



Predator Free New Zealand and the ‘War’ on Pests: Is it a just War?

Michael C. Morris¹

Accepted: 19 November 2019 / Published online: 16 December 2019
© Springer Nature B.V. 2019

Abstract

Conservation policy in New Zealand is centred around an objective to totally eradicate three invasive species; the ship rat (*Rattus rattus*), the brushtail possum (*Trichosurus vulpecula*) and the stoat (*Mustela erminea*), by 2050. The preferred control method to achieve this is large scale poisoning operations with 1080 and similar toxins. This project is backed up by governmental and non-governmental agencies and surrounded with discourse of ‘war’ and ‘invasion’. The ‘Big Three’ predators are endowed with sinister motives as a means of mobilising support. This self-described ‘war’ is evaluated in terms of ‘just war’ theory and found wanting. In particular there are issues with the recruitment of children for killing, humiliation of combatants, questionable economic motives for the ‘war’, deception by government agencies, lack of consultation, a lack of consideration of alternatives, the use of excessive suffering, and unrealistic expectations. An alternative paradigm of ‘compassionate conservation’ is proposed for New Zealand. Instead of trying to get back to a stable pre-colonial state of nature, I propose a holistic approach that respects both ecosystems and their members and takes into account new understandings of ecosystems as dynamic processes.

Keywords Possums · Stoats · Rats · Compassionate conservation · Just war

Introduction: Control of Invasive Species in New Zealand

New Zealand has been described as a biodiversity ‘hotspot’. This term was first used to describe places that combine a high degree of endemic vascular plant species with low remaining levels of original vegetation (Myers et al. 2000). New Zealand is listed as among 35 places where there are at least 1500 endemic vascular plants, and less than 30% of original cover (Mittermeier et al. 2011). The New Zealand bird (Scofield and Stephenson 2013) and invertebrate (Buckley et al.

✉ Michael C. Morris
michael.morris@actrix.co.nz

¹ Auckland, New Zealand

2015) fauna are characterised by unique species assemblages and high degrees of endemism.

New Zealand has long been isolated from other parts of the world, and has no extant native mammalian predators or browsers. It is believed that this contributed both to New Zealand's high bird and plant endemism, and their vulnerability. New Zealand plants and birds supposedly have no defence mechanisms against mammals that were later brought into the country by human introductions (King 2005; Antonelli et al. 2011).

The government agencies in charge of conservation have promulgated policies of controlling and eradicating non-native mammals, especially on smaller islands (King 2005). Control of possums has been part of government policy since 1951 (Cowan 1990).

The intensity of control operations stepped up after retiring physicist Sir Paul Callaghan publicised his ambitious plan to make New Zealand 'predator free' by 2050. This was taken up by the Department of Conservation (DoC), the government agency responsible for pest control. Non-governmental organisations such as Forest and Bird and the New Zealand branch of the World Wildlife Fund also pledged support (Russell et al. 2015).

The Predator Free New Zealand (PFNZ) Charitable Trust now includes disparate groups of stakeholders from the public, private and charitable sectors (Holm 2015). Its website includes advertisements for animal traps supplied by private companies.

PFNZ has a stated aim of eradicating three species by 2050. These are possums (*Trichosurus vulpecula*), stoats (*Mustela erminea*), and ship rats (*Rattus rattus*). PFNZ describes these as the 'Big Three' predators (Wright 2011; Russell et al. 2015).

Of these, the Australian brushtail possum was long considered to be the most destructive (Montague 2000). Possums were introduced into New Zealand from Australia about 150 years ago, so they could be bred in captivity for their fur. Possums were considered a valuable resource, and in the early twentieth century, harvesting was carefully controlled. It was only after damage to native forest became apparent in the 1920s that protections were withdrawn, and releases of possums bred for their fur became illegal (Cowan 1990).

Possums are known to cause defoliation and die-back of a number of native plant species (Payton 2000; Byrom et al. 2016). There are also claims that possums eat birds and bird eggs and native endangered snails but the evidence for this is sketchy and anecdotal, often based on the behaviour of captive possums (Sadler 2000). Video footage provided direct evidence of possums eating live birds in the field in just one study (Innes et al. 1996). In contrast, repeated analysis of thousands of stomach contents since the 1950s have found no evidence of predation (Morgan 1981; Sweetapple et al. 2013 and references therein).

Possums are also known to be a reservoir for bovine tuberculosis (Tb). As a result, most possum control has been on farmland by the government-appointed agency responsible for Tb control (Wright 2011). The ethical issues of culling wildlife for Tb control have been evaluated comprehensively in a special issue of this journal (Burkhardt 2017) using badger culling in the UK as a case study. Culling for

this purpose is outside the scope of this paper, which is concerned with pest control for environmental reasons.

Rats are a frequent cause of predation on eggs, chicks and sitting adult birds. They also eat native invertebrates (Innes et al. 1999; Innes 2005). Stoats were introduced to New Zealand in the 1880s to control rabbits. They are carnivorous and feed on both native and introduced animals, including kiwi (King and Murphy 2005).

Ethical Issues Related to Non-native Mammal Control in New Zealand

The favoured method for large-scale eradication of the “Big Three” in isolated areas of New Zealand is the use of toxins, in particular 1080. This toxin is typically scattered by helicopter in less accessible areas of native vegetation. The use of this toxin is supported by the Department of Conservation.

Hunting groups¹ oppose the use of 1080 because it causes secondary and unintentional poisoning of deer, pigs and other wild and domestic animals. Others have more general concerns over chronic toxicity and the residual effects of toxin on the ecosystem, particularly fresh water (Weaver 2006).

Poisoning by 1080 is ‘severe’ and lasts for hours. Other toxins such as brodifacoum and cholecalciferol, used for ground control, cause ‘extreme’ suffering lasting days to weeks (Beausoleil et al. 2010). For this reason, some animal welfare groups such as the Society for the Prevention of Cruelty to Animals (SPCA 2019), oppose the use of toxins for pest control. In keeping with an animal welfare ethic for pest control (Garner 2017), these groups are less concerned with more humane means of killing.

