Feral Animal Control on Western Australian Islands

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Abstract

Feral mammals occur on many of the islands off the W.A. coast, and control has been undertaken on four species the rabbit, rat (*Rattus rattus*), goat and fox. Rabbits were deliberately introduced to Carnac and Mistaken Islands in the 19820s and 1830s, prior to their arrival in the south west of W.A. by migration from the eastern states. They overgraze vegetation causing loss of cover and erosion, and in some cases compete with nesting seabirds for burrow sites . They have been effectively eradicated on some islands using trails of carrot cubes impregnated with 1080. The rat occurs on many north west islands, predating nesting seabirds and competing with native fauna for shelter and food. On islands of less than 100 ha they have been eradicated using oats impregnated with Pindone. Despite the goat surviving on Bernier Island for nearly 90 years and overgrazing the vegetation, the six species of native mammal on the island have survived and not showed any sign of decline in numbers. The goat has now been eradicated using an experienced shooter operating from a helicopter. The decline of rock wallabies on offshore islands has been attributed to predation by the fox, however fox eradication is difficult as these islands are connected to the mainland at some stage allowing post baiting invasion to occur. Control of fox numbers at acceptably low levels through continuous baiting with fresh meat and 1080 is possible

INTRODUCTION

Many of the 3 000 or so islands off the Western Australian (W.A.) coast support populations of feral animals (Table 1). Seven species of feral mammal are known, however in most cases only one species has become established on an island. Since many of the affected islands are nature reserves with high conservation values, the Department of Conservation and Land Management, with advice and assistance from the Agriculture Protection Board, has been undertaking control and eradication programs on them. In this context the objective of eradication is to eliminate all individuals, while that of control is to reduce the population to acceptable low levels. This paper describes the control and eradication programs conducted since 1965 on four species of feral animal, the rabbit (*Oryctolagus cuniculus*), black rat (*Rattus rattus*), goat (*Capra hircus*) and fox (*Vulpes vulpes*).

Rabbit (*Oryctolagus cuniculus*)

Between 1965-1980 rabbit eradication programs have been undertaken on islands of 4 nature reserves off the south and west coast of W.A. The islands concerned are Carnac Island, Wooded, Morley and Leo Islands in the Houtman Abrohlos, Green Islets (north and south) and Mistaken Island.

All these islands are important breeding sites for sea birds. At least 5 species breed on Carnac Island (19 ha), and this is the only area of overlap between the breeding ranges of the Little Penguin (northern limit) and Wedge-tailed Shearwater (southern limit) (Watson 1959). A population of the Tiger Snake (*Notechis ater*) also inhabits the island and Australian Sea Lions rest on the beaches. Wooded, Morley and Leo Islands support at least 15, 8 and 5 species of nesting sea bird respectively (Storr, *et al.* 1986). The two Green Islets, each 3 ha, have had 7 species recorded breeding on them, and a colony of Australian Sea Lions on their beaches. Mistaken Island, also referred to as Rabbit Island, has had 4

Table 1.
Feral animals on W.A. Islands

Island Name	Land Status	Conservation Value	Feral animal(s)
Sir Graham Moore	vacant Crown land	native mammal	pig
Adele	Commonwealth	seabird nesting	*Rattus exulans*
Browse	mineral reserve	turtle nesting	*Mus musculus*
Lacepede	nature reserve	seabird/turtle nesting	*Rattus rattus*
Bedout	nature reserve	seabird nesting	*Rattus rattus*
Depuch	W.A. Museum reserve	native mammals	fox
Dolphin, Angel Gidley, Keast	nature reserve	turtle nesting, native mammals	fox, cat
Monte Bello	Commonwealth	turtle nesting, native mammals	cat *Rattus rattus*
Prince, Double, Pasco, Boodie, Middle	nature reserve	seabird nesting, native mammals	*Rattus rattus*
Bernier	nature reserve	native mammals	goat
Dirk Hartog	pastoral lease	native mammals	goat, cat, *Mus musculus*
Wooded, Morley Leo	Fisheries reserve	seabird nesting	rabbit,
Rat	Fisheries reserve	seabird nesting	cat
Green	nature reserve	seabird nesting, seals	rabbit
Rottnest	recreation reserve	native mammals, bird nesting	cat
Carnac	nature reserve	seabird nesting	rabbit, *Mus musculus*
Mistaken	nature reserve	seabird nesting	rabbit, fox, *Rattus rattus*
Breaksea	nature reserve	seabird nesting	rabbit
Michaelmas	nature reserve	seabird nesting	rabbit
Recherche Archipelago	nature reserve	flora, seals, seabirds, native mammals	goat

