

## Minimising number killed in long-term vertebrate pest management programmes, and associated economic incentives

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### Abstract

Management of invasive vertebrate species often requires the use of lethal control tools such as toxins, traps, or shooting. However, because these pest species are sentient and have the capacity to suffer, the application of such tools raises concerns about welfare impacts. To address such concerns, research, policy and regulation have focused most often on the welfare impacts (humaneness) of the tools at the individual animal level (ie the 'quality' of the impact) with no attempt to assess welfare at the population level (ie the 'quantity' of the impact). Because control programmes often target large numbers of animals, we suggest that when the welfare costs of pest control operations and strategies are being evaluated, the numbers of individuals involved should be considered in addition to the intensity and duration of individual suffering. We explore this concept using a modelling framework and three New Zealand case studies (brushtail possums [*Trichosurus vulpecula*], ship rats [*Rattus rattus*], and Bennett's wallabies [*Macropus rufogriseus*]) to assess the extent to which typical control strategies used by land managers influence the numbers of animals killed. We test whether a predicted relationship between numbers killed and position on the population growth curve holds across these scenarios, and identify whether it would be economically viable for end-users to adopt more welfare-friendly control strategies (ie those that kill fewer individuals to achieve the required management outcomes) for these pest species, or whether some form of incentive would be required. Computer modelling showed that for four simulated brushtail possum control strategies, the number of animals killed on a 1,000-ha area over 30 years ranged from approximately 13,000 to 26,000. Similarly, for two ship rat control strategies, numbers killed over a 20-year period were 977 for an aerial strategy versus 1,517 for a ground-based strategy. For both species, the strategies that killed fewest animals generally also cost the least. For Bennett's wallabies, because farmers only carry out control for production benefits, the control strategy they are most likely to select would result in the highest number of wallabies killed. To reduce the number of wallabies killed while allowing farmers to achieve some production benefits, farmers would need to receive some additional financial benefit. The concept of welfare incentive then raises questions such as 'what willingness is there to pay for increased welfare' and 'to what extent can reducing control costs substitute for incentive payments in reducing numbers killed?'

**Keywords:** animal welfare, Bennett's wallaby, brushtail possum, control strategies, economic incentives, ship rat