Others advocate a ‘Compassionate conservation’ approach opposing blanket and indiscriminate killing, and thereby showing respect for the lives of invasive species (Wallach et al. 2018). A consensus meeting of experts concluded that wildlife control in general should minimise animal welfare harms (Dubois et al. 2017).

Because of the controversy over current methods of non-native mammal control, the New Zealand Parliament commissioned a report on the continued use of 1080. Commissioner Jan Wright (2011) came out in support of continued and increasing usage of 1080. She concluded that it reduces numbers of the “Big Three” species, improves nesting success for native birds, increases canopy cover for native plants, has limited effect on non-target species, is broken down relatively easily and can be used in inaccessible areas.

In a follow up report, Wright (2013) not only advocates for even more use of 1080 as a means of control, she also strongly discourages any funding for alternatives, on the basis that these are as yet untested. The government has followed this recommendation.²

¹ See for example the website of the New Zealand Deerstalkers Association <https://www.deerstalkers.org.nz/Conservation>.

² Government press releases from the present Green Party minister of conservation can be found at <https://www.beehive.govt.nz/minister/hon-eugenie-sage>. Press releases confirm that the Department of Con-

Ethical Framework for Pest Control

The rationale for controlling non-native mammals is the preservation of biodiversity. This in turn comes from a high level policy document, the *Biodiversity Strategy* (DoC 2000). The *Strategy* lists several economic reasons for preserving biodiversity, but also acknowledges that biodiversity has intrinsic value, according to both indigenous Maori and settler values. This idea is an outshoot from Aldo Leopold's (1949) "Land ethic" in its assumptions that higher complexity and diversity is preferable to lower, and native species are preferable to introduced (e.g. Rolston 1996).

In this view, the value of individuals are of low importance. This applies particularly to the invasive species, who are determined to have lower status because they are not native (Wallach et al. 2018), but even individuals of accidentally killed native species have low consideration.

To justify the mass killing of the "Big Three", government agencies and other predator-free organisations use rhetoric of 'war', 'invasion' and 'military' strategy (Potts 2009; Steer 2015; Holm 2015).

Similar militaristic discourse is common when describing control methods in other countries (Lawson 2005). For these reasons, it would be instructive to use the government's own definition, and to determine to what extent the so-called 'war' against 'pests'³ corresponds to the philosophically rigorous ethical framework of the 'just war' tradition.

Is the 'War' Against Non-native Mammals just?

The just war tradition has a pedigree going back to Augustine and Aquinas, and is based on their Christian theology. It has been formulated and adapted by Childress (1978), and further updated for modern warfare by Campbell (2011) and Ngai (2019).

The premise of the just war ethic is that absolute pacifism is not an option, but there are ethical considerations that must be taken into account before waging a war (*Jus ad bellum*), as well as ethical constraints around right conduct during war-time (*jus in bello*).

Jus ad bellum considerations, as listed by Childress (1978) include:

- War must be waged by a legitimate or competent authority
- There must be a just cause
- There must be right intentions
- There must be an announcement of intention
- War must be a last resort

Footnote 2 (continued)

servation received a boost in funding after the 2018 budget, but this is being channelled into existing control methods.

³ Dubois et al. (2017) discourage the use of negative labelling such as 'pest'.

- There must be reasonable hope of success
- Proportionality (i.e. a reasonable balance between probable good and harm).

The *jus in bello* ethic prescribes right conduct during war time. These include discrimination between military targets and innocents, limitations of the power of weapons used, and the treatment of non-combatants (Childress 1978; Ngai 2019).

Some of the tenets of *jus in bello* have been codified by international law, particularly the Hague Conventions of 1890 and 1907, the Geneva conventions starting in 1864, and the Rome Statute of the International Criminal Court. The latter contains regulations about treatment of non-combatants, the use of poison or other weapons that cause 'unnecessary suffering', 'humiliating and degrading treatment', and conscription of children under 15 years of age.⁴

Ngai (2019) discusses a new criterion to the just war tradition, *jus post bello*, describing, among other things, the conditions required during post-war reconstruction and the restoration of a post-war society.

Is the Present Policy of Pest Eradication a just War?

Legitimate or Competent Authority

The use of 1080 and other means of pest control is part of New Zealand government policy. The central government own the company supplying most 1080 for New Zealand use (Animal Control Products Ltd.). Pest control for environmental protection reasons has a legal mandate in legislation such as the Wildlife Act 1953, the Wild Animal Control Act 1977, and the Conservation Act 1987.

Regional and unitary councils also have delegated authority to make Regional Pest Management Plans and carry out pest control operations for environmental preservation purposes under the Biosecurity Act 1993.

Thus far it appears as if the authority is both 'legitimate' and 'competent' given that it is made up of central and regional government agencies subject to all the checks and balances of a parliamentary democracy. There are however issues with some of the other stakeholders who are encouraged to take part in pest-control operations.

The PFNZ website for example contains advertisements for animal traps, and private individuals are encouraged to use them. Of particular concern is the recruitment of schools in the 'war' against pests. In 2017, school children were encouraged to humiliate possum corpses, and to drown the joeys (Roy 2017). The school agreed to discontinue the drowning process, but school fundraising events involving killing of possums and humiliation of their corpses continues, some of these sponsored by the government-owned Kiwi Bank (Tulloch 2018).

The use of schools in the 'war' against non-native wildlife is analogous to the use of Private Military Contractors (PMCs) during wars against humans. As pointed

⁴ From the United Nations website <https://www.un.org/en/genocideprevention/war-crimes.shtml>.

out by Campbell (2011) PMCs are not subject to the same rules or accountability as state militaries. Using school children to carry out pest control operations is particularly problematic given the prohibition of child soldiers under the Rome Statute of the International Criminal Court.

On its website promoting its predator free stance, DoC endorses the non-governmental PFNZ objectives, which it describes as “an ambitious goal to rid New Zealand of the most damaging introduced predators that threaten our nation’s natural taonga, our economy and primary sector”.⁵

DoC has no authority or expertise in protecting either the economy or the primary sector. In endorsing PFNZ, DoC staff are therefore acting outside their role as a ‘legitimate and competent authority’.