species recorded breeding (Serventy and Whittell, 1976), however 3 of these, the Fleshy-footed Shearwater, Great-winged Petrel and White-faced Storm Petrel have not been recorded in recent times. This island also has the Black Rat (*Rattus rattus*) and fox on it.

The earliest introduction of rabbits was onto Carnac Island in the 1820s supposedly by early American or French whalers as a source of food (Young 1981). Their presence on the island was noted by Charles Fraser, a colonial botanist who visited Carnac Island in 1827. The rabbits were viewed as a valuable asset at this time and were not to be shot or removed from the island without the permission of the Fremantle Harbour Master. It is believed that more rabbits were released onto Carnac Island in 1934, suggesting that the population may have declined naturally at some stage. Rabbits were introduced to Mistaken Island in 1830 by George Cheyne who rented the island for that purpose (Department Fisheries and Wildlife file 192/71). These early introductions of rabbits pre-date the spread of rabbits from eastern Australia to the south of W.A. around 1900. The Leo Island rabbit population originated from two pairs imported by a fisherman from Wooded Island in 1971. The rabbits on Green Islets, and Wooded and Morley Islands were probably released by fishermen for food, however the dates for this are unknown.

The most obvious damage caused by rabbits is the overgrazing of vegetation which ultimately leads to erosion and removes cover for nesting seabirds and terrestial fauna. Aerial photography taken 3 years after rabbit eradication on Carnac Island showed a marked recovery in the islands vegetation, although it was suggested that the plant species composition may have changed as less palatable species increased in abundance (Abbott 1980). Some of the nesting seabirds which burrow, such as Wedge-tailed Shearwater, Fleshy-footed Shearwater and White-faced Storm Petrel, were probably also affected by rabbits through competition for burrow sites.

Population estimates of rabbits on these islands have only been obtained by counting carcasses above ground immediately following baiting and extrapolating to a total population. On Green Islets the population was estimated to be 140 on each of the 3 islets prior to baiting, and on Mistaken Island (14 ha), a population of 300 rabbits was estimated. After baiting on Carnac Island, 60 carcasses were found and removed.

Initial attempts at rabbit eradication were on Carnac Island in 1965 using the one-shot oat method. This was the method used at the time for rabbit control on the mainland and involved setting an oat trail with one oat in a hundred impregnated with a lethal dose of 1080 (sodium monofluoroacetate) (Gooding and Harrison 1964). However, this was not successful on Carnac Island. Attempts at control using myxomatosis in 1968 were also unsuccessful. Subsequent bait preference trials suggested that carrot would be a suitable medium as no other fauna would take the bait. Other advantages included that carrot would not grow on the island, the baits were more attractive because of their higher water content, and they broke down quickly.

Carrot was cut into small cubes, impregnated with 1080 and, in May 1969 laid in bait trails on the island. This was preceded by two nights of prebaiting with unpoisoned carrots. Rabbits have an LD50 for 1080 of approximately 0.5 mg 1080/kg (Wheeler and Hart 1977) and need to eat 10-12 cubes of carrot to receive a lethal dose. This method proved successful in eradicating rabbits on Carnac Island and was subsequently used on the other islands.

All subsequent baiting was also undertaken in late summer or autumn as the moist carrot baits were more attractive and mortality was enhanced by cold and starvation. Wooded and Morley Islands were baited in February 1973, Green Islets in May 1974, Leo Island in May 1976, and Mistaken Island in March 1980.

With the exception of Mistaken Island, all these eradication programs have been successful. Mistaken Island is connected to the mainland by a sandbar and reinvasion occurs from the adjacent peninsula. In this situation, rabbit control rather than eradication is required.

Rabbits are also known from other island nature reserves along the south coast including those in the vicinity of Mistaken Island, however no control or eradication programs have yet been undertaken on these.

