Animal welfare and ethical issues in island pest eradication

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Abstract
Island pest eradications almost always involve killing, often of large numbers of animals. Future eradications must pay more attention to the issues this raises, not only because the issues are important in themselves but also because eradications sit within a wider context of increasing welfare and ethical concerns about animal pest management. The welfare issues include the pain and suffering caused directly by the control method used (to both target and non-target) and any flow on effects (eg. trophic cascades), while the ethical costs relate more to the justification and outcomes of the eradication programme. Eradication programmes will always have uncertainty related to funding, ability to target all individuals, and probability of reinvasion. This uncertainty means such programmes should only proceed and can only be defended on ethical grounds if they are structured in such a way that learning is maximised and applied to reducing uncertainties in future operations. Because structuring eradication programmes as learning experiments will have additional costs (eg. additional monitoring) this approach raises the issue of how much we are willing to pay for that learning and for more rapidly mitigating the welfare and ethical costs of island pest eradication. The consequences of not doing so may put at risk the future eradication programmes.

Keywords: Non-target effects, harm, toxins, costs, benefits, learning experiments

INTRODUCTION
In some countries, the management of mammal pests is coming increasingly under the spotlight because of issues about the ethics of lethal control and the welfare impacts of the various pest control methods employed (Thiriet et al. 2007; McEwen 2008; Warburton and Norton 2009). Animal welfare concerns may also at times be linked to other underlying political motives, such as the hunting lobby’s interests in maintaining invasive species as game animals. Some welfare conflicts have been clear and public, such as the aerial 1080 poisoning of possums in New Zealand (Fisher et al. 2008), the culling of wild horses in Australia (Nimmo and Miller 2007), or the control of white-tailed deer in North America (Warren 1997). To date, however, the eradication of pests from islands has generally not been subject to the level of controversy that has attended mainland control operations, although there are notable exceptions (eg. Anacapa Island rat eradication; Howald et al. 2005). One reason for this is that island eradications have so far mostly involved uninhabited and often remote islands. This is changing as mammal pest eradication are proposed more often for islands that have permanent human habitation, pastoral uses and or are close to highly populated mainland areas. The heightened visibility of such projects often gives rise to controversy. For example, it is doubtful if the removal of introduced hedgehogs from islands off the west coast of Scotland (Jackson 2003) would have engendered such debate if it had happened on one of the more remote, uninhabited islands in the southern Atlantic. Proximity to mainland populations brings closer scrutiny of environmental risks, such as water contamination and non-target impacts and also closer scrutiny of the core justifications for pest management and the tools it employs. Often public opposition is generated from being uninformed or through lack of information, so it is essential for the successful development and management of an eradication programme that public education is considered as important as technology and funding (Simberloff et al. 1997).

Three key prerequisites must be satisfied before eradication is likely to be achievable (Parkes 1993; Cromarty et al. 2002). These focus on animals mainly in relation to the need to kill them: all animals must be put at risk by the control tools; they must be killed faster than they can breed; and there must be no immigration. There is little explicit attention paid to the harm done to the animals during the eradication operation and to local cultural issues about the treatment of animals. We argue in this paper that future eradications must pay more attention to harm done not only because it is important in itself but also because pest eradications sit within a wider context of increasing welfare and ethical concerns relating to animal pest management, increasing animal welfare guidelines, and changes in laws and regulations (Meerburg et al. 2008; Warburton and Norton 2009; Yeates 2009).

ISSUES ASSOCIATED WITH ERADICATIONS

Failure
The number of attempts to eradicate mammal pests, particularly rodents, from islands (Table 1) has been increasing steadily (Nogales et al. 2004; Campbell and Donlan 2005; Clout and Russell 2006; Howald et al. 2007). This trend has been largely self-reinforcing, with success breeding success, leading to operations on increasingly larger and/or more remote islands, and attempts to eradicate multiple rather than single pest species (Parkes and Panetta 2009). The increase in eradication attempts has not, however, been accompanied by a drop in the failure rate, at least for rodents (Parkes and Panetta 2009). This implies that the absolute number of failed operations has increased, which is surprising given the much greater emphasis in recent times on feasibility studies and risk management, including general agreement about the criteria for attempting eradication (Parkes 1993; Bomford and O’Brien 1995; Cromarty et al. 2002; Parkes and Panetta 2009).

From a welfare perspective, failed eradication may have huge cost and little benefit, and so are of major importance. Table 1 lists the number and percentage of successes and failures of eradication attempts for various mammals (based on Nogales et al. 2004; Campbell and Donlan 2005; Clout and Russell 2006; Howald et al. 2007). *= New Zealand data only.

