THE EFFECTS OF GOATS AND RABBITS ON BREEDING SEABIRDS: METHODS OF ERADICATION AND CONTROL

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ABSTRACT. Goats and rabbits (and other animals) have been taken to many oceanic islands by man. Their impact has been severe on the ecology: although no extinctions can be directly attributed to them, they have dramatically reduced the number of seabirds.

Three examples from the southern hemisphere are discussed; looking at the effects of the animals, their eradication and the initial recovery of the islands. General principles of removing problem animals are considered as well as some practical methods. While the examples relate to the south, the methods are applicable to the Atlantic Islands as well as elsewhere.

INTRODUCTION

A variety of animals, including goats and rabbits, have been distributed around the islands of the world by man. While we may criticise this action in hindsight, it was done in most cases for a sound reason and in good faith. Those responsible had no appreciation of the results of their action nor the impact it would have on the ecology of the islands. We should not place blame, but as the reasons for the animals' continued presence on the islands no longer exists, we should take a more positive role to reverse the effects caused, by removing these animals.

Goats and rabbits were released on islands either for the wellbeing of seafarers or accidentally as camp followers of man. There are a few examples of deliberate introductions for other less justifiable reasons. Usually they were placed on the islands to provide a source of fresh meat for seamen in the days of sail and no refrigeration, and to provide food in case of shipwreck. As camp followers, animals have escaped from confinement to establish wild populations. Unfortunately today liberations continue but at a slower rate and they can rarely be justified. For example Clarion Island in the Revillagigedos Group (Mexico) was occupied as recently as 1979 by a small naval garrison, and pigs and rabbits and perhaps some other

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animals, have become feral (HOWELL and WEBB 1990).

There are few, if any, examples of the extinction of seabirds caused directly by goats and rabbits. Most often extinctions have occurred as a result of additional factors, especially hunting by man and the introduction of additional animals, particularly cats and rats (the main species involved being *Rattus rattus, R. norvegicus*, and in the Pacific *R. exulans)*. However, goats and rabbits have caused the extinction of plant species and some land birds.

The main impact of goats and rabbits has been the severe depletion of the vegetative cover and subsequent loss of soil. This has had a major effect on burrowing petrels. The loss of surface vegetation has also eliminated the nesting habitat for smaller species, such as storm petrels, which use vegetation for burrowing rather than the soil. A further effect has been the compaction of the remaining soil which makes it more difficult for burrowing. Burrow numbers are reduced and new burrowing appears to cease.

Both rabbits and goats cause disruption to nesting birds. Rabbits upset burrowing petrels (particularly *Pterodroma* spp.) in several ways: by changing the profile or shape of the burrow, by covering up the prepared nest chamber when the birds are at sea during the pre-laying honeymoon period, by interconnecting burrows thus causing territorial disputes, and by making more than one entrance to the burrows which affects ventilation, humidity and temperature. Goats, on the other hand, cause disturbance to sensitive ground nesting species such as sooty tern (*Sterna fuscata*), and perhaps common noddy (*Anous stolidus*). Larger species such as booby (*Sula* spp.) and albatross (*Diomedia* spp.) do not appear to be affected directly but their nesting range may be restricted by a loss of sheltering vegetation. The loss of cover exposes them to predators and to weather.

Case studies

We can look at some specific examples, rather well removed from the Atlantic Islands but the same effects can be seen there. The removal methods required are likely to be similar.

MACAULEY ISLAND

Macauley Island is a 236 ha island in the Kermadec Group to the north of New Zealand (latitude 30° S). It is volcanic in origin but is inactive. It is largely made up of volcanic tuff and scoria on a basaltic base.

Goats had been present for about 150 years, but there were no rabbits. The vegetation had been reduced to a lawn-like grassland. There was severe soil erosion of the loose tuff and scoria around the coastal fringe. In the grassland, the soil had been compacted and petrel burrows were sparsely scattered throughout. Three species of petrel, (*Pterodroma cervicalis, P. neglecta* and *P. nigripennis*), two shearwaters (*Puffinus pacificus* and *P. assimilis*) and

one storm petrel (*Fregetta grallaria*), masked booby (*Sula dactylatra)*, and sooty tern were all affected. Woody shrubs had been restricted mainly to inaccessible cliff faces and one, *Coprosma petiolata*, survived only in a totally isolated corner (SYKES 1977).

Goats were removed (some 3000+) in 1966 and the few survivors in 1970 (WILLIAMS and RUDGE 1969), the timing and length of the two trips were determined by naval requirements. The animals were shot with .22 calibre rifles, backed up by one high velocity rifle (.222/.270).

