

## Welfare and ethical issues in invasive species management

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DOI: 10.5073/jka.2011.432.019

Keywords: animal ethics, animal welfare, humaneness, invasive species management, uncertainty

### Introduction

Increasingly, invasive species management is being challenged by changing attitudes in society and greater restrictions on the use of control methods. Invasive species management usually involves the deaths of many animals, mostly the target pest(s) but often other non-target species as inadvertent by-kill. Management usually involves a variety of lethal methods such as traps, toxins and hunting, which may differ in their animal welfare costs, their risks to non-target species and, for toxins, of environmental contamination and spread through food webs. 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 (e.g. trophic cascades), while the ethical costs include the consideration of the justification and outcomes of the control or eradication programme. Recently there have been a number of developments that address some of the concerns raised about invasive species management. The development of a framework for humaneness assessment of control tools, modelling of management strategies that minimise numbers of animals killed, and improved definition of management outcomes that incorporate uncertainty are significant steps forward in providing invasive species managers with means of informed choice of the extent to which they can mitigate the welfare and ethical costs of invasive species management.

### A framework for humaneness assessment

A welfare assessment framework was developed recently that produces a ranking of the relative welfare impacts of vertebrate toxic agents on their mammalian targets and other non-target mammals (Sharp and Saunders, 2008). This was modified to improve general utility and applied to a range of invasive species management traps and toxins used for invasive species management in New Zealand (Fisher et al., 2010). Examples are presented to demonstrate the application of the framework, and to highlight some issues with application of the framework identified, particularly the assumption of best-practice application and availability of data. Overall, the welfare impact assessment framework was a useful approach to providing invasive species managers with information to allow selection of control tools on the basis of welfare as well as cost and efficacy, and should provide a future consistency in relative comparisons between control tools for a range of vertebrate pest species.

### Minimising numbers of animals killed

Research, policy and regulation have most often focused on the welfare impacts (humaneness) of the management tools used (Shivak et al., 2005; Warburton et al., 2000). Efforts to mitigate welfare impacts have thus been focused at the individual animal level rather than at the population level. For invasive species management, however, there is a population issue because often large numbers of animals are involved and so the total welfare cost of a control programme may be significant. An example of rodent control for biodiversity protection is presented to show how a modelling approach can be taken to compare the number of animals killed and the operational costs of two different control strategies, and so allow managers to take total welfare cost into account in their choice of control strategy.

### Management outcomes and uncertainty

From a welfare perspective, control operations that fail to manage invasive species effectively may have high costs and little benefit, and so are of major concern (Cowan and Warburton, 2011). Such failures may mean that tens to thousands of the target pest have been killed without achieving the goal of the operation and, in the worst case where there is no further management of the pest species, those animals have died to no good purpose, or at best for a temporary reduction in their impacts. Such uncertainty can be reduced by better definition of proposed outcomes of management by asking questions such as (1) do the perceived benefits actually justify the large-scale killing of the pest species?; (2) is the risk of failure

too high?; (3) will perverse outcomes result in minimal benefits?; (4) will the management fail because of cessation of funding or because of unforeseen technical problems?; and (5) will the benefits of successful management be lost if reinvasion cannot be minimised? These issues all contribute uncertainty to management operations, and failure highlights the welfare and ethical issues, and makes future management more difficult. To address this, programmes must identify uncertainties at the planning stage and develop appropriate mitigation strategies. Such approaches to reducing the risk of failure should be complemented by a learning-based strategy and the adoption of an adaptive management framework that has as its first tenet the need to learn and reduce uncertainty (Walters and Holling, 1990; Warburton and Norton, 2009).

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