The Removal of Problem Animals from Islands

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Abstract

The reasons for eradication of problem animals are considered plus the preparation and planning before beginning. The methodology is examined as well as some likely effects.

Too often the term feral animal is used in relation to problem animals on islands. I have adopted the latter term as it embraces all classes of animals, not only those once domesticated. This enables us to include animals such as rats (*Rattus* spp.), which present the greatest problem. It also overcomes the use of "exotic" in relation to these animals thus including local indigenous species, such as weka (*Gallirallus* spp.) which can be a problem on islands.

REASONS FOR ERADICATION

In suggesting the removal of problem animals we must have sufficient reason for this in addition to the "problem". Often the reasons become confused by persons with specific interests. The main reason should be to restore the intrinsic values of the island itself. Every island has its own special values involving the natural communities it possesses, the special assortment and assemblage of plant and animal species and in the case of the more remote islands their own endemics. It must be acknowledged that no modified habitat will return to its original pristine condition once problem animals are removed. However, it can revert to something resembling it over a long period of time. Immediate results may be spectacular in some instances but a very long time is required to reach the maturity of vegetation that will reflect the original community.

In addition to protecting and enhancing the island's own values, removing problem animals can provide special habitats for endangered plant or animal species which can then be liberated there (Bell, 1989). However as indicated some islands have a very high ecological value and should not be meddled with after the removal of animals. Great Island, in the Three Kings Group to the north of New Zealand, where goats (*Capra hircus*) were removed in 1946 would be a case where one has to consider the special communities on that island as well as the endemics, both plant and animal.

The heavily modified islands where animals and man have had a very long and profound influence are often the best choice if an island is to be rehabilitated and used for more intense management for security and recovery of endangered species.

Atkinson (1989) outlines the biological significance of islands but he also draws attention to the limited number that were free of predators and competitors. There is a planned and systematic rehabilitation of those already affected. While there are limitations to what can be achieved there is a growing pool of experience in methodology and technology in the area of eradication. This will expand with time and will make possible objectives currently unattainable.

Eradication or Control?

It is essential right from the beginning that the objectives for the operation be set and that these objectives are attainable. Usually this should be total eradication and only very occasionally can partial control be acceptable. Total eradication has obvious advantages. It has an end point which means, that even if initially more costly, in the long term it will be less expensive as it will not swallow up funds indefinitely.

Control on the other hand can only be justified to achieve a very specific objective such as protecting an endangered species when perhaps total eradication is impractical at the present time. Examples of this are the predator control programs for endangered species such as takahe (*Notornis mantelli*) and a black stilt (*Himantopus novaeseelandiae*) in the South Island of New Zealand. Often control programs can be more

damaging than the problem itself as the temporary control can upset balances which have established over a period and may cause fluctuations in predator numbers which could prove disastrous. It also has to be recognised that once started they may have to be maintained indefinitely with continuing costs. There is room for some partial removal of animals if the area can be isolated and the animals maintained there by some physical barrier e.g. fencing, such as on Campbell Island where sheep (*Ovis aries*) are now restricted to the south west corner.

Necessity for total commitment

Once the objectives are established there has to be a commitment made to make the necessary funds and staff available to achieve them. The selection of staff is extremely important because they, above everything else, must have the commitment and persistence to achieve the objective. The challenge is as much a mental problem as it is a physical one. It is relatively easy to maintain interest and application when the kill rate is high but much more difficult in the latter stages of a campaign when very few animals remain. The kill of feral cats (*Felis catus*) on Little Barrier Island was 35 cats for 5 459 trap nights, about 1 cat per 156 trap nights in 1979 but in the final year, 1980, only 5 cats were caught for 32 165 trap nights, 1 cat, 6 per 500+ trap night (Veitch 1981). Only the right mental approach and a dedication to the objective gives a successful result.

Necessity for detailed planning and research

In any eradication program planning is an essential element, the better the planning the more chance of success. All the information available on the island should be gathered together to assist the planning. The general topography, plant cover, availability of water, etc. are all vital. Knowledge of the climate, wet and dry seasons, temperature and the like will assist in deciding the best time to conduct a campaign either because it will be more amenable to the work force or it may concentrate the animals into specific areas e.g. snow may force some animals down to a lower altitude or dry conditions may concentrate them near water.

Research relating to the problem animals has to be directed to specific objectives. It is not necessary toward study the situation to prove you have a problem. This, in most cases, is obvious. What is needed are studies to show when the population is at a low point and will be more vulnerable to eradication. The reasons for this could be many but times when food is short, water is at a premium or when the population is at its lower limit are examples.

