placental scarring from the previous litter. Stomach contents were examined to provide information on principal prey species. Samples of brain, muscle, spleen, blood and feces were collected from the first 10 cats on both Home and West Islands for analysis of communicable diseases and parasite presence and also for determination of the genetic origins of the cats.

RESULTS

A total of 29 cats were neutered during the sterilization program. Three of these animals were later requested to be destroyed by their owners. A survey of cat owners conducted while on the island indicated that a further 17 pet cats had been sterilized previously. Another five cats removed during the control program had also been sterilized at some stage but had become stray or feral. Records of the sterilized animals are given in Table 2.

Table 2. The sex, age and location of sterilised cats

	Male		Female	
	Adult	Subadult	Adult	Subadult
Home Is. (Nov. 2000)	5	4	9	8
(previously)	3	-	1	-
West Is. (Nov. 2000)	-	2	1	-
(previously)	4	-	9	-
Total	12	6	20	8

The intensive searches for evidence of cat activity on each of the islands in the atoll indicated that they only inhabited Home, West and South Islands.

A total of 230 cats were removed during this exercise, 43 animals from West Island and 187 from Home Island. Female cats pregnant at the time of removal contained an additional 108 kittens *in utero* that potentially would have survived to enter the cat population. The number of animals removed using the various techniques is given in Table 3.

Table 3. The number of cats removed using the various techniques on West and Home Islands

Technique	West Island	Home Island
Cage trap	11	127
Leg-hold trap with FAP and Pongo lure	15	0
Leg-hold trap with food lure	12	12
Leg-hold trap with Pongo only	Not used	6
Shot	5	14
By Hand	Not used	28

The male-to-female sex ratio of these animals was 0.93. The population age structure for the two islands is presented in Table 4. The age of individuals was arbitrarily assigned according to weight. The lowest weight recorded for a pregnant female was 1.6 kg and this was used as the minimum adult weight for female cats. The weight/age classes for females were 0-0.5 kg for kittens, 0.6-1.5 kg for subadults and 1.6+ kg for adults; males were 0-0.5 kg for kittens, 0.6-2.0 kg for subadults and 2.1+ kg for adults.

Table 4. Population age structure of culled cats

	Male			Female		
	Kitten	Sub adult	Adult	Kitten	Sub adult	Adult
Home Island	21	19	51	21	11	58
West Island	-	5	12	1	7	18
Total	21	24	63	22	18	76

The average weight for adult male cats was 3.38 ± 0.07 kg ($\mu \pm$ s.e.) with a maximum weight of 4.80 kg. The average weight for adult female cats was 2.69 ± 0.06 kg ($\mu \pm$ s.e.) with a maximum weight of 3.75 kg. Counts of fetuses *in utero* and placental scars indicated that the average litter size was 2.85 ± 0.19 kittens ($\mu \pm$ s.e.) with a maximum litter size of six kittens.

Analysis of the stomach contents for individual animals indicated that the majority of cats on Home Island were feeding on household scraps and food put out for the chickens. Grasshopper remains were found in only two cats and one cat had eaten a rat. In contrast, the principal dietary items on West Island were rats and grasshoppers. There was no evidence that cats were predators of chickens, or any other bird species, despite the abundance of young domestic and feral chickens on the two islands.

Analysis of the parasite presence in the cats sampled indicated a high degree of hookworm. Ninety percent of the samples contained this parasite.

DISCUSSION

The control program on the Cocos (Keeling) Islands has served as an important example of how investment in research can lead to practical and valuable outcomes to the benefit of the broader community. Evidence suggested that there were probably a maximum of 10 feral/stray cats remaining on each of Home, West and South Islands at the conclusion of the control program. The program, therefore, resulted in the removal of approximately 90% of feral/stray cats. The success of this operation was due, to a large extent, to the enthusiastic response and participation by the entire community. The public education programs and liaison with the community addressed potential community concerns and resulted in significant public co-operation to the benefit of the project.