Black Rat (*Rattus rattus*)

This species, together with *Rattus norvegicus* and *R. exulans* has been introduced to many islands around the world and these have often had a severe impact on native birdlife (Atkinson 1977, Taylor 1979, Moller 1983) as well as reptiles and invertebrates (Ramsay 1978, Whitaker 1978). In W.A., *R. rattus* occurs on many islands off the north west coast, and *R. exulans* is known from Adele Island off the Kimberley coast.

Since 1981 eradication programs have been under taken for *R. rattus* on five islands including Bedout Island, north of Port Hedland, and Prince, Double,

Pasco and Boodie Islands, all in the vicinity of Barrow Island. The rats are believed to have been introduced between 1860 and 1900 from pearling and fishing vessels which were regularly careened on the islands.

Many of these islands are also important seabird breeding sites. Seven species have been recorded nesting on Bedout Island (Tunney 1902, Bush and Lodge 1977). The vegetation on this island consists almost entirely of *Spinifex longifolius* and the seeds and leaves of this species were heavily grazed by the *R. rattus*, thereby reducing vegetation cover. Predation of eggs and chicks of the seabirds possibly also occurred, although this was not documented prior to the eradication. Tunney (1902) recorded the Common Noddy nesting on Bedout Island in May 1901, however subsequent visits in May 1972 and 1975 and, June 1982 and 1984 have failed to record further nesting by this species.

Boodie Island (470 ha) has a small population of the Burrowing Bettong, *Bettongia lesueur* confined to the limestone portion of the island. This is one of the "critical weight range" mammals which has declined drastically on the Australian mainland and is now restricted to four island populations (Burbidge, this publication). A preliminary survey of Boodie Island suggested that the rat was competing with the *B. lesueur* for burrows in the limestone area.

Prince Island is connected to Barrow Island at low tide and when *R. rattus* were discovered on the island in 1982 it was feared that they may have also occupied the adjacent area of Barrow Island. Fortunately this was not so, however Prince Island became a priority for rat eradication. Native mammals such as the Northern Brushtail Possum *Trichosurus arnhemensis* and the Golden Bandicoot *Isoodon auratus* also occur on the island and presumably move between Barrow and Prince Islands.

Based on headtorching transects on Bedout and Boodie Islands, population estimates of between 7 and 100 *R. rattus* per hectare have been obtained.

The baiting for *R. rattus* on all the islands followed the same procedure. Oats were impregnated with the anticoagulant Pindone (2 pivalyl 1,3 - indandione, 0.17 mg/oat) and placed either in a sealed plastic bag or loose in a 50 m grid pattern, with a bait also placed in the centre of the 50 m square. Baits ranged from 150-230 g. On all the islands except Boodie, the bait stations were left uncovered. Because of the presence of *B. lesueur* on this island, the bait stations were covered with plastic basins with holes cut in the sides to allow access for the *Rattus* but not *Bettongia*. These were partially effective, however the *Bettongia* did obtain access to the oats once they had been dragged to the openings by the *Rattus*.

Ideally this type of baiting should be done when natural food is scarce, that is at the end of the cooler dry season. Bedout Island was baited in September/October 1981, and Double and Pasco Islands were baited in September 1983. Prince Island was baited in April 1983, and Boodie Island was baited in May 1985 for funding reasons.

All the eradication programs were successful. Initially it was suspected that the program on Boodie Island was unsuccessful as *Rattus rattus* tracks were still evident four months after the baiting. However, more recent inspections indicate that this residual population is no longer present. Unfortunately it also appears that efforts to restrict access of the Boodie to bait stations was unsuccessful and the Boodie has also been eradicated. It is anticipated that the Boodie will be re-introduced to the Island in the near future.

Many islands off the W.A. coast still require *Rattus* eradication programs to be undertaken. Middle Island, between Boodie and Barrow Islands supports *R. rattus* and the gazetted rare Golden Bandicoot *Isoodon auratus*. Both species are similar in size and habit and eradication of the *Rattus* will be difficult without some *Isoodon* mortality. Many of the 100 or so islands in the Monte Bello groups, north of Barrow Island, also support *R. rattus*. The two largest islands are each over 500 ha and a major operation will be required to eradicate the rats. The feral cat is also present on some islands. If eradication of these two species is successful, it is proposed to reintroduce the Spectacled Hare Wallaby *Lagorchestes conspicillatus* and Golden Bandicoot *Isoodon auratus*, both of which occurred on the islands until the early 1900s (Burbidge 1971).