Table 1

<table>
<thead>
<tr>
<th>Species</th>
<th>Successes</th>
<th>Failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rats (3 spp)</td>
<td>159</td>
<td>15 (8%)</td>
</tr>
<tr>
<td>Mice</td>
<td>30</td>
<td>7 (19%)</td>
</tr>
<tr>
<td>Goats</td>
<td>120</td>
<td>10 (8%)</td>
</tr>
<tr>
<td>Cats</td>
<td>79</td>
<td>17 (18%)</td>
</tr>
<tr>
<td>Rabbits*</td>
<td>17</td>
<td>2 (11%)</td>
</tr>
</tbody>
</table>
concern. The largest islands on which eradications have failed for rats, cats and goats, for example, were 1815, 650,000, and 28,510 ha, respectively. Failed eradications may mean that tens to thousands of the target pests have been killed or harmed without achieving the goal of the operation. In the worst case, the failure to eradicate means that there is no further management of the pest species on the island and animals have died to no good purpose, or at best for a temporary reduction in their impacts.

Non-target impacts

Most, and probably all, eradications also harm and kill non-target species (eg. Cowan 1992). Minimising such harm is a major component of eradication planning, and the implicit assumption in most eradication feasibility studies is that the benefits of eradication outweigh the costs, including non-target species impacts. Such arguments do not always assuage public concerns as expressed, for example, after the recent deaths of gulls and bald eagles (Haliaeetus leucocephalus) during the rat eradication on Rat Island in the Aleutian Islands (see http://www.all-creatures.org/articles/ar-island.html accessed 27 January 2010). Single species pest eradications may also have perverse effects on non-target species, notably through trophic cascades and mesopredator release, and in extreme cases drive non-target species towards extinction (Courchamp et al. 1999; Roemer et al. 2002). In manipulating populations to the extent of eradication, we need to be sceptical about our motives and about our ability to intervene successfully in large, complex systems (Jamieson 1995).

Choice of eradication methods

A range of methods have been used to eradicate pests from islands (Table 2). All methods have welfare issues for the target and non-target animals involved. Different control tools have different welfare impacts (eg. Mason and Littin 2003), and this has given rise to research into the relative humaneness of control methods and decision support systems as aids to pest managers to assist them make informed choices about methods of control (eg. Littin et al. 2004; Fisher et al. 2008; Sharp and Saunders 2008).

Most island pest eradications involve rodents, and 70% of those have involved the use of non-selective toxins, particularly anticoagulants (Howald et al. 2007). The most commonly used of these, brodifacoum, is increasingly recognised as causing the welfare issues that are associated with the use of such toxins, particularly as it is used for rodent control on mainland and in New Zealand and the USA. Brodifacoum use is now restricted for domestic use (Mason and Littin 2003; Paparella 2006; Meerburg et al. 2008). Brodifacoum use is now restricted for domestic use.

Table 2 Summary of methods used for eradication of mammal pests from islands

<table>
<thead>
<tr>
<th>Methods</th>
<th>Welfare Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trapping</td>
<td></td>
</tr>
<tr>
<td>Cage traps</td>
<td>Stress, self-injury</td>
</tr>
<tr>
<td>Leg-hold traps</td>
<td>Stress, self-injury, trap injury</td>
</tr>
<tr>
<td>Kill traps</td>
<td>Time to unconsciousness, cause of death</td>
</tr>
<tr>
<td>Drowning traps</td>
<td>Stress, time to unconsciousness, cause of death</td>
</tr>
<tr>
<td>Poisoning</td>
<td></td>
</tr>
<tr>
<td>Acute toxins</td>
<td>Symptoms, time to unconsciousness, sub-lethal dosing, persistent effects (e.g., via residues), cause of death</td>
</tr>
<tr>
<td>Anticoagulants</td>
<td></td>
</tr>
<tr>
<td>Hunting</td>
<td>Wounding, stress</td>
</tr>
<tr>
<td>Biological control</td>
<td>Symptoms, time to unconsciousness</td>
</tr>
<tr>
<td>Judas animals</td>
<td></td>
</tr>
</tbody>
</table>

in the USA and the EU, and in New Zealand is no longer used by the Department of Conservation for mainland pest control. Other rodenticides, such as diphacinone, are being investigated as alternatives to brodifacoum for island eradications. The main driver for these assessments is not animal welfare but reducing the risk of secondary poisoning through use of compounds with significantly shorter residue half-lives.

QUESTIONS ASSOCIATED WITH ETHICS AND WELFARE

What are the ethical and welfare issues in island pest eradications?

In simple terms, welfare issues include the pain and suffering caused directly by the control method used (to both target and non-target) and any flow on effects (eg. trophic cascades), whereas the ethical costs relate more to the justification and outcomes of the eradication programme. Ethical issues are more complex because they relate both to the concept of eradication itself and to the specific operation under consideration. A further issue is that of dealing with uncertainty. In such situations, the Precautionary Principle may be applied; namely, acting to avoid serious or irreversible potential harm, despite lack of scientific certainty as to the likelihood, magnitude, or causation of that harm.