The abundance of cats on the three islands was significantly different and this can be attributed to the availability of food and suitable shelter. On Home Island an abundant food supply was present comprising food scraps scavenged within the kampong and around the tip

and also food provided for the villager's chickens. Areas that provided adequate shelter and sites to raise kittens, particularly under the houses in the kampong away from the disturbance of land crabs, were numerous. On West Island, despite its larger size, cat abundance was significantly less than on Home Island. Rats and grasshoppers dominated the diet of cats on West Island. Kittens and young cats were generally only found around the residential area and rubbish tips where they were able to scavenge food scraps. Land crabs were much more abundant on West Island and areas of shelter and sites to raise kittens were limited. Lower food availability and limited sites for shelter would have significantly reduced survivorship, particularly of kittens and young cats. The small number of cats on South Island were located in the vicinity of the pondoks that were frequently occupied and had free-range chickens. These areas would have provided household food scraps and food supplied for the chickens. The absence of cats on other islands in the atoll would have been due to the islands being too small to support a cat population because of limited food and shelter.

One of the major reasons for conducting this control program was the community's concern of potential health risks due to the presence of feral/stray cats. Cats are hosts and reservoirs for a number of diseases and parasites including *toxoplasmosis* which can cause spontaneous abortion and birth defects. Analysis of the cat population sampled indicated a high incidence of hookworm infection. Hookworm larvae can burrow into human skin causing a disease called *cutaneous larval migrans*, also known as "ground itch" (Hotez and Pritchard, 1995).

Predation by cats, rats, and humans, competition with feral chickens, and habitat change have been suggested as the factors responsible for the local extinction of the buff-banded rail on the southern atoll of the Cocos (Keeling) Islands (Garnett, 1992, 1993; Garnett and Crowley, 2000; Reid, 2000). If proposed reintroductions are to be successful, effective control of cats is essential (op. cit.). The campaign conducted thus far, and that outlined for completion, will provide the level of control required.

The trapping techniques previously used in more arid and semiarid environments proved equally as effective under the wetter, tropical conditions on Cocos. The refinement to bait placement, developed while on Cocos, by suspending baits, prevented nontarget animals from removing the baits while maintaining their attractiveness to cats. This new approach to baiting provides a relatively simple means to control cats where nontarget species pose a problem and is likely to be invaluable elsewhere where control is required. This baiting technique will now be used to remove those feral/stray cats remaining on West and South Islands. Instruction in trapping techniques was provided to shire officers nominated to continue the program after our departure. These officers are continuing the trapping program on Home Island to remove the remaining feral/stray cats. These methods, the sterilization program for domestic pets, and the existing procedure of quarantining ships and pleasure yachts will provide the long-term solution to the cat problem on the Cocos (Keeling) Islands.

The success of the control program on the atoll follows a previous eradication program of cats from Hermite Island in the Montebellos group, Western Australia (Algar and Burbidge, 2000; Algar *et al.*, in press). This year, a cat eradication campaign was also

successfully conducted on Faure Island, an area of 58 km² within the eastern gulf of Shark Bay, Western Australia.

ACKNOWLEDGEMENTS

The authors would like to thank: Michael Simms, City of Subiaco Council for organizing and supporting this project; the Shire of Cocos (Keeling) Islands for providing the sponsorship to conduct this program with special thanks to Bob Jarvis (CEO), Bob Bower (Director of Finance) and Mohamed Chonkin (Shire President) for their enthusiastic support and assistance; and Noor Anthoney and Adim Hajat of the Shire of Cocos (Keeling) Islands for their invaluable effort in assisting with the trapping program. We extend our thanks to: Bob Holland (Deputy Administrator, Commonwealth) for providing the boat; and to Brain Abbott, Steve Lane and Rosi Arkrie (Federal Police stationed on Cocos) for their support and assistance. To Wendy Murray (Government Conservator, Parks Australia) and her colleagues our thanks are extended. Finally, we wish to thank all the community for their support, encouragement and generous hospitality while we were on the Cocos (Keeling) Islands, without whom this project would not have met with the success it did. The techniques used in this program have been approved by the Department's Animal Ethics Committee which includes independent members from animal welfare organizations.

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