Research to monitor the effectiveness of eradication methods is also important. The less visible the animal is, the more emphasis on this is required. This enables one to know the effectiveness of a specific control method or where any particular method is failing.

Some islands have a single animal problem but others have several. In the latter case it is important to plan the removal of the animals in the correct order. The removal of one animal can often trigger the increase of another. However most campaigns to date have been planned for the ease with which the job could be done; the larger animals are removed first, and smaller islands are tackled before the larger ones. Planning has to be a little more involved when several animals are to be eradicated. Two factors have to be given serious thought.

The first deals with facilitating the work. The removal of species in the wrong order could make any operation more difficult, and in extreme cases virtually impossible. If goats, burros (*Equus asinus*) and pigs (*Sus scrota*) all occur on the one island as they do on Santiago (Galapagos Islands) then the two major herbivores should be removed after the pigs have been killed. If removed before, the vegetation will tighten up and make the pigs even more difficult to get at. A small number of the herbivores could be used to provide a bait source although in this specific case there could be a complication with the local endangered hawk (*Buteo galapagoensis*) which is a known scavenger.

The other relates to making the habitat less attractive to one of the species. On Campbell Island sheep have been removed from much of the island and the resulting regrowth of vegetation has made this part of the island less suitable for feral cats. This is particularly applicable in wet climates. It also means the animals can be attracted onto artificially cleared tracks and thus become more vulnerable.

Publicizing eradication programs

The question is often raised of whether or not we should publicize eradication programs. In our experience we have always found it best to do so. A more adverse reaction from the public arises if something is done behind closed doors as they become suspicious and do not trust the agencies involved. Today there is growing pressure from animal welfare groups against eradication programs.

In the United States and Britain such welfare and animal rights groups have made it nigh on impossible to run an effective eradication campaign. Often it has been necessary at tremendous expense to move the offending animals rather then destroy them - e.g. the removal of burros from Grand Canyon National Park. Most island rehabilitation programs other than on the very remote islands have been stopped.

Preservation of feral farm animals

A further group which has to be considered is the feral animal preservation groups. These people want to save rare primitive breeds of domestic livestock - goats, sheep, etc. for their possible genetic value to the livestock industry as well as for pure sentiment. The protection of genetic stock has much merit and those interested from a scientific viewpoint generally agree that the breed should be preserved but it usually comes down to a question of where? Again most agree that if it comes to a toss up between preserving indigenous species and habitats or the exotic then there is only one answer and that is the indigenous species. These questions need to be resolved before action is taken and any necessary research on transfers must be made before final eradication. Examples in New Zealand are the black merino sheep on Pitt Island which are now confined to part of their former range which has been designated a scientific reserve, and the removal of goats from the Auckland Islands for breeding research and development before eradication begins.

Methods for eradication

The methods selected for any eradication campaign are part of the planning but must be the best available to achieve the objective. Almost invariably it will be necessary to use a combination of methods. Usually there is one primary method complemented by one or more other methods to achieve specific results and to ensure final eradication. The methods can be divided into five general groups (i) hunting and shooting (ii) poisoning (iii) trapping (iv) habitat manipulation (v) biological control. Each has to be carefully assessed and the right choice made. They also need to be used in the correct sequence to get the best results.

Biological control

Biological control is often considered the simple answer to an eradication or control program. This can be very effective if the population has been isolated from the "disease" (virus) for a long time or in some circumstances has never been exposed to it. A kill of up to 90-95% can be achieved in such circumstances. Despite this it has to be recognised that a good deal has to be known about the "disease" regarding its spread, infection, rapidity of spread and time taken to kill the animal. It is also necessary to know the behaviour of the animals being infected and their reaction once infected. The success of such operations depends very much on contact between individuals - directly or by vector - and may be impaired if a diseased animal "goes to ground" before it has contact with other animals during the infectious stage.

The most important aspect to consider is the small percentage that will remain unaffected and those which develop an immunity. This means that biological control may only be really effective once and much less effective (although still helpful) on future occasions. In some cases biological control may hold the population down to a lower level than it was before. This depends on the "disease" and species involved. It is essential that if biological control is being used then plans must be made to complete the eradication i.e. to eliminate the surviving small percentage immediately after the biological control has run its course. This must be included in the overall plan right from the beginning.

There are some words of caution which must be made. Extreme care must be taken to ensure that the "disease" is host specific. The target population must be totally isolated from any domestic or desired wild population which could be affected. It also has to be appreciated that the use of biological control methods is repugnant to animal lovers who will vigourously oppose such measures.