Just Cause

‘Protection of natural taonga’ is the stated cause for predator control that is within the remit of the ‘legitimate and competent authority’. This is based on the *Biosecurity Strategy* (DoC 2000), which affirms that biodiversity, as defined by diversity in numbers of species, ecosystems and genetic variation, has intrinsic value.

In its broadest form, the protection of nature from all threats, including land clearances, animal agriculture and fishing, could be described as a ‘just cause’. The implementation of strategies to achieve this cause will be discussed below.

Right Intentions

It is an important consideration among particularly the Christian strand of the just war theory that the side waging war do not hate their enemy (Childress 1978). Those declaring war also need to be clear that there is no hidden agenda. Related to this would be a requirement to be honest about the intentions of both one’s own side and the enemy. There is a common saying that the first casualty of any war is the truth, and this certainly appears to be the case in the ‘war’ against the ‘Big Three’.

Possums are reservoirs for bovine tuberculosis (Tb) (Gormley et al. 2018), and there is evidence that this was the real reason for drumming up anti-possum hatred, with their environmental depredations being an excuse. The first edition of Caroline King’s *Handbook of New Zealand Mammals* describes how the discovery that possums are responsible for the spread of Tb stimulated a ‘dramatic increase’ in government funding in the 1970s, even though their effect on the environment had been known since the 1920s (Cowan 1990). A later edition (Cowan 2005) does not mention the link between funding and the discovery that possums spread Tb.

Further evidence that rhetoric on the necessity of predator control is as much (or more) related to economics than conservation is the mention of ‘the economy and primary sector’ on the DoC web page endorsing PFNZ. It is also interesting that

⁵ <https://www.doc.govt.nz/nature/pests-and-threats/predator-free-2050/>.

introduced trout, which also prey on native species, are provided special status in New Zealand because of their economic importance (Steer 2015).

Of concern too are the concerted campaigns to engender hatred towards the 'Big Three', particularly possums. These go beyond simple militaristic discourse found in other pest control campaigns (e.g. Lawson 2005). Potts (2009) describes several instances of public humiliation and denigration of possums. The involvement of schools is a disturbing development in this rhetoric.

Steer (2015) interviewed staff members of governmental and non-governmental pest control agencies, and described their 'jingoism and xenophobic political rhetoric'. These representatives saw 'squeamishness' as a weakness, and liked to assert their 'kiwi bloke' credentials by the way in which they dispatch their quarry. The government representatives privately agreed that it is unreasonable to attribute malicious intent to animals who are just trying to survive, but that the war rhetoric has a valuable propaganda function (Steer 2015).

In other words, the possum has become a 'foe' not just an enemy. They have gained our enmity not just because their lifestyle clashes with ours, or because they threaten our territory, but because they are perceived to be totally immoral and depraved (Holm 2015).

Related to the discourse of the 'evil' possum⁶ is exaggeration of their effects. Evidence for possums regularly preying on birds is sketchy (qv), yet it is asserted as absolute fact in the Parliamentary Commissioner's report (Wright 2011), with no referencing. Wright (2011) similarly accuses possums of eating the endangered snail *Powelliphanta*, again with no direct evidence. The claim is based on patterns of damage to native snail shells when the snails were fed to captive possums. The logic is that because possums damage shells in a certain pattern, all shells damaged in a certain pattern are caused by possums (Sadler 2000). Such damage was originally attributed to predation by native parrots (Meads et al. 1984).

A creature that regularly kills native birds or valued invertebrates is easier to hate than one that merely competes for their habitat or damages plants. Possums have to be classed as 'predators' for the term 'Predator Free New Zealand' to mean anything. Descriptions of the 'Big Two Predators and the Voracious Vegetarian' would somehow lack impact.

In conclusion therefore, there is suspicion over 'right motives' for including the possum among enemy predators. The exaggeration of predation damage, the increase in funding for possum control when it was discovered they threaten the economy, and differing status of introduced and indigenous animals based on economic impact and benefit, suggests that economic imperatives often trump environmental ones.

⁶ One of my 9-year-old students recounts how a book that she was reading in class described possums in this manner.

Announcement of Intention

This is related to the requirement to declare war, and could not apply to wars against nonhuman animals who would not understand a formal declaration. However, in this context, it could be applied to defenders of the ‘enemy’ who are also New Zealand citizens, such as 1080 protestors and those concerned with the lives and welfare of the predators.

While DoC have made no secret of their overall policy of controlling invasive pests, the particular PFNZ campaign, with its more ambitious goal of complete eradication by 2050 was launched without adequate consultation (Linklater and Steer 2018). Proper community engagement over wildlife control programmes was one of the principles agreed by an expert panel (Dubois et al. 2017), and this was lacking in New Zealand.

A proper declaration of ‘war’ was not followed.

Last Resort

The cause of environmental protection could be perceived to be a ‘just’ one, but the question needs to be asked whether eradication of the ‘Big Three’ through large scale poison drops is the only way to achieve it. The Parliamentary Commissioner for the Environment (Wright 2013) and the New Zealand government have precluded any funding for alternative non-lethal means of pest control, even though these have been tested or are in development elsewhere.

One of the more promising alternatives is contraceptive control using immunological agents that target antigens on eggs and sperm in possums. Genes expressing immuno-contraceptives could be inserted into ghost bacteria or carrots. These genetically modified baits could then be dropped instead of toxins (Ji 2009).

Immuno-contraceptive research targeting antigens on the sperm or egg was discontinued in Australia due to the slow progress being made, but in 2006, a contraceptive vaccine for New Zealand possums was considered to be only 3–4 years away (J.A Duckworth Personal communication, cited by Coleman and Forsyth 2007).

A chemical agent that targets ovarian function has been developed for controlling rats in New York by sterilising the females. This could, in theory, be adapted for other mammalian pests (Witmer et al. 2017). If funding was channelled into this direction, this could lead to a breakthrough in ‘pest’ control.

Genetic drive techniques, such as Trojan females that produce infertile males through the female mitochondrial line (Gemmel et al. 2013; Russell et al. 2015) are another promising line of research. Some of these techniques have been trialled in laboratory mice (Campbell et al. 2015).

