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The Ethical Cost of Predator Free New Zealand 2050: Suffering in the name of Conservation

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The Predator Free 2050 (PF 2050) programme aims to eradicate key introduced mammals of New Zealand by 2050 in order to conserve endangered species. This is mainly done by the aerial spreading of 1080 and other poisons. This eradication programme causes a prolonged death agony of intense suffering for millions of animals. Besides target animals such as possums, rats and stoats, poison victims also include native endangered birds, farm animals and companion animals, in particular dogs. I explain why this approach is unethical, unnecessary and unrealistic. I argue for an immediate ban of these poisons and state that PF 2050 has a one-sided focus on introduced mammals, rather than considering other causes such as habitat destruction and dairy farming which are greatly impactful. The New Zealand government should invest in alternative, compassionate conservation solutions, such as fenced sanctuaries, birth control methods and translocations.[1]

Predator Free 2050

In 2012 the late physicist Sir Paul Callaghan called for an 'Apollo Programme' for New Zealand, which was namely the elimination of introduced mammals which were held responsible for bringing many native species in jeopardy. The work by the Parliamentary Commissioner for the Environment, Jan Wright, has been the main catalyst resulting in the PF 2050 strategy.[2] Wright has directed the attention to possums, rats and stoats in particular, which she thinks of as an "evil triumvirate."[3] Wright recommends eradicating these animals by using the poison 1080, which is seen as the only cost-effective solution to reach this target. PF 2050 has been called "the world's most ambitious predator management programme" by Minister of Conservation Maggie Barry.[4] The goal of this programme is indeed enormous, given the large size of New Zealand.

It is beyond doubt that many species in New Zealand are threatened with extinction. In a 2010 study of 179 countries, New Zealand holds the worst place in terms of its proportion of threatened species.[5] The New Zealand Threat Classification System shows that 3,747 or 35% of

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[1] I am very grateful to Dr. Jane Goodall for our conversations on this topic, her sharing of information and commenting upon several drafts of this article. My sincere thanks also to Prof. Dr. Marc Bekoff, with whom I chair the Ethics Committee of the Jane Goodall Institute Global, for the information he shared with me and for reviewing this article. He is one of the few people who is writing on this underexposed topic on the international level (see for example Bekoff, 2020 and Bekoff, 2022). Thank you to Sarah Wertkin, who serves on committees of the Jane Goodall Institute Global and holds a degree in anthrozoology, for proofreading this text.

[2] See in particular Brown *et al.*, 2015: 17, Wright, 2011, Wright, 2013, Wright, 2014 and Wright, 2017.

[3] Ibid., 2014: 3.

[4] Anonymous, 2016: 3.

[5] Bradshaw *et al.*, 2010: 8.

New Zealand's native species are at risk or threatened with extinction. At least 75 native animal and plant species have become extinct since the arrival of humans in New Zealand.[6] Is this all due to the introduction of predators? If so, is poisoning with 1080 a justification, or should we opt for other solutions?

During lectures in New Zealand, Jane Goodall has been asked repeatedly about her thoughts on the killing of introduced predators. While recognizing the impact of introduced species, Goodall called for finding more humane ways than poisoning.[7] Goodall commented:

"For many years I have been devastated by the cruel methods used to kill predators because of their supposed danger to livestock or human life – such as leg hold traps or poison baits. Only too often the targeted animals die slow deaths in extreme pain. Moreover other non-target animals are often killed in the same way.

The campaign in New Zealand to exterminate all non-native animals in order to save the country's unique indigenous species from invasive species who were introduced, intentionally or unintentionally, relies on the use of poisons which are known to cause intense suffering and agonizing deaths. As I read more and more about this plan I became increasingly concerned. And I was deeply shocked when I learned that school children were told that possums were evil and taught to kill them in any number of cruel ways.

Dr. Koen Margodt is an independent scientist who I asked to sit on the Ethics Committee of the Jane Goodall Institute Global. And this paper is the result of his intensive research into the ethics of the New Zealand campaign, the impact of these poisons on the ecosystem, if the strategy was likely to succeed, and alternative ways of controlling introduced species."[8]

Is 1080 a 'Humane' Poison?

The standard technique for erasing introduced species is by using the 1080 poison, or sodium fluoroacetate. This poison is applied in cereal or carrot baits and spread over large areas by helicopter. This pesticide is mainly used in New Zealand, which uses around 80% of the world production of 1080, and to a lesser extent in Australia, Israel and the United States.

