FORUM ARTICLE

Fenced sanctuaries need critical evaluation: a reply to Innes et al. (2012)

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We welcome a reply by Innes et al. (2012) to our article (Scofield et al. 2011) questioning the contribution of 'predator-proof' fences. We note that Innes et al. do not question the fundamental points of our thesis: (1) fence costs have not been properly assessed and evaluated; (2) that fenced sanctuaries enhance conservation of species has not been properly evaluated; (3) cheaper methods exist to achieve significant improvements in species' threat status at national levels. We also wish to acknowledge the widespread debate that has accompanied the publication of this paper (see Brookes 2011; Forest & Bird website 2011).

We agree with Innes et al. (2012) that many local restoration projects pursue a range of goals and have little doubt they attain some of them. We agree that careful, systematic, comprehensive monitoring and timely evaluation of these projects is needed to be able to reach strong conclusions about their contributions. We expect that trial and error across restoration sites will help identify what works, what can be achieved, and what is sustainable (socially and financially). We believe that it is crucial that the results of such experimentation are rigorously determined and published to enable knowledge sharing not just within local project communities but also among the interested public and professional communities.

We accept Innes et al.'s (2012) contention that many ecosystems present on the New Zealand mainland are absent from islands but emphasise that our paper was entitled 'Are predator-proof fences the answer to New Zealand's *terrestrial faunal biodiversity crisis*?' (emphasis our own). Ecosystem protection, while unquestionably important in a perfect world, cannot be the number one priority of conservation in New Zealand today. We contend that there are too many endemic species that require management to prevent their extinction and these require investment ahead of addressing the much more expensive and philosophically problematic goal of intact ecosystem restoration and protection. We also wish to point out that due to transient environmental conditions, snow and access, fenced sanctuaries would not, practically, be the answer to ecosystem protection in some areas, e.g. coastal dunes, braided riverbeds and the South Island high country (Walker et al. 2005).

Innes et al. note that predator 'proof' fences have admitted stoats (*Mustela erminea*) and weasels (*M. nivalis*) and, more commonly although still infrequently, ship rats (*Rattus rattus*). Details of these invasions should be published to allow the causes and potential solutions to such issues to be resolved. We acknowledge that the fences are successful at keeping out ferrets (*Mustela furo*), brushtail possums (*Trichosurus vulpecula*), hedgehogs (*Ericaceus europaeus*) and Norway rats (*Rattus norvegicus*) but question whether expensive fences are the most cost effective method of keeping numbers of these predators below the threshold needed for target species to survive or flourish (for a theoretical basis to this assertion see Basse et al. (1997); for a practical New Zealand application of this technique see Whitehead et al. 2008). To claim that extremely expensive fences are successful because they exclude goats (*Capra hircus*), various species of deer, rabbits (*Oryctolagus cuniculus*), hares (*Lepus europaeus*), sheep (*Ovis aries*) and cattle (*Bos taurus*) simply reinforces our contentions; these mammals can be excluded at a fraction of the cost by using cheaper fences. Furthermore, given the admissions of mammals outlined by Innes et al., we suggest that these fences be called predator-resistant rather than the factually incorrect predator-proof. We also question the use of the term pest-proof throughout Innes et al. In New Zealand, pests include bird species such as Indian myna (*Acridotheres tristis*) and Australian magpie (*Gymnorhina tibicen*), as well as invertebrates such as wasps (*Vespula* spp.). In this context, these fences are clearly not pest-proof and were never designed as such; nor is it necessarily essential for all non-predatory pests to be eradicated from an area for vertebrate conservation to be successful. It is crucial for this debate that the terminology is precise.

Innes et al. suggested the improved ranking by Miskelly et al. (2008) of four bird species (brown teal *Anas aucklandica*, little spotted kiwi *Apteryx owenii*, South Island saddleback *Philesturnus carunculatus*, North Island saddleback *Philesturnus rufusater*) could be attributed, in part, to the occurrence of populations within fenced sanctuaries. We dispute this because, for a taxon to achieve an improved conservation status, the total population must cross one or more thresholds in relation to population size or rate of population change (Townsend et al. 2008). The thresholds used in the New Zealand threat classification system include the number of mature individuals (250, 1000, 5000, 20 000, 100 000) and the population trend over a decade (or three generations, whichever is longer) of >10% increase, or >10%, >30%, >50% or >70% decline, which is determined in all subpopulations and also over the entire area of occupancy (Townsend et al. 2008). It is our contention that none of these four species had translocations into fenced areas that altered any of these critical thresholds. We do not deny that successful translocations to fenced areas might improve the conservation status of some bird species (especially for critically endangered seabirds; see Scofield et al. 2011, p. 314), but most translocations to fenced areas are not of taxa whose status is likely to be improved. Furthermore, the number of black robins (*Petroica traversi*),

a critically endangered species, has recently declined and this was probably due to the effects of the unsuccessful translocation to a predator-resistant fenced area (Kennedy 2009). As far as we can determine no species of reptiles or amphibian had their conservation status improved by fenced sanctuaries (Hitchmough et al. 2009). A review of conservation options for grand skinks (*Oligosoma grande*) and Otago skinks (*O. otagense*) in this issue (Reardon et al. 2012) found that trapping unfenced areas can be as effective as fences in conserving these critically endangered reptiles. Crucially however, they concluded that trapping has several advantages including flexibility, and cost-effectiveness when covering large areas. As skink populations require large areas of predator-free habitat to expand, a non-fenced trapping regime will no doubt be critical in improving these species' conservation status from critically endangered. We strongly encourage these authors to, as they suggest, further investigate the relative benefits of these methods at the ecosystem level. Certainly some species of insects may benefit from fenced sanctuaries (i.e. Watts et al. 2011) and an exciting new project in Hawai'i has recently been developed to protect critically endangered *Achatinella* snail species (OANRP 2011). We are not aware of any plant species that have had their threat status benefit as a result of occurring within fenced sanctuaries.