Such techniques are not without environmental and ethical implications. If invasive animals infected with the gene drive were to spread to other countries, this could cause dramatic population loss in these places. This is a particular concern for possums spreading to Australia, where they are a valued native species, in contrast with their treatment in New Zealand (Potts 2009). Safeguards in the gene drive

technique to ensure the eventual decline of the gene drive population have been proposed (Esvelt and Gemmel 2017; Noble et al. 2019), but these will require further development, international consultation and consensus to approve their use.

Chemical repellents, including systematic agents that are absorbed into plant tissue, are possible candidates for preventing possum damage to sensitive plants. At present, their application is generally restricted to nurseries. It is interesting that this application is only used in Australia, where the objective is to repel possums, not to kill them. The use of possum repellents in a natural environment would require more thorough testing (Coleman and Forsyth 2007).

Other alternative proposals to a full-scale 'war' include the strategy of Linklater and Steer (2018). These authors propose predator control at small scales only, together with other strategies such as habitat restoration and management of threatened species. One example of such management is the 'operation nest egg' initiative, whereby kiwi chicks are kept in captivity and only released when they are old enough to be past the most dangerous period for predation (Bassett 2012).

In conclusion, the dismissal and withdrawal of funding for any alternatives to full-scale pest control provides evidence that the 'war' on wildlife was not declared as a last resort.

Reasonable Hope of Success

The stated aim of the PFNZ campaign is to make New Zealand free from the 'Big Three' by 2050. Linklater and Steer (2018) consider this objective to be unrealistic and expensive. They estimate that the implementation of the programme will require 0.54% of New Zealand's GDP from now until 2050.

Such expense will detract from environmental initiatives that may be more efficient such as reversing habitat destruction for land use, which DoC (2019) presents as having the biggest impact on environmental destruction. Animal agriculture in particular has been responsible for clearing most of New Zealand's lowland forests and wetlands (Park 1995; Joy 2015). It is presently responsible for destruction of fresh water habitats through nutrient overloading, which is threatening New Zealand fresh water fish species with extinction (PCE 2004; Joy 2015).

Linklater and Steer (2018) further argue that ecological interactions are complex, and eradication of just the targeted species could lead to unintended ecological consequences.

For example one study on rat control showed that re-invasion of rats outside the control area meant that the number of rats found 24–30 months after treatment was higher than the pre-treatment numbers (Griffiths and Barron 2016).

Stoats eat rats, and if rats are unavailable due to poisoning, stoats may 'prey switch' to kill more native birds (King and Murphy 2005). There have been several cases in New Zealand and overseas where rat eradication programmes have led to an explosion in numbers of mice (Caut et al. 2007). Since mice have also been reported to eat eggs and nestlings (Ruscoe and Murphy 2005), this would simply mean swapping one predator for another.

A 1080 poisoning operation targeting possums resulted in an increase in rat numbers after 2 years and mouse numbers after a year. It has been suggested that this is due to rats and mice competing with the possums (Ruscoe et al. 2011).

A further consideration is whether eradication could be maintained. Predator eradication has been successful in some refugia, such as offshore islands and some mainland sanctuaries. The predator-free status of these places is only maintained however through strict movement control and expensive fences that require continuous maintenance. Maintaining predator-free status in an entire country would be far more difficult and expensive (Linklater and Steer 2018).

In conclusion, further studies, including economic cost–benefit analyses, need to be conducted before it can be concluded that an environmental policy based around predator eradication has the best chance of success in terms of better environmental outcomes. A consortium of experts also listed achievable and measurable outcomes as an ethical requirement for wildlife control (DuBois et al. 2017).

Proportionality

Proportionality is a broad criterion that determines whether more good will come from a war than harm. It is related to the chance of success discussed above, in that one harm caused by any war is the channelling of resources away from initiatives that may be more effective.

Another type of harm can be manifested in damage to our psyche, what virtue ethicists (e.g. Hursthouse 1999) describe as ‘residue’. Thus, even if a particular act is considered the ‘lesser of two evils’ and therefore permissible, the perpetrators of the act still bear the moral consequences to their character.

Moral ‘residue’ can be translated into harmful behaviour. It is here that the use of children as participants in the ‘war’ against ‘pests’ is particularly problematic. Recruiting school children appears to be a phenomenon unique to New Zealand. The United Kingdom for example operates a policy of badger culling in some places for TB control, but licences for killing operators are regulated by legislation (McCulloch and Reiss 2017a).

A link between animal and human abuse is now well established, and there is increasing evidence that there is a causal relationship. When children even witness animal abuse carried out by trusted adults such as teachers, this can be a predictor for later abusive behaviour towards humans and non-humans (Gullone and Roberson 2008). Conversely, teaching children respect towards animals can help them become more empathetic towards humans and non-humans alike (Hawkins et al. 2017).

While concern for both the intrinsic and instrumental value of the natural environment is a worthy objective (‘just cause’), it needs to be balanced against competing ethical objectives. To an animal rights advocate, the lives of both the native birds preyed upon by rats and stoats, and the predators and by-catch killed by toxins, have equal value. Under an animal welfare paradigm suffering counts equally, even if lives are of lesser importance (Garner 2017).

Numbers killed or saved as a result of pest control in New Zealand are hard to quantify. John Innes has estimated the number of birds killed by pests to be 26 million per year, based on predation rates and data on density of bird nests.⁷

Possum numbers have been estimated at 30 million in 2009 (Warburton et al. 2009). Numbers of rats are harder to predict, and their numbers fluctuate widely. However, Harper and Rutherford (2016) present data on rat density in different parts of New Zealand. The range is 0.38–8.22 rats per hectare. Taking the average, and multiplying by the area of the three main islands of New Zealand produces a figure of approximately 100 million rats, though these can proliferate to many times this number in 'mast' years (Harper and Rutherford 2016).

Some estimates of stoat density in summer from trapping and capture-recapture data are 4.2 per square km in forest (Alterio et al. 1999), and 1 per square km in alpine habitat (Smith et al. 2008). Multiplying by the areas of New Zealand covered by forests and subalpine habitats (78,000 and 30,000 square km respectively) gives a population of 357,000.

In simple terms, if total eradication was possible, then the death of at least 130 million predators would save the same numbers of native birds in 5–6 years.