While most biological control usually refers to "disease" it does not have to be solely this. Fitzgerald (1978) proposed a novel way of possible rodent eradication by the release of single sex stoats (*Mustela erminea*). There is one historical example of this in New Zealand but it is not well documented. It relates to cats released on Mangere Island to control rabbits (*Oryctolagus cuniculus*) about 1900. The cats did eliminate the rabbits (but I suspect they were never firmly established) and much of the birdlife. However as most of the birds were seabirds which only visited the island seasonally there was nothing to sustain the cats during the rest of the year and they died out. Evidence indicates that carnivores need a small mammal present to sustain a permanent population on a small island.

Habitat manipulation

Habitat manipulation is a less obvious eradication/control method but can be very valuable in reducing or confining problem animals. Islands

do not always make this option an easy choice. The main value probably lies in the advantage that can be gained where one or two animal species are removed from an island where there is a combination of animals. The changes in vegetation resulting from this can be quite dramatic and can be most disadvantageous to some species. This is more likely to be the case in wetter climates. Taylor (1968) studied the rabbits on the neighbouring islands Rose and Enderby (Auckland Islands) and found that the removal of cattle (*Bos taurus*) on the former allowed the vegetation to become unsuitable for rabbits over much of the island. They are now confined to very restricted areas where they could be quickly eliminated and may even die out naturally.

Poisoning

The most obvious control tool is poison but many people regard it as the answer to all problems. It is not a "cure all" but rather an efficient tool if used properly. There is a need to use the most effective poison for the species being removed. What is suitable for one species may be impractical for another. The susceptibility of some species to certain poisons is well known. Also some poisons can be detected by some species e.g. the Norway rat (*R. norvegicus*) can detect 1080 in bait (I. McFadden pers. com.)

Possibly the most important part of any poisoning campaign is the selection of a suitable bait or carrier for the poison. This selection has to have two objectives, it must (i) be very attractive to the target species and (ii) if possible, unattractive to non-target species. In the latter case the presentation can be made to avoid non-target species. Considerable success has been achieved by the use of green dyed baits which are less attractive to birds. In other cases the baits can be presented in tunnels so that they are available to one species (e.g. rats) but not others. The actual preparation of baits is also important. It was found that bird kills associated with 1080 carrot poisoning for possum (*Trichosurus vulpecula*) occurred primarily as a result of poorly cut carrot with a high percentage of "fines" or "chaff". Once these were removed bird kills were reduced dramatically.

In addition to direct poisoning of non target species one also has to be aware of the chances of secondary poisoning. Most poisons remain in the carcass of the poisoned animal for some time. The type of poison used will determine what species are likely to be the most vulnerable. Dogs (which may be required for follow up hunting) are highly susceptible to 1080 and birds of prey to the modern second generation anticoagulants. These are all factors to be considered in planning. As well as the obvious non-targets we also have to consider less obvious species, lizard, crustacea, insects and other invertebrates, and contamination of food chains.

Another aspect which has to be considered in poisoning, and also for trapping, is that the baits or traps have to be placed so that every animal has access to them. This means that every territory must have at least one bait site or trap which the local resident has access to. To achieve this is it necessary to get an even spread of bait by aerial or ground laying. In the latter case it often means an extensive track network is required. This can add considerably to the cost and length of time needed for an eradication program. Half-measures will not work.

Lures may be used in association with poison baits (or traps) but here again it is necessary to be aware of what attracts the target species but does not attract non-target ones. Fruit-based lures often attract bird species such as honeyeaters. Trials in New Zealand with kiwi (*Apteryx* spp.) have shown that the reactions are not always consistent and there could be a certain amount of curiosity in investigating a new smell in the territory. It is also possible to use more novel methods. The last cat caught on Little Barrier Island was attracted to the trap by urine impregnated saw-dust from a cat-boarding home. The prey can also be attracted to the area by using a caged, live female in oestrus. Oestrus can be artificially induced with hormone injections but needs to be done under veterinarian supervision.

Trapping

Trapping is the integral part of any hunting program along with shooting. Trapping methods vary considerably but generally large to medium sized animals are shot or trapped. Medium to small animals are trapped usually alive in cage or leg traps and small animals are taken in kill traps. Small animals can be taken in live traps for sampling methods or biological studies but in extermination kill traps are used exclusively.

Success in trapping depends very much on a thorough knowledge of the animal's behaviour and habits. A good knowledge of the animal's behaviour exposes its weaknesses which can be exploited. For example cats will use a track if it is available to them and therefore can be funnelled through a trap. Stoats find tunnels irresistible and tunnel traps can be highly successful.

