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POLICY PERSPECTIVE

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Predator Free 2050: A flawed conservation policy displaces higher priorities and better, evidence-based alternatives

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Abstract

New Zealand's policy to exterminate five introduced predators by 2050 is well-meant but warrants critique and comparison against alternatives. The goal is unachievable with current or near-future technologies and resources. Its effects on ecosystems and 26 other mammalian predators and herbivores will be complex. Some negative outcomes are likely. Predators are not always and everywhere the largest impact on biodiversity. Lower intensity predator suppression, habitat protection and restoration, and prey refugia will sometimes better support threatened biodiversity. The policy draws attention to where predators are easily killed, not where biodiversity values are greatest. Pest control operations are already contested and imposing the policy is likely to escalate those conflicts. While "high-profile," a focus on predator eradication obscures the fact that indigenous habitat cover and quality continues to decline. Thus, the policy is flawed and risks diverting effort and resources from higher environmental priorities and better alternatives. Biodiversity conservation policies should be guided by cost-benefit analyses, prioritization schemes, and conservation planning in an adaptive management framework to deliver nuanced outcomes appropriate to scale- and site-specific variation in biodiversity values and threats. The success of biodiversity sanctuary-"spillover" landscapes, habitat restoration, and metapopulation management provide the foundation to build a better policy.

KEYWORDS

biodiversity conservation, brushtail possum *Trichosurus vulpecula*, eradication, exotic species, introduced predator, invasive species, islands, mammals, rats *Rattus rattus*, *Rattus exulans*, *Rattus norvegicus*, stoats *Mustela erminea*

1 | INTRODUCTION

New Zealand's (NZ's) government has launched the world's largest mammal eradication—to exterminate stoats (*Mustela erminea*), brushtail possums (*Trichosurus vulpecula*), and rats (*Rattus rattus, Rattus norvegicus, Rattus exulans*) from the entire country by 2050 (Owens, 2017). The species targeted by the *Predator Free 2050* policy (Bell, 2016, p. 110) impact biodiversity on the world's islands, especially NZ's (Jones et al., 2016). The policy identifies potential social and economic benefits too (e.g., public engagement in conservation, sustaining natural capital). Island eradications have occurred globally (Jones et al., 2016) and NZ is a world leader in the practice (Russell & Broome, 2016). The attempt will therefore be keenly watched and potentially emulated by other countries.

Regarded as audacious and aspirational, the policy attracted widespread attention in international media (Anonymous, 2016; Owens, 2017). Critique, however, especially of its scientific support, has been limited. This is surprising because the policy appears to be flawed on multiple levels: technical, financial, social, ecological, and ethical. Although well-meant, the high-profile policy may direct attention and effort away from higher biodiversity priorities and alternative policies better supported by science, lower-risk and more suited to the biodiversity conservation capacity and needs of NZ.

2 | TECHNOLOGY, FINANCE, AND SCALE

Predator Free 2050 has been positioned as a rational progression from mammal eradications on NZ's small, offshore islands (Parkes, Byrom, & Edge, 2017). It is, however, more accurately described as a "project born in a leap of faith" (Sir Rob Fenwick: Chair of the Predator Free NZ Trust and a Director of Predator Free 2050 Ltd., Fenwick, 2017). Scientists commenting on the policy acknowledge it to be unachievable with current or even near-future technologies (Parkes, Nugent et al., 2017).

Island eradications amount to only 0.2% of NZ's land area (Parkes, Byrom et al., 2017) and its main islands are over 4,000 times larger than the world's biggest islands cleared of rats. The challenges sometimes overcome on small islands (e.g., pest refugia, compensatory immigration, and reproduction: Doherty & Ritchie, 2017) cannot yet be addressed on much larger ones. The policy's success is, therefore, reliant on yet to be invented and tested "silver-bullet" technologies (Goal 3.4: Bell, 2016, p. 110) affordably killing, or making infertile, every individual, everywhere. Gene drive or "Trojan" females (Esvelt & Gemmell, 2017) are being considered, but evidence for immunity to gene-edited infertility suggests that they are unlikely to be the required panacea (Hammond et al., 2017). Such technologies are also a very long time from being operational in situ or "socially licensed."