We had not been aware of the important research results to be found in the 'grey literature' of Fitzgerald (2009) and Watts (2007) before they were quoted in Burns et al. (2012). This highlights the need for communication in the ongoing debate. These papers hold important data that may be crucial and we suggest publication of these data in a peer-reviewed journal would be a significant milestone in our understanding of the value of fences.

Recently an ambitious project has been proposed to establish 12 restoration zones on DOC land, each of 100 000 ha (*Dominion Post*, 9 December 2011, p. A4). Each site would include 1000 ha enclosed by a predator-resistant fence, an inner zone of 10 000 ha to be intensively managed by trapping, and an outer zone of 89 000 ha where cyclical hunting and aerial poisoning of pests will occur. This proposal called for the expenditure of $84m capital (presumably 2011 dollars) spread over a 20-year period. It estimated that such a proposal would have $16m a year in operating costs and cost $20m a year to maintain, or 20% of DOC's existing biodiversity budget.

How can the merits of these and other fenced sanctuary proposals be evaluated critically? The opening sentence of Innes et al. (2012) is crucially important: 'The focus on value for money is an increasingly important aspect of conservation management, given that resources for conservation are far exceeded by the potential needs that could be funded.' As Martin Weitzman (1992, p. 363) observed, 'We cannot preserve everything ... The laws of economics apply to diversity.' We argue that economic evaluation should be a core part of the evaluation of all biodiversity projects, including fenced sanctuaries.

Innes et al. (2012) argue that social science strategies including semi-structured interviews, and analysis of additional documents from case studies are better suited to 'emergent ... fenced sanctuaries' than a postal survey and cost-effectiveness analysis as used by Scofield et al. (2011). We agree that richer datasets are preferable to sparse datasets. However, it is crucial to consider what high-level goal is sought by investing in fenced sanctuaries (and in other conservation investments). It is noticeable that the motivation advanced for many such investments is their claimed ability to protect indigenous flora and fauna. Campbell-Hunt et al. (2010, p. 8) state: 'The most effective way to protect indigenous flora and fauna in New Zealand is by creation of natural environments that are free of introduced pest mammals, a strategy that has been widely employed on New Zealand's offshore islands. This strategy is now increasingly in use on mainland New Zealand, made possible by the design and development over the past ten years of highly specialised mesh fences that act as a barriers to all introduced mammals.' The recent proposal for 12 restoration projects argued they can 'avert a biodiversity disaster with a solution that is also economically appealing' (*Dominion Post*, 9 December 2011, p. A4). This suggests that *the* primary criterion to assess these projects should be their cost-effectiveness at protecting species, habitat and ecosystems, and their benefit–cost ratios.

Despite the reluctance of ecologists to 'let factors other than biology dictate conservation priorities' (Naidoo et al. 2006, p. 685), economic costs are important, and economic evaluations are often insightful, practicable, and have been completed for a variety of biodiversity projects (Cullen et al. 1999, 2005; Shwiff et al. 2005; Busch & Cullen 2009; Laycock et al. 2009). Biodiversity project prioritisation methods are now employed in New Zealand. The Project Prioritisation Protocol (Joseph et al. 2009) provides a variant of cost-effectiveness analysis (CEA). It was first applied to single-species projects and has recently been adapted to rank New Zealand ecosystem projects (H. Possingham, University of Queensland, pers. comm.). Benefit–cost analysis (BCA) could be used to provide rigorous economic evaluation of fenced sanctuary projects. Benefit–cost analyses require more data and analyst effort than does CEA, but crucially, BCA informs decision-makers if the total benefits of a project exceed total costs (Hanley & Barbier 2009; Moran et al. 2010). BCA have been used recently to evaluate land-use change projects in Australia, Italy, and Canada (Pannell et al. 2012; INFFER; www.inffer.org) and could be used to evaluate biodiversity projects, including sanctuary projects (D. Pannell, University of Western Australia, pers. comm.).

To ensure there is transparency over objectives and to avoid surprises about outcomes, it is important that searching questions are asked from time to time about biodiversity projects and planned investments. Scofield et al. (2011) urged that five evaluation-related questions should be asked by those thinking about fenced sanctuaries. It still seems pertinent to ask these questions.

(1) What species conservation goals do we really want to achieve?
(2) How much will meeting our goals cost – not just right now but over the next 25 years?
(3) Can we achieve our goals in a less expensive way with less infrastructure and fewer up-front costs?
(4) Is pest control over a larger area a viable alternative to a fenced sanctuary?
(5) Is the best approach for our area a single fenced site or would the money be better spent on many smaller projects?

In conclusion, we observe that a growing amount of literature points to the inescapable economic nature of biodiversity projects (Weitzman 1992; Naidoo et al. 2006; Joseph et al. 2009; Carwardine et al. 2011; Laycock et al. 2011; White & Sadler 2012). Biodiversity expenditures, even when supposedly directed by endangered species legislation, upon analysis can reveal surprising behaviour by decision-makers (Metrick & Weitzman 1996). There is a need for publication of economic and biodiversity outcome data from sanctuary (and other)

biodiversity projects to ensure better understanding of these projects and the goals that are being pursued.

There are rigorous, logical, practical methods for evaluating biodiversity projects, including fenced sanctuaries. It is essential to evaluate these projects, particularly from an economic perspective, and not to rely solely upon biological measurement. Investments in biodiversity projects, including fenced sanctuaries, are difficult to justify if they do not rank highly in such evaluations.

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