Traps can be used whether baited or unbaited depending on the target species. The bait may be

displayed either on the trigger mechanism of the trap - as in the back-breaker rat or mouse trap or may be displayed beyond the trap but in such a way that the animal has to trigger the trap in order to reach it - as in the case of cat trapping on Little Barrier Island (Veitch 1985). In some cases it is necessary to conceal the trap very carefully when dealing with a very sensitive or cautious species. On the other hand it can be quite unnecessary with a curious or non-cautious species.

There are a multitude of trapping methods from which one can choose, such as large enclosures which provide a one way entrance. These can be as large as required or may be a small simply constructed funnel trap. These trap the quarry live and they have to be subsequently destroyed. Variations on the simple snare can be used very effectively and as this is a "kill" trap it can be left for longer periods unattended. It can be a very effective method on trails as many poachers have proved.

Other traps include a variety of mechanical, usually spring loaded, devices of various designs. These usually catch the animal by the leg and restrain it (it must therefore be securely tethered) or it can be one that kills instantly. Any trap which either confines or holds the animal must be serviced at least every 24 hours. Kill traps on the other can be left for longer periods. Nets may have some place in a few specialized control programs.

Hunting and shooting

While either biological control or poisoning will take out the bulk of a population, it is often necessary to complete the eradication by direct physical involvement, trapping as covered above, and shooting. Shooting takes considerable skill because you are dealing with a very small number of animals which are under stress and may already have been subjected to considerable disturbance. While anyone can shoot animals when they are common, a hunter has to be very familiar with his quarry and the country it lives in if it is rare. He must be able to predict where it may live (i.e. preferred habitat) and when it is likely to expose itself while feeding, drinking, etc. some spotlighting at night may be necessary.

Hunting may be aided by using dogs to locate and hold the quarry or to flush it out and make it visible to shooters. Other methods such as using a "judas" goat (a goat released with a bell) to link up with surviving herds so that they can be found in heavy cover can also be used.

Non-target species

With either poisoning or trapping one has to accept that in addition to destroying the target species there will be a non-target kill. What has to be assessed and accepted is the level of the non-target kill. For example on Little Barrier island the non-target catch was relatively high. however 800+ of this was the Polynesian rat (*R. exulans*) which were all killed. The non-target catch of birds was 160 of which half were brown kiwis *(A. australis)*. In this case the kill rate was much lower as gin traps were being used and serviced regularly. Many of the birds had only minor injuries or bruising and could be released. Had humane kill traps been used it would have meant all animals caught would have been killed.

Factors helping eradication

While I have stressed the need for different approaches, the difficulty of the operation and the need for persistence, there are a few factors which help the eradication program. Once animal numbers get to a very low level and are under constant pressure, their social structures and sex ratios often become upset. Breeding is often disrupted through insufficient time to develop mutual acceptance, or even difficulty in finding a partner. Several campaigns on different species in New Zealand (possums, cats, wekas) have found that the last few female animals have not carried foetuses i.e. have failed to breed. In some instances the animal becomes more vulnerable as it tends to move about in search of other animals to associate or mate with. The more we know about the biology of the species we are eradicating the better we will be placed to predict such breakdowns.

The removal of problem species can result in unexpected and often dramatic recoveries such as occurred in Hawaii when a totally unknown legume plant *Canavalia kauensis*, appeared after goats were excluded from an area in Volcanoes National Park on Hawaii Island (St John 1972).

Weed problems

However all the results may not be beneficial. Often weed species spring up and become a problem. (Taylor 1968). While this may be an argument for doing nothing, normally the problem is only short term and natural succession allows a stable community, similar but not identical to the original, to develop. In some instances some short term management may be warranted.

Prevention better than cure

Eradication programs are usually costly operations and prevention is better than cure. Much greater effort, and in particular publicity and care, must be directed against further islands being invaded by problem animals either deliberately or by accident. The deliberate release of problem animals must be seen as a very serious offence. One may consider the latter as something which should have ceased in our more enlightened society but the record suggests otherwise. More pigs were released after the major shooting of those present on the Chetwode Islands and the same occurred with goats and rabbits on Whale Island. Goats have been put back on Stephenson Island after stock had been removed from the island for some years. Wekas are still being released on islands by "well-meaning" people. Natural, or accidental, invasions are more difficult to control but where the introduction is the result of carelessness then it is inexcusable. Several near misses involving rodents have occurred with expeditions. The most recent was the near-introduction of mice to Mangere Island. In the mid 70s a nest of mice and an adult female were discovered in equipment during a landing and were destroyed. The equipment had been stored in a non-rodent proof shed over winter. Ship-wrecks present a continuing problem.