For many years, the Tull Chemical Company in the United States has been producing 1080. In New Zealand, 1080 is manufactured in pellet forms by Animal Control Products Ltd / Orillion. China also appears to play a role in the manufacturing of 1080 for New Zealand.[9]

On the cellular level, 1080 inhibits energy production for normal cell function, which results in the accumulation of citrate in blood and tissues. As a result, without energy, cells die and animals die from gradual cardiac failure, progressive depression of the central nervous system or respiratory arrest following severe convulsions.[10]

Wright notes that "A pest control method should kill possums, rats and stoats humanely" and their "death should not be lingering and painful".[11] However, in her 85 pages report of 2011, she only reserves a single page for welfare considerations related to 1080. Referring to a report

[6] Ministry for the Environment & Stats NZ, 2019: 17.
[7] See O'Callaghan, 2019.
[8] Personal communication, 31 July 2022.
[9] Mason, 2013, McQueen, 2017: 13, Mills, 2014 and Ross & Eason, 2021: 10. See also https://orillion.com/products/ and https://pestoff.co.nz/about/.
[10] Eason *et al.*, 2011: 1-2.
[11] Wright, 2011: 34.

commissioned by the National Animal Welfare Advisory Committee (NAWAC), she writes that the "NAWAC report rated 1080 as moderately humane."[12]

I disagree with Wright's interpretation of the NAWAC report. The NAWAC report nowhere assesses 1080 as 'moderately humane', quite on the contrary. Authors Ngaio Beausoleil (Massey University) and colleagues remark that poisons cannot be humane, as this would mean that these would not have a negative impact on the animal. They write that it would be more accurate to have rankings from "most to least inhumane".[13] They evaluated different poisons and gave these an overall grade from 1 to 8, with a higher number indicating a higher, negative animal welfare impact. The impact of the poisons was also scored as No, Mild, Moderate, Severe or Extreme.

The impact score of 1080 for the target animals (possums, rats and stoats) varies between 6 and 6.5 on a maximum of 8. The overall impact goes from 'severe' to 'severe to extreme' and it lasts hours before these animals die (see Table 1). It is difficult to imagine how Jan Wright can call such a detrimental impact 'moderately humane'.

Assessment of Welfare Impact of 1080 (based upon Beausoleil et al., 2010)			
	Relative Animal Welfare Impact (1-8; 8 is most negative)	**Impact of Poisons**	**Duration**
Possums, Rabbits and Rodents	6/8	Severe	Hours
Carnivores	6.5/8	Severe to Extreme	Hours

Table 1

Possums are likely to consciously experience "nausea, lethargy/weakness, sickness and pain"[14]. Signals include retching, vomiting, lack of coordination, spasms and tremors. Rats "were considered to experience severe pain, nausea, sickness, breathlessness and anxiety for hours"[15]. Literature is referred to which describes poisoned black rats behaving depressed, hypersensitive to touch and light, showing regular convulsions and "suddenly squealing, sometimes rapidly circling the cage or gripping the cage wire with their front feet or teeth, and, while lying on their sides or backs, making rapid paddling motions"[16]. Carnivores "likely experience severe to extreme nausea, lethargy, sickness and breathlessness."[17]

Charles Eason (Lincoln University) and colleagues also published an evaluation of the toxicology of 1080. The researchers doubt calling 1080 a humane poison, as this is partly based upon subdued behavior in herbivores and statements that carnivores in the final stages of poisoning can't experience pain due to having entered a state of unconsciousness. Also, the existence of poisons that are even more detrimental from a welfare perspective, such as brodifacoum, may result in seeing 1080 as more humane.

[12] Ibid.: 52.
[13] Beausoleil *et al.*, 2010: 96.
[14] Ibid.: 25.
[15] Ibid.: 92.
[16] McIlroy (1982) in ibid.: 50.
[17] Ibid.: 93.

In possums the onset of illness lasts about two hours. Sickness behavior lasts about nine hours and possums die on average after 11.5 hours. Eason and colleagues write that in "carnivores, and notably in dogs, central nervous system disturbances are marked, and poisoned dogs run uncontrollably, retch and vomit, and appear distressed and agitated with prolonged involuntary muscle contractions exacerbated by convulsions and seizures prior to death from respiratory failure."[18] Even more than two months after a 1080 operation dead possums have been shown to pose a serious risk to dogs.

In her book *The Quiet Forest: the Case against Aerial 1080* Fiona McQueen, a professor in rheumatology, shares various testimonies of dogs responding to primary or secondary poisoning related to 1080. She refers to the experience of a West Otago family, as described by Tony Orman in the September 2015 edition of *NZ Dog's World*. The family had been on a hunting trip in a region that had been declared safe, several months after a 1080 drop. Upon their way home, their dogs became "crazed with pain" and "started chewing through the wire mesh separating them from the family."[19] Later that evening the black Labrador Ice "started howling and barking. She was reportedly "maddened with the pain" to the extent that she "snapped her metal chain and crashed through the glass door from the porch into the house.""[20] All dogs had to be put down.

An early morning in 2015, Penelope Young's family awoke due to their three-year-old black Labrador Lulu's "ferocious barking". Young witnessed that Lulu "was running around banging into things, shaking and frothing." Attempts to make Lulu vomit were to no avail. "She ran off into the darkness and we heard a splash. Then nothing. Lulu had died in her favourite swimming hole."[21] Young says that her children (aged 5, 7 and 8) were traumatized and were having nightmares about Lulu's death, whom they considered as a family member. Lulu had retrieved a possum's carcass on their property, which boarders the Hunua Ranges. Before reopening the area to the public, the Auckland City Council reportedly dropped some fifty tons of 1080 bait over 21,500 hectares in the Hunua Ranges in August and September. A toxicology test supported the diagnosis of 1080 poisoning.