If a "silver-bullet" technology does not manifest, it is conservatively estimated that the attempt will cost $32 billion or almost $1 billion every year until 2050 (Parkes, Nugent et al., 2017). That equates to the NZ government spending around 1.5% of its international revenues ($62 billion) or 0.54% of GDP annually-–a large investment compared to government expenditure on other environmental protections (0.33% of GDP), universities (0.9%), and defense (1%; The NZ Treasury, 2015). The $97 million so far allocated is not enough to sustain the project.

Nonetheless, if scale, unproven technologies, and uncertain finance were the only challenges, eradicating the five mammals might, eventually, be possible. But there are considerably more complex challenges too. In particular, small-mammal eradication successes worldwide have occurred only on islands with simpler predator–prey communities and without human populations and economies to also navigate.

3 | SOCIO-ECOLOGICAL COMPLEXITY

As well as the five species targeted, NZ's largest islands have six other introduced mammalian predators or omnivores (ferrets *Mustela putorius furo*, weasels *Mustela nivalis,* hedgehogs *Erinaceus europaeus*, mice *Mus musculus*, cats *Felis silvestris*, and pigs *Sus scrofa*) with substantial ecological impacts (King, 2005). The 11 predatory species depredate and scavenge another 20 species of introduced mammalian herbivores (lagomorphs, macropods, and ungulates). These 31 introduced species interact in complex ways with each other and indigenous species. Eradicating just five predator species from such a complex community will likely have adverse effects for some indigenous species and the environment (Bodey, Bearhop, & McDonald, 2011; Norbury, 2017; Rayner, Hauber, Imber, Stamp, & Clout, 2007; Ritchie & Johnson, 2009; Zavaleta, Hobbs, & Mooney, 2001). Unintended consequences may include the eruption of unwanted herbivores and competing predators (e.g., mice and rabbits, and cats and other mustelids: Caut et al., 2007; Courchamp, Langlais, & Sugihara, 2000; Goldwater, Perry, & Clout, 2012) and invertebrate biodiversity declines (Watts, Thornburrow, Cave, & Innes, 2014). Some effects will be unexpected and may be unrecoverable (Doherty & Ritchie, 2017; Ritchie & Johnson, 2009).

Consider also that, while introduced predators threaten indigenous biodiversity they are not the largest impact on biodiversity in all places. The biodiversity values of some NZ ecosystems are impacted more by other introduced animals, particularly grazers and browsers, than the predators being targeted (e.g., Cruz, Thomson, Parkes, Gruner, & Forsyth, 2017; Forsyth et al., 2015). Also, in other environments and at some scales, lower intensity predator suppression, habitat protection and restoration, and enhanced refugia from predators may be more efficient at protecting and recovering biodiversity (Doherty, Dickman, Nimmo, & Ritchie, 2015; Doherty & Ritchie, 2017; Ruffell & Didham, 2017). Predator eradication, therefore, is not always and everywhere the strategy most likely to protect biodiversity (e.g., Bodey, McDonald, Sheldon, & Bearhop, 2011; Hoare, Adams, Bull, & Towns, 2007; Ruffell & Didham, 2017).

When the goal of biodiversity policy is predator eradication, rather than biodiversity protection, resources may be diverted from more substantial threats and better, multifaceted biodiversity recovery strategies (Doherty & Ritchie, 2017; Helmstedt et al., 2016). For example, the policy was championed by a government that oversaw continued declines in the quality and quantity of indigenous habitat (Ministry for the Environment [MfE], 2018; OECD, 2017). The policy's implementation has also focused on areas with the most obvious, accessible predators, like those in urban landscapes (e.g., https://predatorfreenz.org/about-us/), rather than in areas with greater, or more vulnerable, biodiversity.

Last, impediments to small mammal eradication from islands with permanent human populations and their economies are significant (Glen, Atkinson et al., 2013; Oppel, Beaven, Bolton, Vickery, & Bodey, 2011). NZ is a democracy with 4.7 million socially and culturally diverse people living in urban and rural landscapes over two-thirds of the country. Its economy is dependent on foreign revenue from tourism, the export of agricultural and horticultural products, and the import of goods and services. Preventing the reinvasion, or vindictive introduction, of eradicated species to such a globalized economy is improbable, particularly for commensal rodents. How biosecurity and invasive species control is achieved is already contested, especially with respect to the humaneness of the methods used, property rights, the autonomy of local and indigenous peoples' governance, and the safety of broadcast poisons that are the mainstay of landscape-scale predator control for the foreseeable future (Goldson et al., 2015; Oppel et al., 2011).