Fast eradication of this nature would require the development of some sort of 'magic bullet' such as a rapid-acting gene drive (Linklater and Steer 2018). Present control operations require the death of far more animals. The use of widespread toxin application has reduced possum numbers from an estimated 70 million to 30 million in 20 years. This period marks several breeding cycles, so the numbers killed would be more than simply the difference between 70 and 30 million.

The effect on eradicating the Big Three also takes no account of other predators such as mice or feral cats, and unintended effects of competitive interactions (qv).

Probabilities of re-invasion and marginal declines in catch per unit effort as the predator population is reduced also need to be taken into account. It is not possible to simply count numbers in order to make an ethical analysis, as has been done for example in cost–benefit ethical evaluations of badger culling in Britain (McCulloch and Reiss 2017b).

Another factor that needs to be considered is a comparison between the suffering of the predator species and the prey animals. Since many of the prey animals would still be eggs, they could not be said to suffer at all. The same cannot be said for the predators. According to a report to the statutory Animal Welfare Advisory Committee, the suffering of 1080 poisoning victims is 'severe' and lasts for 'hours'. Stoats and other carnivores can be poisoned through eating already poisoned corpses. For these animals, the suffering can be 'extreme'. Brodifacoum and cholecalciferol, coagulant poisons used in ground control, cause 'extreme' suffering lasting days to weeks (Beausoleil et al. 2010).

In terms of animal welfare ethics (Garner 2017), more humane lethal alternatives would go some way to addressing 'proportionality'. These include faster acting toxins such as cyanide, which kills in minutes and causes 'moderate' suffering

⁷ As explained on <https://www.stuff.co.nz/science/109855658/how-do-we-know-predators-kill-25-million-birds-chicks-and-eggs-each-year>.

for possums. A new toxin, para-aminopropiophenone (PAPP) was registered in 2011 for use against rats and stoats (Eason et al. 2014). PAPP usually kills within minutes, though suffering can still be ‘severe’ (Beausoleil et al. 2010). Other lethal but more humane alternatives include mechanical kill traps and toxin dispensers that can be reset several times and remotely monitored. This makes them cheaper and more suitable for remote areas (Blackie et al. 2014; Campbell et al. 2015). Non-lethal alternatives such as contraceptives and gene drive technology also need to be considered for ‘proportionality’.

Proportionality not only needs to consider possible harms but also assumptions on the good that will arise from the ‘war’. The stated objective of PFNZ is the eradication of the ‘Big Three’ in order to protect ‘native species’. The Department of Conservation also states that protection of ‘taonga’ is important in their endorsement of Predator Free New Zealand. The Maori word was used in the 1840 Treaty of Waitangi to describe elements of the cultural and natural environment precious to pre-colonial Maori. The term is therefore loaded in favour of native species only.

However, the recent DoC (2019) document for public consultation on a new biodiversity strategy takes a more nuanced approach to preservation of ‘nature’, stressing that it means more than simply counting numbers of species. It also states that non-indigenous species have their place in the wider environment.

This represents a shift in our understanding of biodiversity and the way ecosystems form. It also represents a move away from ‘nativism’ (Wallach et al. 2018), the view that only native species count in the ecosystem.

Worster (1994) suggests that the views that complex ecosystems are better than simpler ones and high diversity is better than low is based on the climax model of ecological succession, which is now outdated. Under the old paradigm, an ecosystem mends itself after a disturbance. The species composition changes as the ecosystem gradually increases in diversity and complexity until it reaches a ‘climax’ ecosystem. Under such a paradigm it is perhaps understandable why conservationists have emphasised the need to maintain the ‘balance of nature’ (Ellis 2015).

We now know that ecological succession does not involve progress towards a ‘climax’ ecosystem. Landscapes are in a permanent state of disturbance and chaos. This is particularly the case in New Zealand, where large and small scale disturbances such as tree fall, earthquakes, landslides and frost have led to a greater variety of species assemblages at the landscape level (Wyse et al. 2018).

Under this model, predators and introduced species do not need to be eradicated, since limited predation could be considered as simply another ‘disturbance’ that could lead to more variety of ecosystems. It is also known that ecosystems are more resilient than first thought, and can adapt to the presence of invasive species (Pickett 2013).

Instead of trying to reconstruct nature to some hypothetical (and possibly imaginary) pre-colonial past by wiping our non-domesticated post-colonial species, it may be better to manage nature for the benefit of humans and non-humans alike (Ellis 2015) through holistic programmes such as those advocated by Linklater and Steer (2018). An expert panel (Dubois et al. 2017) recommended developing a ‘culture of co-existence’.

Jus in Bello

This criterion covers ethical conduct in war, including treatment of non-combatants and limitations on the power of weapons used (Childress 1978; Ngai 2019). It has been codified in international law, including restrictions on conscription of children under the age of 15.⁸

The use of child combatants in the 'war' against 'pests' has been described above under 'proportionality'. The use of poisons, and poisoned weapons is implicitly forbidden under international law, as is 'committing outrages upon personal dignity, in particular humiliating and degrading treatment'. The latter is a common feature of community events such as 'possum tossing', and school fundraisers (Tulloch 2018).

Enforced sterilization, as mandated by contraceptive baits and gene drive is also forbidden, though this needs to be balanced against the alternatives of more toxins.

Jus Post-bello

This describes the nature of any post-war society, and would include any negotiated settlement with the enemies after surrender. The nature of the 'war on pests' means that direct negotiated settlements would not be possible, but the relationship between the government agencies responsible for the 'war' and their detractors still needs to be considered.

It is here that the need for honesty and transparency by the government agencies is most apparent. The community as a whole needs to be able to trust its government if a healthy democracy is to be retained.

The lack of proper consultation (announcement of intent) and exaggerated claims and 'Jingoism' (Steer 2015) to justify eradication (right intention), does not engender trust in the government.

In addition, the use of child conscripts could have long lasting effects in future adult populations in reducing their empathy to animals and humans alike (Gullone and Roberston 2008).

Conclusions

There are a number of ways in which the self-described 'war' against the 'Big Three' species, and the plan for total eradication by 2050 falls short of the 'just war' ideal recognised by most Western societies, and codified in international law. Victims of the unjust war are not just animals, but human members of society. A summary of concerns is listed in Table 1.