Unfortunately, the New Zealand authorities do not maintain dog poisoning records, though no less than 254 dogs were reported to have been killed due to 1080 between 1960 and 1976.[22] Wright writes in 2011 that only eight dogs have died because of 1080 over the last four years. Remarkably, a 2011 survey indicates that many more dogs died of 1080: "In 2011, Otago University's School of Pharmacy and the National Poisons Centre surveyed 125 veterinarians. Only 52 replied to the postal survey, but these reported that they had seen 65 dog deaths related to 1080 in their practices over the previous 12 months."[23]

Possum baits containing 1080 can kill over 90% of deer populations, though commonly this ranges between 30% and 60% of the population. An aerial 1080 drop in October 2017 over Marlborough's Molesworth Station resulted in hundreds of deer dying or around 90% of the

[18] Eason *et al.*, 2011: 6.
[19] McQueen, 2017: 129.
[20] Ibid.
[21] Anonymous, 2015. Also reported in ibid.
[22] Eason *et al.*, 2011: 13.
[23] McQueen, 2017: 129.

population. A second drop, in Timaru Creek near Lake Hawea, killed 90-95% of the deer population. Adding deer repellent reduced mortality, but still 50-62% of the deer were killed.[24]

Eason and colleagues mention that 1080 can be lethal for various other animals as well, including goats, cows, sheep, rabbits, pigs and cats. Also, sub-lethal consequences should not be overlooked, as animal studies have shown that repeated exposure to 1080 can affect the skeleton, muscles, testes, heart, lungs, liver, kidney and fetus. They warn that "risk communicators must take care not to trivialise the toxicity of 1080".[25]

Is 1080 dangerous for humans? Yes, Wright acknowledges that seven baits could kill an adult and a single bait could seriously harm a child. She adds that only one person is known to have died after eating 1080-laced jam bait (which is now banned).[26]

In July 2021 Christchurch company Pest Control Research Ltd was fined $275,000 because a worker was poisoned in 2019 and nearly lost his life after exposure to highly toxic vapor linked to the manufacture of 1080. Waikato Regional Councilor Kathy White commented that fluoroacetate values in his urine were 500 times higher than WorkSafe's Biological Exposure Index (BEI) limit. He had to spend four weeks in hospital and another two months recuperating out of hospital. According to WorkSafe's head of specialist interventions, Catherine Gardner, "Health and safety requirements were not met from the very start of the project" and "he was extremely lucky to survive". The facility had no signs of 1080 on the outside of the building, was located next to a children's swimming pool and ventilation seemed to consist of merely opening a roller door.

Councilor White commented that "New Zealand has a history of understating the risks with 1080" and "There's a lack of transparency around the risks of 1080 poisoning in this country."[27] Urine testing of workers over a ten-year period resulted in 143 people testing positive, of whom 24 were above the BEI limit. White adds that a family from Putāruru were in a coma for weeks after eating a wild boar curry. Even though 1080 poisoning was indicated as a likely cause, no testing took place until 18 days later. Furthermore, "When one South Island regional council killed 142 sheep in a poison operation gone wrong, they offered compensation on condition of confidentiality."[28]

Reports exist of human exposure in China, which are "probably linked to poor handling and inadequate safety procedures associated with its unregulated or illegal use."[29] Over a period of two years, not fewer than 68 patients have been reported with characteristics of fluoroacetate poisoning from the Habin Medical University. Unfortunately, as of today there is still no effective antidote for 1080 poisoning.[30]

1080's Twin Poison – Brodifacoum

Two poisons have been registered for aerial distribution in New Zealand – 1080 and brodifacoum. The DOC wrote in 2017 that aerial baiting with brodifacoum is the most common

[24] Ross & Eason, 2021: 37. Visual footage of animals dying due to 1080 poisoning can be seen in the documentary *Poisoning Paradise: Ecocide New Zealand* by Clyde and Steve Graf from 2009 (https://www.youtube.com/watch?v=3gy6qBJtmtQ&t=4209s).
[25] Eason *et al.*, 2011: 14 and ibid.: 25. See also Wright, 2011: 50.
[26] Wright, 2011: 49.
[27] Kathy White as quoted in Campbell, 2021: 9.
[28] Ibid.
[29] Ross & Eason, 2021: 10.
[30] Ibid.: 15-16 and 18.

method and the current agreed best practice for islands. Between 1997 and 2017, 49 New Zealand islands have been treated by means of aerial baiting with brodifacoum.[31]