Since removal, a survey (some 10 years later) has shown remarkable changes. A small woody tree (*Myoporum obscurum)* has moved up from the cliff faces where it had been restricted onto the island plateau, a large sedge (*Cyperus ustulatus*) has covered most of the grassland but particularly a large portion of the eroding fringe. The soil has become loose and is more difficult to walk on, burrow numbers have increased dramatically - at least a 10-fold increase over all. Booby nesting pairs have doubled and sooty terns, formerly in their hundreds, now occur in their thousands.

The smaller petrels - little shearwater and white-bellied storm petrel have not been able to recover because the Pacific rat is still present.

There have been no ill effects, such as weed invasion, as a consequence of the removal but the increase in sedge has made it more difficult to move about on the island.

While Macauley Island was heavily modified by goats, the presence of two herbivores, goats and rabbits, is much worse. This is evident in the next two case studies.

PHILLIP ISLAND

Phillip Island is a small island, 190 ha, off Norfolk Island which lies over 1,000 km east of Australia on latitude 29° S, (similar to the Kermadecs). It has a height of 280m.

Goats and rabbits had been present for 150 years. Pigs had also been present for about 50 years but were apparently eliminated in c. 1836 (ANON 1989). Most of the top soil and vegetation had been lost - it had been estimated that over one metre of soil, perhaps more in some areas, has been lost. Despite this, seabirds have persisted although primarily surface nesting species: masked booby, sooty tern and three species of noddies (*A stolidus, A. minutus* and *Procelsterna cerulea*). One plant species, the Phillip Island glory pea (*Streblorrhiza speciosa*), was lost and another reduced to a single plant (*Hibiscus insularis*). About 1910 the goats were removed by shooting. In 1981/83 rabbit eradication began using myxomatosis and while a dramatic decline was achieved, they began to increase again after a short period of stabilisation. The rabbits were poisoned using sodium monofluroacetate (1080) after pre-feeding with non-toxic baits. It was necessary to throw some baits onto inaccessible ledges. Follow up work after the poisoning included trapping and gassing. The final rabbits were shot and extermination was achieved in 1986. The vegetation is slowly

recovering but there is a major weed problem (African olive) [*Olea europea africana*]. Some "debris" dams have been put in to trap eroding soil and replanting has begun. Tourist operators on the main Norfolk Island are complaining that their "famous" red island is turning green. Seabird numbers are increasing and some recolonisation has occurred.

Four petrel species (*Pterodroma nigripennis, P. neglecta, P. solandri* and *P. cervicalis*) and two shearwaters (*Puffinus assimilis* and *P. pacificus*) plus the surface nesters mentioned above, a large number of red tailed tropic birds (*Phaethon rubricauda*) and a small colony of Australasian gannet (*Sula serrator*) now nest on the island. At least two of the petrels have recolonised the island. With the removal of rabbits, surface nesting species have increased although the situation is confused in the case of sooty tern as the eggs are still harvested by residents of Norfolk Island.

ROUND ISLAND

Round Island is a small island lying 22.5 km to the north-east of Mauritius. It is 151 ha and rises to a height of 280 m, on latitude 19.51° S.

Goats have been present for 150 years and the rabbits almost 200 years. Like Phillip Island there has been a major soil loss and loss of vegetation. However, it has the last remaining example of Mauritius lowland palm savana and is a refuge for seven reptile species (some now extinct in Mauritius except for Round Island). It also has a history of seabird exploitation by man (MERTON et al. 1989).

The goats were shot out in 1979 (shooting had been a regular pastime and goat numbers never reached the proportions they did on islands such as Macauley). The rabbits were poisoned using a pellet bait with brodifacoum the active ingredient. While on Phillip Island the bait was broadcast, on Round Island it was set out on a 10m grid. Two spreadings of bait were carried out (pulse baiting) about two weeks apart. The final few remaining rabbits were shot (MERTON 1987).

The results have been quite spectacular and the recovery is being closely monitored. The palms are recovering and the two very rare palms - bottle palm (*Hyophorbe lagenicaulis*) which had been reduced to only nine adult trees has now over 500 young palms scattered over the island and the rarer hurricane palm, (*Dictyosperma album va. conjugatum*) (two remaining adults) has not recovered but is being cultivated in a nursery. Because of the higher profile the island has been given, exploitation of seabirds has ceased and significant increases have occurred in breeding numbers.

The island has the main concentration of red-tailed tropic birds in the Indian Ocean and has a large wedge-tailed shearwater population estimated at 500,000. The rare Round Island Petrel (*Pterodroma arminjoniana*) has doubled its numbers. There have been similar increases in some of the reptiles, especially *Leiolopisma telfairi*.

While there is still a lot of bare rock without soil, the natural revegetation is being assisted by planting, debris damming and the re-introduction of plant species lost to the island has begun. There is a small weed problem involving two aggressive species but these are being kept in check by regular weeding.