It can be seen that the present strategy of complete elimination of so-called 'pests' by the extensive use of poisoning, as encouraged by government agencies (Wright 2011, 2013) is ethically flawed. A more holistic approach that

⁸ Article 8, Rome Statute of the International Criminal Court. <https://www.un.org/en/genocideprevention/war-crimes.shtml>.

Table 1 Summary of the way in which the ‘war’ on non-native mammals for ostensible reasons of conservation violates the conditions for a ‘just war’

Just war criterion	Violations
<i>Justification for war (jus ad bello)</i>	
Competent authority	Use of Private Military Contractors (PMCs)
Right intention	Intentions appear more related to protecting primary industries and the economy, not conservation Demonization of the enemy Exaggeration of enemy effects
Announcement of intent	No public consultation for the Predator Free 2050 plan
Last resort	No consideration of alternative means of non-lethal pest control No consideration of other alternative measures for conservation
Reasonable hope of success	Predator eradication is unrealistic
Proportionality	Diversion of resources from other conservation initiatives Desensitisation of PMCs, particularly children An idealistic ‘back to nature’ approach
<i>Right conduct in war (Jus in bello)</i>	
	Use of poisoned weapons Weapons causing ‘unnecessary suffering’ Humiliation of dead combatants
<i>Reconstruction of a post-war society (Jus post bello)</i>	
	Erosion of trust in government Future effects on empathy of PMCs, particularly children

takes into account the ecosystem, its members and the human society protecting it is required. The following policy changes would allow a more ‘compassionate conservation’ ethos (Wallach et al. 2018) to take hold in New Zealand.

1. An end to discourses of war, invasion and xenophobia (Potts 2009; Steer 2015). Evidence-based discourse on the way in which certain species are threatening conservation efforts are certainly appropriate, but must be presented in a more dispassionate manner.
2. Dead combatants should be treated with dignity.
3. Any wildlife control must be carried out under the guidance of professionals, licensed by the appropriate government agency, and informed by independent science.
4. All those licensed to perform wildlife control should be adults.
5. Wildlife control needs to be for the purposes of conservation only and not for primary productivity, Tb control or the economy. Culling possums for Tb control would require a different ethical framework and require an ethical analysis first (e.g. McCulloch and Reiss 2017b).
6. All control methods that cause prolonged suffering need to be discontinued. This would include not only the widely used 1080 toxin, but toxins such as brodifacoum, cholecalciferol and phosphorus.
7. Non-lethal alternatives to wildlife control need to be thoroughly researched.

8. The aim should shift from unrealistic total eradication to a holistic conservation strategy that incorporates lower levels of control with habitat regeneration and restoration and other strategies (Linklater and Steer 2018).
9. The aim should likewise shift from an approach of going 'back to (pre-colonial) nature', to one where nature is protected for human and non-human animals alike (Ellis 2015).
10. There should be consultation and open dialogue with the public on how best to achieve conservation aims. The Biodiversity discussion document (DoC 2019) provides a useful start for meaningful discussion.

In summary, while some killing may be an unfortunate price to pay to protect the environment and its 'taonga', it is important that we develop morally as a society and do not only become environmental zealots when we want to kill things.

Compliance with Ethical Standards

Ethical Statement This paper did not require any experimentation on human or non-human animals. No human or non-human animals were harmed during the research or writing process.

References

- Alterio, N., Moller, H., & Brown, K. (1999). Trappability and densities of stoats (*Mustela erminea*) and ship rats (*Rattus rattus*) in a South Island *Nothofagus* forest, New Zealand. *New Zealand Journal of Ecology*, 23, 95–100.
- Antonelli, A., Humphrey, A. M., Lee, W. G., & Linder, H. P. (2011). Absence of mammals and the evolution of New Zealand grasses. *Proceedings of the Royal Society B*, 278, 695–701.
- Bassett, S. (2012). *Operation nest egg incubation and chick rearing best practice and protocols*. Wellington: Department of Conservation.
- Beausoleil, N. J., Fisher, P., Warburton, B., & Mellor, D. J. (2010). How humane are our pest control tools? Part 1. Vertebrate toxic agents and kill traps in mammal species. Unpublished report prepared for Biosecurity New Zealand, project no. 11326. 86 p.
- Blackie, H. M., MacKay, J. W. B., Allen, W. J., Smith, D. H. V., Barrett, B., Whyte, B. I., et al. (2014). Innovative developments for long-term mammalian pest control. *Pest Management Science*, 70, 345–351.
- Buckley, T. R., Krosch, M., & Leschen, R. A. B. (2015). Evolution of New Zealand insects: Summary and prospectus for future research. *Austral Entomology*, 54, 1–27.
- Burkhardt, J. (2017). From the editor: Preface to this special issue on animal welfare impact assessment. *Journal of Agricultural and Environmental Ethics*, 30, 465–468.
- Byrom, A. E., Innes, J., & Binny, R. N. (2016). A review of biodiversity outcomes from possum-focused pest control in New Zealand. *Wildlife Research*, 43, 228–253.
- Campbell, L. B. (2011). Just war, legitimate authority and non-state actors. Master of Arts thesis in Political Science, Kansas City, Missouri.
- Campbell, K. J., Beek, K. J., Eason, C. T., Glen, A. S., Godwin, J., Gould, F., et al. (2015). The next generation of rodent eradications: Innovative technologies and tools to improve species specificity and increase their feasibility on islands. *Biological Conservation*, 185, 47–58.
- Caut, S., Casanovas, J. G., Virgos, E., Lozano, J., Witmer, G. W., & Courchamp, F. (2007). Rats dying for mice: Modelling the competitor release effect. *Austral Ecology*, 32(8), 858–868.
- Childress, J. F. (1978). Just war theories: The bases, interrelations, priorities and functions of their criteria. *Theological Studies*. <https://doi.org/10.1177/004056397803900302>.