Wright writes in 2017 that aerial broadcast of brodifacoum has been seldomly used on the mainland and only within fenced areas.[32] However, her report does not mention anything about using brodifacoum in *ground* operations. Russell and colleagues write in 2015 in *BioScience* that brodifacoum and other anticoagulants are widely used for control in mainland homes, businesses and fragmented natural habitats.[33] John Parkes and colleagues note that leg-hold traps and hand-laid toxins such as brodifacoum and cyanide are used on farmlands and adjacent areas to suppress possums because of risk of bovine tuberculosis.[34] Ravneel Chand and Belinda Cridge write in 2020 that "many regional councils in New Zealand have favored the use of brodifacoum for pest control given its availability and ease of application"[35]. And James Ross and Charles Eason write in 2021 that "More recently, research teams have discussed adopting island eradication techniques on the NZ mainland using aerial brodifacoum."[36]

If anything, brodifacoum is even more cruel than 1080. The report written by Beausoleil and colleagues rates the welfare impact of brodifacoum on target species between 7.5 and 8 on a maximum of 8, the overall impact Severe to Extreme and the duration until death days to weeks (see Table 2). In possums "haemorrhaging commonly occurred in locations likely to cause severe pain and other negative experiences such as breathlessness e.g. abdomen, lungs, heart, muscles, gut and reproductive organs. There is no evidence of reduced consciousness before death and severe to extreme negative affective states are likely to be experienced. These include: pain due to hemorrhaging; lethargy and weakness due to blood loss; and breathlessness if haemorrhaging occurs in respiratory structures."[37]

Assessment of Welfare Impact of Brodifacoum (based upon Beausoleil et al., 2010)			
	Relative Animal Welfare Impact (1-8; 8 is most negative)	**Impact of Poisons**	**Duration**
Possums	8/8	Severe to Extreme	Days to Weeks
Rodents	7.5/8	Severe to Extreme	Days
Carnivores	7.5/8	Severe to Extreme	Days to Weeks

Table 2

Similar descriptions are given for other animals. Rats become anorexic for several days before death and remain conscious until death. Also in carnivores there is no indication of reduced consciousness. "Ferrets and cats likely experience severe to extreme pain and lethargy for days to

[31] Broome *et al.*, 2017: 8-9 and 19.
[32] Wright, 2017: 114.
[33] Russell *et al.*, 2015: 522.
[34] Parkes *et al.*, 2017: 154.
[35] Chand and Cridge, 2020: 6.
[36] Ross & Eason, 2021: 39.
[37] Beausoleil *et al.*, 2010: 35.

weeks, as well as breathlessness if haemorrhages involve respiratory structures."[38] Nevertheless, as recently as 2017 Wright calls brodifacoum only "relatively inhumane"[39]

Why use brodifacoum at all, if it has such a detrimental welfare impact and 1080 is available anyway? Graham Nugent (Landcare Research) and colleagues explain that usually some animals survive 1080 because they have only eaten a limited amount of bait. Research has shown that such "sub-lethal poisoning often resulted in a strong and long-lasting (>2 years) aversion to the bait used to poison them, and that this learned aversion was not easily overcome."[40] The long interval between intake of the poison and the appearance of sickness symptoms makes brodifacoum more effective when aiming for the killing of all target animals. This shows at once a major flaw in the PF 2050 programme – *using 1080 alone will not do the job*. It depends upon brodifacoum and therefore these can be called twin poisons.

Impact on Native Animals and the Environment

What about the impact of 1080 and brodifacoum on native species and the environment? Conservation in New Zealand is approached as a cost-benefit analysis, with a focus on total population numbers. The reasoning goes that in the end 1080 poisoning allows native species to become more numerous and that the poison disappears from the environment. However, the picture is more complex than this.

While it is acknowledged that poisons kill members of native species, it is also argued that the reduction of introduced predators ultimately results in a positive effect at the population level and therefore is a conservation success. For example, if 1080 were to kill 30 kea, which are large native parrots, in a population of 100, the predator reduction may still allow the population to bounce back to around 130 birds in total. This approach is ethically flawed, as it focuses only on the total population of kea, while neglecting the suffering of the individual birds.

The impact of 1080 on bird populations has changed over time due to the way 1080 has been spread, via carrot or cereal baits, which birds feed on. During the 1990s 1080 operations with carrot baits caused a 50% mortality in North Island robins and nearly a 80% mortality in tomtits, however, populations bounced back due to the bird's high reproductive rate and predator reduction. In the meantime, modifications to baits have reduced the mortality in birds. Eason and colleagues write that birds in general are less susceptible to 1080 than mammals, but responses vary per species. Symptoms of 1080 poisoning in birds include slowness, lack of balance, ruffled feathers, salivation, vomiting and – in the terminal phase – convulsions and coma. Apart from lethal effects, we also need to consider the sub-lethal effects of 1080 poisoning, such damage to the wing muscle.[41]

Clare Veltman and Ian Westbrooke (DOC) evaluated 48 surveys on the impact of 1080 poisoning in 13 native bird species. They indicate that the mortality is less than 4% in kiwi, kākā and kōkako. However, they also remark that the number of surveys has been small compared to the number of aerial 1080 baiting operations. During the period from 1998-2008, a total of 322 aerial 1080 baiting operations were undertaken on public conservation lands, in which only 15 operations banded or radio-carrying birds were observed. They add that many of the surveys had small sample sizes and that this creates a false sense of security: "small sample sizes meant we

[38] Ibid.: 93.
[39] Wright, 2017: 114.
[40] Nugent *et al.*, 2019: 1.
[41] Eason *et al.*, 2011: 3.

could not rule out rates of death greater than 20% in 21 (55%) of those cases."[42] Furthermore, they note that very few of the surveys were related to pre-feeding operations, even though the number of such operations increased to 80% in 2007-2008 and these may increase the risk of bird mortality (due to more bait consumed). Also, "11 native bird species for which deaths were reported after 1080 operations have not been studied"[43]. Veltman and Westbrooke advocate setting up long-term forest bird population monitoring at poisoned sites.