A significant and growing proportion of New Zealanders (NZers; 40%) oppose the use of poison for controlling invasive animals (Russell, 2014). Those concerns will also be shared by some customers of NZ's tourism, agriculture, and horticulture, with a growing sensitivity to the inhumane treatment of animals and environmental toxins. An increase in poison use to meet *Predator Free 2050* goals will probably run counter to these trends both in local communities and international markets.

Genetic modifications of wildlife to spread infertility (see Section 2) are proposed as alternatives to poison use but are the subject of international controversy among scientists and others because of the potential for unintended, uncontrollable consequences (Esvelt & Gemmell, 2017). Discussions to develop and test these technologies in NZ have already been criticized for their lack of openness (Fisher, 2017). The release of genetically modified mammals in NZ will also raise concerns in other nations (Esvelt & Gemmell, 2017). NZ's current government is opposed to the release of genetically edited organisms, underlining how fraught any reliance on genetically engineered solutions may be.

Added to this complexity are the views of NZ's "first-nation" peoples, the Māori, some of whom also oppose poison use and genetic manipulations of wildlife. The eradication of some introduced species is also contentious because some Māori regard them as culturally important. The Pacific rat, for example, while targeted by *Predator Free 2050*, is protected on some Māori lands. The policy does not consider the cultural barriers to its success, instead opting to engage with Māori after the fact.

An ethical case for nationwide predator eradication is being developed a posteriori (Morton, 2017). The rationale is that a net ethical benefit will be achieved because no further killing would be required. But a positive ethical "balance-sheet" depends on the humanness of control techniques and eradication success, about which there are substantial uncertainties (Cowan & Warburton, 2011; Doherty & Ritchie, 2017). The improbability of success and the perception by some that current tools are cruel are substantial barriers to ethically robust outcomes. More compassionate approaches to managing predators (Wallach, Bekoff, Batavia, Nelson, & Ramp, 2018) are not being considered.

Ultimately, the *Predator Free 2050* policy's implementation has enormous consequences, negative as well as positive, for people and their environments. To be successful, such consequential conservation policies should encourage debate and not fuel the escalation of existing conflicts (van Eeden, Dickman, Ritchie, & Newsome, 2017). They should also be designed to reinforce public trust in the institutions that implement them (Crowley, Hinchliffe, & McDonald, 2017) so that wider support for environmental governance is not put at risk (Oppel et al., 2011). Didactic policy that only tells the public what *must* be done should be avoided (Crowley et al., 2017; van Eeden et al., 2017). Unfortunately, *Predator Free 2050* is just such a policy, having been designed without formal consultation or participatory research and development with the wider public. The social science it has supported, while well intentioned, was instigated after the policy was announced and implemented (MacDonald, Edwards, Greenaway, Tompkins et al. 2017). And that research has been directed at obtaining a "social license" for new pest control technologies (e.g., gene editing), not toward developing and implementing a biodiversity policy informed by NZers (MacDonald et al., 2017). The risks of policy implementation, and then failure, eroding wider support for conservation have not been adequately considered.

4 | BETTER POLICY AND PRACTICE

It would have been better had mammalian predators not been introduced to NZ. However, now that they are here, and without a realistic chance of removing most of them, we need to find ways of managing the ecosystems they have invaded and the biodiversity they threaten.

Many of NZ's native species persist, and some even thrive, alongside introduced predators (e.g., Hoare, Shirley, Nelson, & Daugherty, 2007). For the most vulnerable species that cannot, NZers have proven that they can be protected in sanctuaries where predators are intensively managed (e.g., http://www.sanctuariesnz.org; e.g., Armstrong, 2017; Armstrong et al., 2014). Importantly, they have also proven that the "spillover" from those sanctuaries is substantial and facilitated by lower-cost, larger-scale predator suppression in the landscapes surrounding them (Miskelly, Empson, & Wright, 2005). NZers are also beginning to investigate how habitats might be better managed to increase refugia from predators and to adapt prey to their presence (Hoare, Shirley et al., 2007; Norbury, Heyward, & Parkes, 2009; Urlich, 2015).