With the increase in use of north west islands as bases for oil exploration and production, one concern is the introduction of *R. rattus*, and other exotic plants and animals through equipment brought from the mainland. The oil companies on Barrow and Lowendal Islands are required to fumigate equipment and materials with methyl bromide, and wash larger equipment with high pressure water.

Goat (*Capra hircus*)

Goat eradication has only been conducted on one island off the W.A. coast, Bernier Island, 40 km west of Carnarvon, although they also occur on several islands off the south coast, particularly in the Recherche Archipelago. Bernier Island is one of the largest islands off the W.A. coast (5000 ha) and is an important nature reserve. Six species of mammal occur on the island. Four of these, the Western Hare-wallaby *Lagorchestes hirsutus*), Banded Hare-wallaby (*Lagostrophus fasciatus*), Boodie

(*Bettongia lesueur*), and Western Barred Bandicoot (*Perameles bougainville*) are gazetted rare. Of the two rodents *Pseudomys albocinereus* and *P. praeconis* which also occur on the island, *P. praeconis* is now only known on Bernier Island, after having originally been collected on the adjacent mainland in 1858.

Goats were introduced to Bernier Island in 1899 by Mr G. Baston who took up a pastoral lease on the island. Four female and one male Angora goat were taken to the island for milking. When the Aborigines and Medical Department opened hospitals on Bernier and Dorre Islands in 1907 for aborigines suffering from venereal and other diseases, the goats remained and were encouraged as a source of food and milk. The goats remained when the hospitals closed in 1917.

When Bernier and Dorre were gazetted as an A Class reserve for the Conservation of Fauna in 1957, the goats were declared vermin on the islands. Goats did not become established on Dorre Island.

After the first detail ed biological survey of Bernier and Dorre Island in 1959 (Ride *et al.* 1962) a comparison was made between the vegetation of goat free Dorre Island and Bernier Island. the widespread occurrence of sand drift on Bernier Island was attributed to the effects of grazing by the goats and it was recommended that the goat population be exterminated without delay.

The trampling of vegetation by goats may also have had some effect on the fauna, however despite the goats presence on Bernier Island for nearly 90 years, there has been no evidence of decline of the native mammals resident on the island.

Between 1962-1972 several ground shooting expeditions were made to Bernier Island and over 550 goats were either shot or removed alive from the island. Even Gurkha troops were used in one operation (Waldon 1971). At one stage during this period the population of goats was estimated to be 350. In 1981/2 estimates of the population, after another 60 had been shot or removed, was between 60-80. Ground shooting parties never succeeded in eradication because some of the goats were able to escape into the rugged cliffs and caves on the west coast.

In 1976 it was suggested that shooting from a helicopter was the only way that complete eradication could be achieved. However it was not until 1984 that Commonwealth funds became available to charter a helicopter to undertake this work. The eradication operation was programmed for May 1984 and used an experienced helicopter pilot and an Agriculture Protection Board shooter. Prior to this, the Department of Agriculture mustered 43 goats and removed them from the island for research into developing Angora wool strain. Subsequently another 37 goats were shot from the air or removed alive giving a total population of 80 goats on the island prior to eradication.

For 12-18 months following the eradication program the District Wildlife Officer at Carnarvon had reports from fishermen that goats were still present on the island. However inspection in 1986 and 1987 by helicopter and foot have failed to find any trace of goats on Bernier Island and the eradication program is now regarded to have been successful.

Fox (*Vulpes vulpes*)

Foxes occur on only a few islands off the W.A. coast and only on those which retain some connection to the mainland. Fox control has been undertaken on several islands in the Dampier Archipelago, adjacent to the Burrup Peninsula (Dolphin, Angel Gidby, Keast, Collier Rock and Legendre Islands). All, except Legendre Island, are nature reserves.