In March 2020, the DOC confirmed that six out of 12 monitored kea in the Matukituki valley in Aspiring National Park died from 1080 poisoning. DOC argued that overall, aerial 1080 operations benefit kea because of the reduction in rats and stoats. Also, DOC added that kea coming near humans are more at risk, as they learn to eat human food, whereas the risk to kea in remote areas is very low.[44] However, in July 2020 it was reported that three of the six kea with radio tracking were found dead after a 1080 operation in the *remote* Wet Jacket, Fiordland. Unfortunately, once again the monitored sample was small and DOC thus missed another chance for robust data collection – "Initially 21 kea were monitored in the area, but only six monitors were left active prior to the drop."[45] Kea are curious, highly intelligent parrots and therefore it should not come as a surprise that also in remote areas 1080 operations are killing several of these magnificent birds. Ten years after their article, the key recommendations by Veltman and Westbrooke still remain to be applied.

One of the reasons why New Zealand authorities prefer to use 1080 over other poisons is that they claim it has limited impact on the environment. Under favorable conditions, 1080 is broken down by soil microorganisms within one to two weeks. However, at colder temperatures (below 11° Celsius) breakdown may take several weeks, acknowledges Jan Wright, "in extremely dry and cold conditions, 1080 may remain in baits for several months."[46] Due to dilution 1080 is said to be detectable in water for only a limited amount of time (less than 24 hours).[47] The situation is worse for brodifacoum.

During the 1990s, brodifacoum was hailed as a milestone in reducing stoats through secondary poisoning.[48] However, this also affects other species, as Chand and Cridge explain: "brodifacoum can persist in possum carcasses for at least 8 mo[nths], placing predatory and scavenging birds such as weka, morepork, southern black-backed gull and Australasian harrier at significant risk of secondary poisoning (…)."[49] Wright confirms that "there is a very high risk of by-kill – at least 21 species of native birds including kiwi, kākā, kākāriki [New Zealand parakeet] and tūī are known to have been killed by brodifacoum."[50] She writes that it accumulates in the tissue of animals for years and stays in the soil and water for a long time. Therefore, the DOC recommended in 2002 using brodifacoum only sparingly.[51]

Unfortunately, poisons like brodifacoum have already spread widely across New Zealand, as researchers from the DOC acknowledge: "preliminary research suggests that residues of anticoagulant poisons (not just brodifacoum) are widespread in New Zealand fauna, although the

[42] Veltman & Westbrooke, 2011: 26.
[43] Ibid.: 21.
[44] Department of Conservation, 2020.
[45] Rowe, 2020.
[46] Wright, 2011: 44.
[47] Eason *et al.*, 2011: 9.
[48] Brown *et al.*, 2015: 20.
[49] Chand & Cridge, 2020: 6.
[50] Wright, 2011: 59.
[51] Brown *et al.*, 2015: 10.

consequences of the residues are little understood. This may undermine social license to use such toxins in the future."[52]

The War of Perception

I've mentioned that possums, rats and stoats have been called the 'evil triumvirate'. Expressions like "a good possum is a dead possum"[53] remind us of dark chapters of human history. A national campaign is calling for every Kiwi (or New Zealander) to support the total eradication of possums, rats and stoats. Introduced species are presented as pests, vermin – evil beings that deserve nothing less than being destroyed. The government, local authorities, industries, NGOs and *even* schools and youth organizations are involved and call for citizens, teenagers and children helping to kill the evil invaders.

PF 2050 is resulting in a witch hunt, where schools are actively involved. Schools organize hunts as fundraisers and children are encouraged to trap possums and rats. Some schools hold 'best dressed possum' competitions for children.[54] Schools set up obstacle courses, where children need to run and jump over obstacles while carrying dead possums. Kids are encouraged to kill rats and to partake in activities such as 'smashin' vermin'. Sometimes this goes beyond what is even legally permitted, like when a North Island school drowned joeys – the babies of possums – in a bucket of water. The joeys' mothers had been shot and their skins and fur were sold.[55]

New Zealand is at war with the species they have once introduced, as Michael Morris (Royal Agricultural University) highlights in the *Journal of Agricultural and Environmental Ethics*.[56] Presenting rats, possums and stoats as pests, vermin, evil predators that deserve to be exterminated is a highly distorted and unfair picture.

To begin, without the introduction by humans, rats, possums, stoats and numerous other species would not have been introduced intto New Zealand. Of course, some of these animals accidentally were brought over, and others intentionally. Only one species is morally responsible for this situation – humans.