- Coleman, J. D., & Forsyth, D. M. (2007). *Review of research into alternatives to the use of 1080 for management of browsing damage by mammals in Tasmania*. Hobart: Prepared for Department of Primary Industries and Water.
- Cowan, P. E. (1990). Brushtail possum. In C. King (Ed.), *The handbook of New Zealand mammals* (pp. 68–98). Oxford: Oxford University Press.
- Cowan, P. E. (2005). Brushtail possum. In C. King (Ed.), *The handbook of New Zealand mammals* (2nd ed., pp. 56–80). Melbourne: Oxford University Press.
- Department of Conservation (DoC). (2000). *New Zealand biodiversity strategy 2000–2020*. Wellington: New Zealand Government.
- Department of Conservation (DoC). (2019). *Te koira o te koiora: Our shared vision for living with nature: A discussion document proposal for a biodiversity strategy for Aotearoa New Zealand*. Wellington: New Zealand Government.
- Dubois, S., Fenwick, N., Ryan, E. A., Baker, L., Baker, S. E., Beausoleil, N. J., et al. (2017). International consensus principles for ethical wildlife control. *Conservation Biology*, *31*, 753–760.
- Eason, C. T., Miller, A., MacMorran, D. B., & Murphy, E. C. (2014). Toxicology and ecotoxicology of para-aminopropiophenone (PAPP)—A new predator control tool for stoats and feral cats in New Zealand. *New Zealand Journal of Ecology*, *38*, 177–188.
- Ellis, E. C. (2015). Ecology in an anthropogenic biosphere. *Ecological Monographs*, *85*, 287–331.
- Esvelt, K. M., & Gemmel, N. J. (2017). Conservation demands safe gene drive. *PLoS Biology*, *15*(11), e2003850. <https://doi.org/10.1371/journal.pbio.2003850>.
- Garner, R. (2017). Bovine TB, badger culling and applied ethics: Utilitarianism, animal welfare and rights. *Journal of Agricultural and Environmental Ethics*, *30*, 579–584.
- Gemmel, N. J., Jalilzadeh, A., Didham, R. K., Soboleva, T., & Tomkins, D. M. (2013). The Trojan female technique: A novel, effective and humane approach for pest population control. *Proceedings of the Royal Society B*, *280*, 2013–2549.
- Gormley, A. M., Anderson, D. P., & Nugent, G. (2018). Cost-based optimization of the stopping threshold for local disease surveillance during progressive eradication of tuberculosis from New Zealand wildlife. *Transbound Emerging Diseases*, *65*, 186–196.
- Griffiths, J. W., & Barron, M. C. (2016). Spatiotemporal changes in relative rat (*Rattus rattus*) abundance following large-scale pest control. *New Zealand Journal of Ecology*, *40*, 371–380.
- Gullone, E., & Roberston, N. (2008). The relationship between bullying and animal abuse behaviors in adolescents: The importance of witnessing animal abuse. *Journal of Applied Developmental Psychology*, *29*, 371–379.
- Harper, G. A., & Rutherford, M. (2016). Home range and population density of black rats (*Rattus rattus*) on a seabird island: A case for a marine subsidised effect? *New Zealand Journal of Ecology*, *40*, 219–228.
- Hawkins, R. D., Williams, J. M., & Scottish Society for the Prevention of Cruelty to Animals. (2017). Assessing effectiveness of a nonhuman animal welfare education program for primary school children. *Journal of Applied Animal Welfare Science*, *20*, 240–256.
- Holm, N. (2015). Consider the possum: Foes, anti-animals, and colonists in paradise. *Animal Studies Journal*, *4*, 32–56.
- Hursthouse, R. (1999). *On virtue ethics*. Oxford: Oxford University Press.
- Innes, J. (2005). Ship rat. In C. King (Ed.), *The handbook of New Zealand mammals* (2nd ed., pp. 187–203). Melbourne: Oxford University Press.
- Innes, J., Brown, K., Jansen, P., Shorten, R., & Williams, D. (1996). *Kokako population studies at Rotoehu Forest and on Little Barrier Island*. Science for Conservation Series 30. Wellington: NZ Department of Conservation.
- Innes, J., Hay, R., Flux, I., Bradfield, P., Speed, H., & Jansen, P. (1999). Successful recovery of North Island kokako *Callaeus cinerea wilsoni* populations, by adaptive management. *Biological Conservation*, *87*, 201–214.
- Ji, W. (2009). A review of the potential of fertility control to manage brushtail possums in New Zealand. *Human-Wildlife Conflicts*, *3*, 20–29.
- Joy, M. (2015). *Polluted inheritance. New Zealand's fresh water crisis*. Wellington: Bridget Williams Books.
- King, C. (2005). *The handbook of New Zealand mammals* (2nd ed.). Melbourne: Oxford University Press.
- King, C., & Murphy, E. (2005). Stoat. In C. King (Ed.), *The handbook of New Zealand mammals* (2nd ed., pp. 204–221). Melbourne: Oxford University Press.