Foxes arrived in the coastal Pilbara in the early 1930s and have spread to the Burrup Peninsula and adjacent island through low tide connections, since then. Patrols by fisheries vessels through the Dampier Archipelago in the 1950s reported foxes on Dolphin Island (Ces Piesse, pers comm). Cats probably arrived with the first settlers in the Pilbara in the 1860s and many have since become feral and spread to the Burrup Peninsula and adjacent islands. Feral cats have probably increased in number since Dampier was constructed in 1966.

Both the cat and fox are efficient opportunistic predators and their diet closely follows the abundance of prey species (Coman and Brunner 1972, Green and Osborne 1981). The decline of the rock wallabies *Petrogale rothschildi* and *P. lateralis* on north west islands and mainland reserves has been attributed to predation by the fox (Kinnear *et al.* 1984). Dolphin Island now supports an estimated population of only 50 *P. rothschildi* while similarly sized, but fox free Enderby Island supports an estimated 1 500 *P. rothschildi.* Foxes also dig up turtle nests and consume eggs and hatchlings. Other native fauna, such as small rodents, lizards and birds are probably also preyed upon by the fox and cat.

In October 1980, fresh meat baits impregnated with 1080 were laid on 39 beaches around Dolphin Island, however foxes were still present one month later. In May 1981, bait preference trials were conducted using fresh meat and factory prepared baits. Fresh meat baits were preferred by foxes.

Table 2.
Summary of feral animal control on W.A. islands.

	RABBIT	RAT	GOAT	FOX
1. ISLANDS	Carnac Is. 19 ha Wooded Is. Morley Is. Green Is. 6 ha Mistaken Is. 14 ha	Bedout Is. 31 ha Prince Is. 4 ha Double Is. 100 ha Pasco Is. 1 ha Boodie Is. 470 ha	Bernier Is. 5 000 ha	Dampier Archipelago
2. SOURCE/DATE OF INTRODUCTION	whalers and fishermen 1820-1971	pearlers and fishermen 1860-1900	pastoral lease 1899	natural spread 1930s
3. DAMAGE	overgraze vegetation causing erosion, competition with nesting seabirds for burrow sites	predation of nesting seabirds, competition with native mammals	overgraze and trample vegetation	predation of native fauna including rock wallabys and turtle eggs
4. POPULATION ESTIMATES AT TIME OF BAITING	20-50/ha	7-100/ha	80 total	?
5. METHOD OF CONTROL	carrots/1080 prebaiting and bait trails	oats/pindone 50 m grid for bait stations	ground and aerial shooting	meat/1080 ground and aerial baiting 100 grid
6. DATE OF CONTROL	1965-1980 April/May	1981-1985 Sept/Oct April/May	1965-1984 (May)	1980-1984 Sept/Oct
7. RESULTS OF CONTROL	successful except Mistaken Island	successful except Boodie Island	successful?	successful for 4 months then foxes re-appeared.

These baits weighed approximately 400 g and contained 2 mg 1080. The fox has an LD 50 of 0.15 mg 1080/kg (King, pers comm) and the cat 0.4 mg 1080/kg (McIlroy 1981). The native predator on the islands, the Little Northern Native-cat *Dasyurus hallucatus* has a significantly higher tolerance to 1080 with an LD of 5.7 mg 1080/kg (McIlroy 1981). In September 1984, 2 500 fresh meat baits each of 250 g and containing 1.5 mg 1980 were dropped from an aircraft in a 100 m grid pattern over the Burrup Peninsula and adjacent islands. Another 1 000 baits were laid from the ground around facilities on the Burrup Peninsula. The baiting of the Burrup Peninsula was seen as an effective way of creating a fox free buffer zone between the mainland and islands.

No fox activity on the islands was observed for four months after the baiting, however by February 1985 fox tracks were again evident and turtle nests were dug up. Another baiting program was undertaken in November 1987 with similar results. Effective control will require more frequent baiting than has been undertaken in the past as reinvasion of the islands by foxes occurs from the adjacent mainland. A control program for exotic predators will be included in the plan for management of the nature reserves of the Dampier Archipelago presently being prepared.

COST OF ERADICATION AND CONTROL

Feral animal eradication and control programs are often labour intensive and require equipment that is expensive to purchase and/or operate. Access to some of the islands is also expensive, as either charter vessel or helicopter must be used.