Secondly, how could we possibly blame rats, possums and stoats for trying to survive? These species have adapted in ways to stay alive and predation is an important part of it, at least for rats and stoats (as possums are mainly herbivorous).

Third, the image created about rats, stoats and possums is very biased and one-sided. All of these are intelligent and sentient animals with rich emotional lives. Let us focus on rats for a moment. Jeffrey Burgdorf and Jaak Panksepp showed through elegant scientific experiments that rats have an affective preference for tickling above being lightly petted on the back. Rats being tickled vocalized 352% more than when petted – they emit 50-kHz ultrasonic vocalizations, inaudible to the human ear. These vocalizations are associated with a positive affective state, as these are typical for positive interactions such as play. Rats also run four times faster to a hand that will tickle them than to a petting hand. And rats significantly press more a bar resulting in tickling than a bar that has no such consequences.[57]

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[52] Ibid.: 25-26.
[53] Wright, 2011: 71.
[54] Tulloch, 2018.
[55] Roy, 2017.
[56] Morris, 2019.
[57] Burgdorf & Panksepp, 2001.

Research published in 2019 in *Science* demonstrates that rats quickly learn successfully alternating roles during hide-and-seek role play. The game was not based upon traditional food rewards, but on mere engagement in playful interactions with researchers. The researchers call rats 'strategic players', as they apply a variety of strategies during both seeking (such as systematic searches, using visual cues and targeting past hiding locations) and hiding (like being silent when hiding, changing hiding locations and preferences for opaque over transparent hiding locations). Upon being found, the rats would often run away and rehide – this prolonged the game but also delayed the reward. This behavior suggests that the game was experienced as being rewarding by itself. The researchers remark that 'the animals looked like they are having fun' – they would undertake frantic searches, tease the researchers and make 'joy jumps' ('freudensprünge'). They emitted ultrasonic sounds when finding a researcher, but remained silent when they were found. Their behavior is seen as purposeful and indicative of 'complex mental representations'. The researchers also observed intense neuronal activity in the medial prefrontal cortex, an area that is linked to perspective taking and social cognition.[58]

The war against possums, rats and stoats is not only worrisome from an animal welfare perspective, but also regarding the well-being of children and teenagers that need to participate in this campaign. Research by Michael Morris shows that "New Zealand appears unique in encouraging children to kill animals, as part of a government recruitment strategy"[59] rather than limiting killing operations to licensed adults. Government agencies and conservation NGOs collaborate to involve children in trapping and killing activities and emphasize that teachers should educate children about the importance of eradicating invasive predators. Morris notes that only few organizations and sources encourage a more critical and empathic attitude, such as the Jane Goodall Institute and the Science Learning Hub.[60]

Various parents and children despair due to the social pressure from peers, teachers and school authorities to participate in actions they consider repugnant or immoral themselves.[61] How does it affect a sensitive boy or girl, who feels empathy and sadness about killing possums, when adults pressure them to 'man up', decorate dead possums and humiliate them? What impact does this have on their further development?

Research with 267 undergraduates by Clifton Flynn shows that more than 70% of those who have witnessed animal abuse, report still being bothered years later.[62] Flynn notes that "Those who witnessed cruelty were more likely to be affected than those who actually perpetrated it" and "Witnessing the abuse and being helpless to prevent it may make the psychological impact even worse."[63]

Furthermore, violence towards animals tends to be linked to other forms of antisocial behavior.[64] Andrew Rowan reports that "It is implicitly assumed by humane educators that societal activities where animal abuse is either explicitly endorsed (…) or implicitly accepted, can have an adverse impact on the development of empathy for life and appropriate prosocial behavior."[65] Michael

[58] Reinhold *et al.*, 2019.
[59] Morris, 2021: 7.
[60] For Jane Goodall and the Jane Goodall Institute on the topic of introduced species and 1080 in New Zealand, see Bekoff, 2020 and O'Callaghan, 2019. For the Science Learning Hub, see https://www.sciencelearn.org.nz.
[61] Bekoff, 2017b.
[62] Flynn, 2000.
[63] Ibid.: 90.
[64] Bekoff, 2017a.
[65] Rowan, 2021.

Morris writes that "there is a well-established link between children abusing animals and becoming abusers of human and nonhuman animals as adults (…)."[66] He refers to research where it was "found that children who merely witnessed animal abuse were more likely to become animal abusers, even when the children had not been abused themselves."[67]

PF 2050 is undertaking a war of perception, which brings a highly distorted picture of rats, stoats and possums. It is befitting for a propaganda campaign aimed at stirring emotions of hate and disgust towards animals whom one wants to destroy. However, introduced animals are innocent victims of historical human decision-making. Furthermore, whatever strategy is chosen about handling introduced species, children and teenagers should never ever be involved in hunting, capturing, trapping or killing animals. Animal abuse can haunt them for many years. Schools should teach young people respectful attitudes towards animals and nature, based upon compassion and empathy, rather than putting their self-development into jeopardy.