Methods of removal

The above case studies give some idea of methodology, but there are a few basic principles:

1 - The proposal to remove the animals must be achievable.
2 - There must be total commitment of resources and of the personnel involved.
3 - There must be adequate planning and efficient execution.
4 - There must be persistence to achieve the objective.

The removal of goats is normally carried out by shooting but there are some variations to this. Once the pressure is put on goats they either resort to the forest or cliff faces where they are less accessible. In the forest this may mean that hunting with dogs, or the use of a "Judas" goat, may be necessary to help find the herds. The "Judas" goat is an animal caught alive and released with a bell, or more recently with a radio transmitter, so when the animal rejoins a herd it can be more easily traced and the herd destroyed. It is preferable to have a distinctive coloured animal so that the shooter can avoid shooting it. Once it is on its own again, it will go off and find another herd. On inaccessible cliff faces shooting from a helicopter is the most practical and effective method. Poisoning can be used with baits especially where food is short, 1080 being the most effective poison. Some success has been achieved where browsing has produced a definite "browse line". Branches can be tied down within reach of the goats and the leaves painted with 1080 gel.

Rabbits on the other hand are usually poisoned using pelleted baits. Various poisons can be used - strychnine, arsenic, cyanide, 1080 etc but most authorities now favour pindone or brodifacoum which are safer and more humane, although the latter is recommended for eradication. The use of myxomatosis is often suggested but while this may provide a large reduction it does not cause extermination and unless followed up by an effective supporting eradication programme will not achieve the desired result (viz. Phillip Island). Its use also causes considerable controversy. Poisoning, too, often does not achieve total extermination and it is usually necessary to complete the task by physical means such as trapping and shooting.

There can be contrary opinion to the removal of animals from rare breed societies and often it is necessary to check whether there is any interest in the animal being removed. However, this should not change the policy - it is not a question of should the animal be removed or not, but that the animal is in the wrong place. If there is a significant interest then

the interested party can be given a limited time to collect a representative sample and transfer them to another satisfactory location. Animal rights activists also raise objections but they seem to overlook the rights of the indigenous species which are under threat.

Other factors which need consideration are:

1 - Where more than one animal species exists on an island then the order in which they are removed can be critical. As a general rule, it is often better to take the smaller animals first. However each situation needs to be assessed individually to determine the best course.

2 - The likely effects on non-target species. This can normally be avoided but at times a certain non-target kill has to be accepted. An acceptable level of non-target kill has to be decided. Once the problem animal(s) are removed then the non-target species can recover quickly.

3 - Similarly, there can be a secondary kill caused by species eating the poisoned carcases of problem animals. Again, this can be reduced by collecting the rabbit carcases where practical or by supplying an alternative non-toxic food source. Again, an acceptable level of secondary poisoning kill may have to be set.

4 - There must be effective monitoring throughout the programme so that should any undesirable trend develop it can be corrected immediately. The monitoring should continue well after the time when total eradication appears to have been achieved. We cannot afford to stop until we are certain the objective has been reached. Post-eradication monitoring will also show up subsequent problems such as aggressive weeds, etc.

All these factors have to be considered in the planning stages and not after the programme has begun.

Conclusion

While we should not waste time trying to place blame on others for historical releases, we must take every step to prevent further modern day releases, whether deliberate or accidental. Not to do so with our current knowledge would be irresponsible. Today we have the ability and technology to achieve eradication of most problem animals from islands, although in many instances resources, i.e. money, may not be available to tackle the very large islands. However, we should be actively pursuing a programme of the ecological restoration of islands, of which the removal of goats and rabbits (as well as other problem species) is often the first step. Failure to act would make us culpably negligent. The Atlantic Islands appear to be one area in need of such a policy.

REFERENCES

ANON:

1989. *Phillip Island, Revised Draft Plan of Management*. Australian National Parks and Wildlife Service.

HOWELL, S. N. G. AND WEBB S.:

1990. The Seabirds of Las Islas Revillagigedo, Mexico. In *The Wilson Bulletin*. Volume 102. Pp 140-157.

MERTON, D. V.:

1987. Eradication of rabbits from Round Island, Mauritius: A Conservation Success Story. In *Dodo*. Volume 24. Pp 19-43.

MERTON, D. V., ATKINSON, I. A. E., STRAHM, W., JONES, C., EMPSON, R. A., MUNGROO, Y., DULLOO, M. E. AND LEWIS, R.:

1989. *A management plan for the restoration of Round Island*. Jersey Wildlife Preservation Trust.

SYKES, W. R.:

1977. *Kermadec Island Flora: an annotated checklist*. New Zealand Department of Scientific and Industrial Research Bulletin 219.

WILLIAMS, G. R. AND RUDGE, M. R.:

1969. A population study of feral goats (*Capra hircus*) from Macauley Island, New Zealand. In *Proceedings of the New Zealand Ecological Society*. Volume 16. Pp 17-28.