Some experts suggest that a national network of sanctuaries, with predator suppression in adjacent landscapes could achieve NZ's biodiversity goals without the extreme costs and risks of attempting complete eradication (Parkes, Nugent et al., 2017). Predator eradication at small scales, alongside species reintroductions and restocking, and habitat restoration and predator suppression at larger scales, would support the development of national metapopulations of threatened species. The sanctuary-spillover sites would be selected because they are national biodiversity "hotspots" with the potential to be connected by dispersal or species translocation with other hotspots. Only pests with the largest or particularly critical impact need to be targeted in each sanctuary-spillover site to achieve biodiversity outcomes. Sometimes predators but, at other times and places herbivores or weeds, for example, will be prioritized and targeted. The pests managed are likely to be very different between sites depending on the different biodiversity values prioritized at each (Parkes & Nugent, 1995). This is a strategy that is possible with current tools and finance in an adaptive management framework (Glen, Pech, & Byrom, 2013; Parkes & Nugent, 1995; Parkes, Nugent et al., 2017) that already receives widespread public support.

Predation from introduced mammals is one of the threats to NZ's biodiversity (Goldson et al., 2015) but it should not be overstated when considering biodiversity conservation at the national scale (Doherty & Ritchie, 2017; Parkes & Nugent, 1995). Its prominence resulted from the traditional focus of ecological investigations on large, iconic native vertebrates in biodiversity reserves (e.g., birds) with less attention on other native taxa (e.g., invertebrates and flora) and communities in the modified environments that dominate NZ (MacLeod, Blackwell, Moller, Innes, & Powlesland, 2008; Trimble & Van Aarde, 2010). But biodiversity conservation requires policy that enables site and species prioritization for nuanced conservation management across space and time (Doherty & Ritchie, 2017). Habitat loss, pollution (especially of aquatic habitats), and urban and rural development have been the major causes of biodiversity loss in NZ (MfE, 2018; OECD, 2017). For example, around two-thirds of the country's indigenous forests, and almost all of the indigenous grasslands and lowland forests, have been removed or fragmented and all but ~10% of its wetlands drained (Norton et al., 2016). A focus on predator eradication does not address these other more fundamental causes of biodiversity decline or opportunities to recover it.

5 | CONCLUSIONS

The world will be watching NZ with interest as its *Predator Free 2050* policy is implemented. It will likely prove a useful case study in the interaction between science, government, and communities for other nations to consider when deciding how to design and implement biodiversity policy. Unfortunately, it is already clear that the policy has not been well informed by scientific knowledge or conservation best practice. It also misdirects attention from more fundamental and direct threats to biodiversity protection and recovery.

While predator control and exclusion remains a necessary part of biodiversity conservation in NZ, the nationwide eradication of predators is not. And if biodiversity recovery is our ultimate goal then predator eradication is secondary to the need for somewhere for biodiversity to live. Supported by modern socio-ecological theory and practice, NZ's biodiversity goals (Norton et al., 2016) could be better achieved with a less extreme (i.e., less costly and lower risk), and more nuanced and multifaceted policy. That policy would use existing, proven technologies and strategies, and be guided by scale- and context-dependent cost-benefit analyses and prioritization schemes (Helmstedt et al., 2016; Parkes & Nugent, 1995), and incorporate decision theory (Driscoll et al., 2010), conservation planning (Margules & Pressey, 2000; McIntosh, Pressey, Lloyd, Smith, & Grenyer, 2017), and adaptive management (Doherty & Ritchie, 2017; Parkes, Robley, Forsyth, & Choquenot, 2006).

Biodiversity recovery requires different strategies in different places, at different scales, in different communities of people, and at different times. Protecting some species from introduced predators will likely remain a focus of conservation in NZ's biodiversity sanctuaries. That focus, however, must not detract from other biodiversity conservation priorities at the national scale, including the pressing need to protect and grow habitat. While *Predator Free 2050* is well intentioned, NZ's future conservation policies need to be less bombastic, and better informed by the environmental, ecological, and social sciences.

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