Why PF 2050 is an Unrealistic, Unnecessary and Unethical Project

The PF 2050 poisoning strategy is (i) unrealistic, (ii) unnecessary and (iii) unethical. First, the poison strategy of the New Zealand authorities boils down to what Rob Fenwick, chairman of the Predator Free NZ Trust and a director of Predator Free 2050, has called a "project born in a leap of faith"[68]. Fenwick adds that the DOC admits that it cannot by itself win the "predator-free crusade" – the help of the community is needed – and that the budget is insufficient to win "this war"[69]. I believe the New Zealand authorities will never reach their **unrealistic** goal of removing all possums, stoats, rats and other introduced species from all of New Zealand and certainly not by 2050. The aim of removing introduced species fully from New Zealand will result in an eternal cycle of destruction, which will be extremely costly – both financially and ethically.

Scientists remark that the repeated use of 1080 does not kill all the animals, it is not feasible to trace all survivors, there is the development of strong bait shyness and there is immigration from neighboring areas by members of the same and other species. The DOC tempers expectations when they write in 2015: "While on islands eradication is feasible, control operations on the mainland aim to maintain pests below damage thresholds because of ongoing pest reinvasion."[70]

Note that this also makes it inherently attractive to cover as many areas as possible with poison, just to avoid thresholds of survival. However, Wright recognizes that medical officers need to set buffer zones around tracks, rivers and lakes used for drinking water.[71] Also, it is necessary to install large exclusion zones for areas where humans live and fields with cattle such as cows and sheep. These will remain territories from where reinvasion occurs.[72] Moreover, removal of the mentioned species is likely to have unintended consequences, such as attracting other introduced and unwanted mammals like mice, rabbits and cats.[73]

The support for aerial distribution of 1080 is largely driven by its presumed cost-efficiency. James Russell and colleagues wrote in 2015 that aerial distribution of poisons may cost only NZ$20 per

[66] Morris, 2021: 7.
[67] Ibid. See also Bekoff, 2022.
[68] Fenwick, 2017.
[69] Ibid.
[70] Brown *et al.*, 2015: 16.
[71] This results in tense situations, as when fishermen were upset in 2014 because of a helicopter dropping 1080 along the Mokihinui River. A senior policy adviser justified this because otherwise 'pests' would survive along the river banks (McQueen, 2017: 159).
[72] Ibid.: 163.
[73] Linklater & Steer, 2018, Nugent *et al.*, 2019 and Parkes *et al.*, 2017.

hectare. They conservatively estimate that a 50-year campaign would cost NZ$9.04 billion. However, by looking at *real* scenarios involving the need for *repeated* distribution of poisons, John Parkes and other researchers argue in 2016 in the *New Zealand Journal of Ecology* that the *minimum* cost would be NZ$1200 per hectare or NZ$32 billion across all of New Zealand.[74] They mention that this comes down to no less than 15% of New Zealand's gross domestic product.

Brian Owens wrote in 2017 in *Nature* that the "government and philanthropic groups have committed to donate about NZ$3 billion by the 2050 deadline"[75]. This covers only 30% of the calculations of Russell and less than 10% of those by Parkes. Both the practical infeasibility and the astronomic financial costs turn the PF 2050 project into a highly unrealistic endeavor.

Secondly, in order to save New Zealand's endangered species, it is **unnecessary** to cover the country with 1080 and other poisons. In a seminal article published in 2018 in *Conservation Letters*, conservationists and biodiversity experts Wayne Linklater and Jamie Steer argue that the focus on predator removal risks to detract from more important priorities: "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."[76] According to Linklater and Steer, the main causes for loss of biodiversity in New Zealand are "Habitat loss, pollution (especially of aquatic habitats), and urban and rural development."[77] Rather than putting a focus on a nationwide eradication of introduced species, they advise putting priority on biodiversity recovery through the protection and growth of habitat. They would limit predator control to biodiversity sanctuaries that need to provide a safe haven to endangered species.

In a 2019 report, the Ministry for the Environment described the decline of native ecosystems. It acknowledges among other things the loss of forests and wetlands. Whereas before humans arrived, 80% of New Zealand was covered by forests, nowadays this has shrunk to only 26%. Wetland areas have been reduced to a mere 10% compared to pre-human arrival and continue to decline. This is due to farming and urban expansion.[78]

Between 1994 and 2017, the number of dairy cattle in New Zealand increased by 70 percent to 6.5 million. Even though the number of sheep decreased, cattle excrete more nitrogen per animal. Both the area used for dairy farming and the number of cattle per hectare has increased. As a result, the total amount of nitrate-nitrogen leached from livestock has increased from 189,000 tons per year in 1990 to 200,000 tons per year in 2017. More than 80 percent of the river length in pastoral land areas turned out not to be suitable for swimming. Due to long lag times, the full impact of the environmental harm will take years or decades to become clear. And reversing this situation will be extremely expensive.[79]