- Lawson, B. M. H. (2005). The war of the roses: Demilitarizing invasion biology. *Frontiers in Ecology and the Environment*, 3, 495–500.
- Leopold, A. (1949). *A sand county almanac*. Oxford: Oxford University Press.
- Linklater, W., & Steer, J. (2018). Predator Free 2050: A flawed conservation policy displaces higher priorities and better, evidence-based alternatives. *Conservation Letters*. <https://doi.org/10.1111/conl.12593>.
- McCulloch, S. P., & Reiss, M. J. (2017a). Bovine tuberculosis and badger culling in Britain: Science, policy and politics. *Journal of Agricultural and Environmental Ethics*, 30, 469–484.
- McCulloch, S. P., & Reiss, M. J. (2017b). The development of an Animal Welfare Impact Assessment (AWIA) tool and its application to bovine tuberculosis and badger control in England. *Journal of Agricultural and Environmental Ethics*, 30, 485–510.
- Meads, M. J., Walker, K. J., & Elliot, G. P. (1984). Status, conservation and management of land snails of the genus *Powelliphanta* (Mollusca: Pulmonata). *New Zealand Journal of Zoology*, 11, 277–306.
- Mittermeier, R. A., Turner, W. R., Larsen, F. W., Brooks, T. M., & Gascon, C. (2011). Global biodiversity conservation: The critical role of hotspots. In F. E. Zachos & J. C. Habel (Eds.), *Biodiversity hotspots: Distribution and protection of conservation priority areas* (pp. 3–22). Dordrecht: Springer.
- Montague, T. L. (2000). *The brushtail possum: Biology, impact and management of an introduced marsupial*. Lincoln: Manaaki Whenua Press.
- Morgan, D. R. (1981). Predation on a sparrow by a possum. *Notornis*, 28, 167–168.
- Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. B., & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403, 853–858.
- Ngai, T. C. (2019). Was Iraq war a “just war” or just a war. An analysis from the perspective of just war theory. *Open Journal of Political Science*, 9, 373–382.
- Noble, C., Min, J., Olejarza, J., Buchthal, J., Chavez, A., Smidler, A. L., et al. (2019). Daisy-chain gene drives for the alteration of local populations. *Proceedings of the National Academy of Sciences*, 116, 8275–8282.
- Park, G. (1995). *Ngā Uruora: Ecology and history in a New Zealand landscape*. Wellington: Victoria University Press.
- Parliamentary Commissioner for the Environment (PCE). (2004). *Growing for good: Intensive farming, sustainability and New Zealand's environment*. Wellington: PCE.
- Payton, I. (2000). Damage to native forests. In T. L. Montague (Ed.), *The brushtail possum: Biology, impact and management of an introduced marsupial* (pp. 111–125). Lincoln: Manaaki Whenua Press.
- Pickett, S. T. A. (2013). The flux of nature: Changing worldviews and inclusive concepts. In R. Rozzi, S. Pickett, C. Palmer, J. Armesto, & J. Callicott (Eds.), *Linking ecology and ethics for a changing world. Ecology and ethics* (Vol. 1). Dordrecht: Springer.
- Potts, A. (2009). Kiwis against possums; a critical analysis of anti-possum rhetoric in Aotearoa New Zealand. *Society and Animals*, 17, 1–20.
- Rolston, H. (1996). Feeding people versus saving nature? In William Aiken & Hugh LaFollette (Eds.), *World hunger and morality* (2nd ed., pp. 244–263). Upper Saddle River: Prentice-Hall.
- Roy, E. A. (2017). New Zealand's possum war: 'barbaric' drowning of babies at school fair sparks outcry. *The Guardian* 5 July 2017. <https://www.theguardian.com/world/2017/jul/05/new-zealands-possum-war-barbaric-drowning-of-babies-at-school-fair-sparks-outcry>.
- Ruscoe, W. A., & Murphy, E. C. (2005). House mouse. In C. King (Ed.), *The handbook of New Zealand mammals* (2nd ed., pp. 203–221). Melbourne: Oxford University Press.
- Ruscoe, W. A., Ramsey, D. S. L., Pech, R. P., Sweetapple, P. J., Yockney, I., Barron, M. C., et al. (2011). Unexpected consequences of control: Competitive vs. predator release in a four-species assemblage of invasive mammals. *Ecology Letters*, 14, 1035–1042.
- Russell, J. C., Innes, J. G., Brown, P. H., & Byrom, A. E. (2015). Predator free New Zealand: Conservation country. *BioScience*, 65(5), 520–526.
- Sadler, R. (2000). Evidence of possums as predators of native animals. In T. L. Montague (Ed.), *The brushtail possum: Biology, impact and management of an introduced marsupial* (pp. 126–131). Lincoln: Manaaki Whenua Press.
- Scofield, P., & Stephenson, B. (2013). *Birds of New Zealand: A photographic guide*. Auckland: Auckland University Press.
- Smith, D., Wilson, D., Moller, H., Murphy, E., & Pickerell, G. (2008). Stoat density, diet and survival compared between alpine grassland and beech forest habitats. *New Zealand Journal of Ecology*, 32, 166–176.

- SPCA (Society for the Prevention of Cruelty to Animals). (2019). 1080—What is it, and what can be done about it? <https://www.sPCA.nz/news-and-events/news-article/1080-what-is-it-and-what-can-be-done-about-it>.
- Steer, J. (2015). The reconciliation of introduced species in New Zealand: Understandings from three 'exceptional' case studies. Ph.D. thesis, University of Auckland.
- Sweetapple, P. J., Ruscoe, W. A., & Nugent, G. (2013). Dietary changes in response to population reduction in the possum *Trichosurus vulpecula* in New Zealand. *Wildlife Research*, *40*, 561–569.
- Tulloch, L. (2018). Teaching our kids to kill in name of conservation. *Stuff*, 22 January 2018. <https://www.stuff.co.nz/environment/100695495/teaching-our-kids-to-kill-in-name-of-conservation>.
- Wallach, A. D., Beckoff, M., Batavia, C., Nelson, M. P., & Ramp, D. (2018). Summoning compassion to address the challenges of conservation. *Conservation Biology*. <https://doi.org/10.1111/cobi.13126>.
- Warburton, B., Cowan, P., & Shepherd, J. (2009). How many possums are now in New Zealand following control and how many would there be without it. Landcare research contract report LC0910/060.
- Weaver, S. E. (2006). Chronic toxicity of 1080 and its implications for conservation management: A New Zealand case study. *Journal of Agricultural and Environmental Ethics*, *19*, 367–389.
- Witmer, G. W., Raymond-Whish, S., Moulton, R. S., Pyzyna, B. R., Calloway, E. M., Dyer, C. A., et al. (2017). Compromised fertility in free feeding of wild caught Norway rats (*Rattus norvegicus*) with a liquid bait containing 4-vinylcyclohexene diepoxide and triptolid. *Journal of Zoo and Wildlife Medicine*, *48*, 80–90.
- Worster, D. (1994). *Nature's economy: A history of ecological ideas* (2nd ed.). Cambridge: Cambridge University Press.
- Wright, J. (2011). *Evaluating the use of 1080: Predators, poisons and silent forests*. Wellington: Parliamentary Commissioner for the Environment.
- Wright, J. (2013). *Update report: Evaluating the use of 1080*. Wellington: Parliamentary Commissioner for the Environment.
- Wyse, S. V., Wilmshurst, J. M., Burns, B. R., & Perry, G. L. W. (2018). New Zealand forest dynamics: A review of past and present vegetation responses to disturbance, and development of conceptual forest models. *New Zealand Journal of Ecology*, *42*, 87–106.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.