Two criteria used to assess the feasibility of eradication (Parkes 1993; Bomford and O’Brien 1992, 1995; Cromarty et al. 2002) are particularly relevant to welfare and ethical issues. The first states that the benefits of eradication must outweigh the costs, which is a utilitarian view (Singer 1990). Although the benefits and costs are usually considered to be monetary, there is no reason why the same balancing of costs and benefits should not be undertaken from a welfare perspective. Such an approach underlies the application of various national codes of animal welfare (eg. http://www.biosecurity.govt.nz/regs/animal-welfare/ stds accessed 1 February 2010). Most island eradications have been based on the premise that the long-term benefits to the at-risk indigenous species outweigh any welfare impacts in the short-term. Nevertheless, any welfare impacts in the short term should be minimised by explicit consideration of animal welfare as a criterion when selecting eradication methods, and preferably by selecting those methods that pose the least harm. The second states that the techniques used for eradication must be acceptable to stakeholders and communities. In effect, this is usually another cost-benefit decision by those involved, balancing the need for efficient and effective killing methods to minimise risk of failure against the various community views on the ethical issues involved and welfare costs of the methods used.

How might the welfare and ethical issues be addressed?

Welfare impacts can be described by a formula that accounts for the direct impacts on target and non-target species, and includes flow on effects as part of the non-target impacts.

\[ \text{WC}_{\text{TL}} = (\text{WC}_{\text{TL}*N}) + (\text{WC}_{\text{TSL}*N}) + (\text{WC}_{\text{NTL}*N}) + (\text{WC}_{\text{NTSL}*N}) \]

where:

\[ \text{WC}_{\text{TL}} = \text{Welfare cost to target species that are killed} \]

\[ \text{WC}_{\text{TSL}} = \text{Welfare cost to target species that are sub-lethally poisoned or injured} \]

\[ \text{WC}_{\text{NTL}} = \text{Welfare cost to non-target species that are killed} \]

\[ \text{WC}_{\text{NTSL}} = \text{Welfare cost to non-targets that are sub-lethally poisoned or injured} \]

N = the number of animals in each of these categories
The welfare costs are minimised when $N$ is minimised and the method(s) chosen has the least welfare cost. Eradication programmes should therefore aim for success as quickly as possible to minimise any births during the process, and use the most humane and target-specific methods. If the indigenous species that is threatened by the invasive has very high conservation value (e.g. is the world’s sole population), the benefits of eradication are likely to be considered greater than if the indigenous species also occurs elsewhere. Benefits and costs thus need to be weighed against each other, and a higher cost (including welfare costs and uncertainty) might be accepted when the benefits are exceptionally high.

Ethical issues can be addressed by considering a series of questions. Based on the principles underlying the ethical approval of the use of animal in research, Yeates (2009) presents a generic ethical decision-making algorithm to assist this process for pest management (Fig. 1).

In the case of island pest eradication, two sets of questions should be asked. First, do the conservation benefits actually justify the killing of the exotic species? The justifications for island pest eradications have encompassed a wide range of projected benefits – how should different benefits be contrasted and/or combined? The number of island pest eradications is increasing but, at a global level until recently, little thought appears to have been given to prioritisation – on how many and which islands is it crucial to remove invasive alien species? Second, is the risk of failure too high? Will perverse outcomes result in minimal benefits, will the eradication fail because of cessation of funding or because of unforeseen technical problems, or will the benefits of successful eradication be lost if the islands cannot be secured from natural or human-assisted future invasions?

These issues all contribute uncertainty to eradication attempts. Failures highlight the welfare and ethical issues, and justifiably raise the bar for future attempts. To address this, programmes must identify uncertainties at the planning stage and develop mitigation strategies, which are done increasingly as part of eradication feasibility studies. Such approaches to reducing the risk of failure should be complemented by a learning-based strategy. This is the central feature of the ethic proposed by Warburton and Norton (2009); to ensure that even if eradication fails it provides knowledge to improve future attempts. They suggest that this ethic can be made functional within an adaptive management framework that has as its first tenet the need to learn and reduce uncertainty (Walters and Holling 1990).

CONCLUSIONS

Welfare impacts (i.e. inhumaneness) of the eradication methods used are an increasing focus of opponents of the killing of invasive species, and some methods, such as anticoagulant toxins, will most probably continue to be a concern. However, even if eradication methods were ‘humane’, wildlife managers planning or conducting eradications still face ethical challenges. These revolve around whether the number of animals killed is justified in terms of the conservation benefits achieved, especially when the uncertainty surrounding an eradication attempt is high, with the risk that many animals may be killed for no benefit. Eradication programmes will always have uncertainty such as that related to funding, ability to target all individuals, and probability of reinvasion. We propose that programmes with such uncertainty should only proceed and can only be defended on ethical grounds if they are structured in such a way that learning is maximised and applied to reducing uncertainties in future operations. Because structuring eradication programmes as learning experiments will have additional costs (especially for additional monitoring) this approach raises the issue of how much we are willing to pay for that learning and for ensuring the welfare and ethical costs of eradication programmes are reduced.

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REFERENCES


Fig. 1 Ethical decision making algorithm (from Yeates 2009).


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