Natural invasions on islands free of problem animals are less frequent today since the major peaks in populations following introductions, which tended to overflow onto nearby islands, have ceased. More stable population levels do not appear to offer the same threat. However some species do have population peaks following good food years and this may have been the reason why stoats reached Maud island which is at their extreme range for swimming. Table 1 gives a list of problem animals on islands in New Zealand.

SUMMARY

1. Eradication of problem animals is feasible and can be very beneficial.
2. Establish the reasons for eradication and the priorities.
3. Set the objectives and make a total commitment of resources.
4. Plan in detail to achieve objectives and monitor success or otherwise.
5. Prevention of problem animals establishing is better and much cheaper than cure.

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Table 1
Problem Animals

Recent Liberations (1) Accidental Introductions (2) Invasions over past 25 years (3)

SPECIES	ISLANDS	
Pig	*Chetwode	(1)
Goat	*Whale	(1)
	*Rurima	(1)
	*Herekopare	(1)
	Bird (Fouveaux Strait)	(1)
	Stephenson	(1) farm stock
Wallaby	*Great Barrier	(1)
Rabbit	Whale	(1)
Possum	D'Urville	(1)
	Great Barrier	(1) rumoured
Stoat	*Adele	(3) temporary clearances achieved
	*Maud	(3)
	Motukawanui (Cavalli)	(3)
Rat	Big South Cape **r**	(2)
	Somes **r**	(2)
	*Lizard **e**	(3)
	*Codfish **n**	(2)
	*Whenuakura **n**	(3)
	*Poutama **r**	(2) or (3)
	Duffers Reef **r**	(3)

n = norvegicus **r** = rattus **e** = exulans

Mouse	*Mangere	(2)
Weka	*Trio	(1)
	*Rabbit (French Pass)	(1)
	Blumine	(1)
	Allport	(1)

*Since removed in some cases before species became really established.

Appendix 1

Problem animals on New Zealand Islands

Problem Animal	Islands cleared of problem animals over last 50 years. (-) approximate size in ha. [-] eradication not yet complete	Some islands where problem animals still remain. In recommended order of priority for eradication.
Cattle	Campbell (11 216) [Pitt (6203)]	Enderby (Auckland Islands) (710)
Sheep	South East (219) Mangere (113) [Campbell] [Pitt]	
Pig	Aorangi (Poor Knights Islands) (106) Chetwodes (242/81) [Mayor (1288)]	Blumine (377), Pitt, Auckland (45 975), D'Urville (16 782), Great Barrier, (28 510) Mayor
Goat	Great King (Three Kings) (c.435), Cuvier (181), Nukutaunga (Cavalli Islands) (c.10), Whale (140) East (c.8), Maud (309), Macauley (306), Rurima (c.6) Herekopare (28) Raoul (2938)	Auckland, Great Barrier, Bird (c.30)
Wallaby	Great Barrier	
Rabbit	Inner Chetwode (242) Native (Stewart Island) (c.66) Sugarloaf (New Plymouth) (<.5), Motupuna (Wellington) (<.5), Motunau (c.4) Whale Browns (c.60) Korapuki (Mercury islands) (18)	Rose (75), Enderby, Stanley (Mercury Group c.120), Ohinau (c.45) Slipper (210)
Possum	Codfish (1336) Kapiti (1970)	Tarakaipa (<5)
Cat	Cuvier, Herekopare (28), Putahina (141), Little Barrier (2817) Motuihe (179)	Pitt, Raoul, Auckland, Campbell, Mayor
Rats	Noises, Maria (1) David Rocks (<1) Otata (22) [Motuhoropapa (10)] n; Titi (32) n; Tawhitinui (5) r; Rurima e; Lizard (Mokohinau) (0.8) e; Codfish n; Whenuakura (2) n; [Whale] n; Poutama (c.20) r; Breadsea (150) n; Korapuki e n = norvegicus r = rattus e = exulans	Numerous: priority should be set on (a) importance and practicability (b) future use of island (c) proximity of island to other rodent free and very valuable islands
Weka	Trio (17), Rabbit (French Pass (>5), Maud, ([Blumine], Codfish, Kundy (19) Herekopare	Blumine, Pitt, Chetwodes, Open Bay (15), Jacky Lee (30), Motinui (c.35), Solander (111), Allport (<5), Arid (c.345)