Estimate of costs for some of the programs undertaken to date are presented below:

Black Rat (*Rattus rattus*)

1. Bedout Island: (baiting and follow-up inspections) helicopter hire - 6 hours $2 400
   bait $500 personnel travel allowance $600

   $3 500

2. Boodie Island: (ANPWS funding) including charter vessel, bait, travel allowances (3 persons) and equipment

$9 600

Goat (*Capra hircus*)

Bernier Island: (ANPWS funding) May 1984 helicopter hire $25 000 travel allowance, equipment April 1985- follow-up inspection by helicopter $10 000

$35 000

Fox (*Vulpes vulpes*)

Dampier Archipelago: aircraft hire, meat baits (per baiting program)

$2 000

REFERENCES

Abbott, I. (1980). The distribution and cover of plant species on Carnac Island, Western Australia. *Journal of the Royal Society Western Australia*. 63 (2). 39-45.

Atkinson, I.A.E. (1977). A reassessment of factors, particularly *Rattus rattus*, that influenced the decline of endemic forest birds in the Hawaiian Island. *Pacific Science* 31, 109-133.

Burbidge, A.A. (1971). The fauna and flora of the Monte Bello Island. Dept. Fisheries and Fauna Report No. 9.

Bush, T.E., and Lodge, G.A. (1977). Birds of Bedout Island. *The Western Australian Naturalist* 13 (8) 189-190.

Coman, B.J., and Brunner, H., (1972). Good habits of the feral house cat in Victoria. *Journal Wildlife Management*, 36 848-853.

Gooding, C.D., and Harrison, L.A. (1964). "One-shot" baiting. Journal of Agriculture Western Australia 5, 12-15.

Kinnear, J.A., Onus, M., and Bromilow., B. (1984). Foxes, feral cats, and rock wallabys. *SWANS* 14 (1) 3-8.

McIlroy, J.C. (1981). The sensitivity of Australian mammals to 1080 poison I. Marsupial and Eutherian carnivores. *Australian Wildlife Research* 8 (21) 385-402.

Moller, A.P. (1983). Damage by rats *Rattus norvegicus* to breeding birds on Danish Islands. *Biological Conservation* 25, 5-18.

Ramsay, G.W. (1978). A review of the effects of rodents on New Zealand invertebrate fauna In Dingwall, P.R. Atkinson I.A.E., and Hays, C. (eds.). The ecology and control of rodents in New Zealand

Nature Reserves. New Zealand Dept. Lands and Survey Information Series 4 : 89-95.

Ride, W.D.L., Mees, G.P., Douglas, A.M., Royce, R.D. and Tyndale-Biscoe, C.H. (1962). The results of an expedition to Bernier and Dorre Islands. Shark Bay W.A. in July 1959. Dept. of Fisheries publication, Ed. A.J. Fraser.

Serventy, D.L., and Marshall, A.J. (1964). A natural history reconnaissance of Barrow and Monte Bello Islands, 1958. CSIRO Division of Wildlife Research Technical Paper No. 6.

Serventy, D.L. and Whittell, H.M. (1976). Birds of Western Australia (5th edition). University of Western Australia Press.

Taylor, R.H. (1979). Predation on Sooty Terns at Raoul Island by rats and cats. Notornis 26 (2), 199-202.

Tunney, J.T. (1902). Field notes on Bedout Island. *Emu* 1 (2), 73.

Waldon, A.C. (1971). Goat eradication, Bernier Island. *SWANS* 2(3) pp 60-61.

Watson, J.A.L. (1959). The birds of Carnac Island Western Australia. *The Western Australian Naturalist*, 6 (8) 185-190.

Wheeler, S.H. and Hart. D.S. (1979). The toxicity of sodium monofluoroacetate to wild rabbits *Oryctolagus cuniculus* (L.) from three sites in Western Australia. *Australian Wildlife Research*, 6 57-62.

Whitaker, A.H. (1978). The effects of rodents on reptiles and amphibians In Dingwall, P.R. Atkinson, I.A.E. and Hay, C. (eds). The ecology and control or rodents in New Zealand Nature Reserves. New Zealand Dept. Lands and Survey Information Series 4 75-86.

Young, C. (1981). Rabbit eradication on islands off the W.A. coast *SWANS* 11 (1), 13-16.