Moreover, farming is an important cause of climate change. New Zealand has one of the highest greenhouse gas emissions rates per person, namely 17.5 tons of carbon dioxide equivalent greenhouse gasses per person. This is 33% higher than the average for industrialized countries. Nearly half of the emissions in New Zealand come from agriculture The distribution of some species is already shifting in New Zealand due to higher temperatures. It is estimated that this will

[74] Ibid.: 157.
[75] Owens, 2017: 150.
[76] Linklater & Steer, 2018: 1.
[77] Ibid.: 4.
[78] Ministry for the Environment & Stats NZ, 2019: 21-23.
[79] Ibid.: 35, 57-61 and Wright, 2014: 7.

also result in further spreading of introduced species, such as rats reaching higher elevations due to warmer temperatures, and the arrival of new species through the international shipping trade.[80]

Conservationists thus rightly indicate that the focus of attention needs to be on a wider approach to conserve New Zealand's biodiversity. 1080 will not stop the detrimental impact of intensive farming and climate change.

Third, PF 2050 creates tremendous and prolonged suffering in animals who ingest 1080 and other poisons, which is why this practice is highly **unethical** and disturbing. Advocates of PF 2050 emphasize the suffering of native birds killed by introduced predators, referring to an estimated yearly loss of some 25 million chicks and eggs of native bird species.[81] The vulnerability of these native island species, which have not evolved defense mechanisms against predators, adds an extra dimension of tragedy to this whole situation. However, the suffering of stoats, rats, possums and many other animals by poisons like 1080 and brodifacoum is way more intense and prolonged than the quick killing by a predator. The killing of birds and eating of eggs does not compare to the slow, horrendous, cruel and extremely painful death that may last for weeks due to poisoning.

Species conservation does not offer a carte blanche justification for the use of poisons. There are excellent reasons for conserving New Zealand's native species, including the well-being of its members, their ecological role and the many other ways these bring value. However, we should not take it for granted that species conservation simply overrules the interests of individuals. After all, enjoyment, suffering and a wide range of experiences all occur on the individual level – it is only individuals which have experiences, not species as such.

Humanity has become way more sensitive to animal suffering and rightly so. Conserving New Zealand's native species is of major importance, but this needs to be done in a compassionate and ethical way. Compassionate conservation takes into account the interests of members of both native species and of species introduced by humans.

Public opinion seems to become more critical regarding the 1080 topic. James Russell wrote in 2014 in the *Journal of the Royal Society of New Zealand* that the acceptability of poisons has declined between 1992 and 2012. A survey amongst 3000 adult New Zealanders learns that opposition against poisons such as 1080 increased with 9%, resulting in 42% of respondents believing that such poisons should be allowed, 40% believing these should not be allowed and 18% being undecided. More women were against the use of poisons than men and respondents who had visited a national park or forest area over the last five years were less likely to support the use of poisons.[82] In 2015 Russell and colleagues commented that "many people remain vehemently opposed to 1080, particularly against perceived "indiscriminate" aerial broadcast from helicopters, because of the collateral impacts on game animals and risks for dogs."[83]

Possums, Mice and Other Introduced Species

Besides possums, stoats and rats, there are many other introduced species that are considered pests. Moreover, it is even questionable if these top three are accurate in terms of threats posed towards native species. In a 2017 report, Wright wrote that it is now understood that, from these

[80] Christie *et al.*, 2017 and ibid., 2019: 19-24 and 92-103.
[81] Daly, 2019.
[82] Russell, 2014.
[83] Russell *et al.*, 2015: 522. New Zealand citizens also have written critical books on the 1080 topic – see Kelly, 2020, McQueen, 2017 and Robinson, 2017.

three species, rats and stoats have the largest impact on forest birds. As possums are herbivorous, they damage trees, but also are seen as a direct threat to birds by eating eggs, chick and occasionally adults of some birds. Nevertheless, their impact does not seem to compare to that of rats and stoats. Indeed, in an overview of causes leading to the extinction of nine native bird species, possums are only mentioned for one species (South Island kōkako) and this together with rats and stoats. Regarding the threat imposed to 14 existent forest birds, possums are never mentioned as the main predators, only as an additional threat.[84]

In the same report, Wright acknowledges that mice pose an important indirect threat to native threatened species, namely as a food source for stoats and through food competition by eating worms and insects. After a 1080 poisoning operation targeted animals always return. The increase of stoats may be mainly due to mice rather than rats: "In pure beech forests, it is mice rather than rats that undergo population irruptions and drive the increases in stoats."[85] When trees mast, these provide more fruit and seeds than normal. Unlike possums, who only have one or two young per year, mice populations thrive as a consequence. Due to such irruptions, Doug Armstrong (Massey University) and colleagues comment that "mice are so far the Achilles heel of many programmes"[86]. However, 1080 does not seem to have the desired effect on mice.

Since 1080 is not effective to handle mice irruptions, the method used instead is brodifacoum. For example, the Million Dollar Mouse Project aimed to remove all mice from the Antipodes islands, which lie 750 kilometers southeast of New Zealand. A dedicated website[87] explains that mice predate the eggs and chicks of seabirds and also eat large numbers of insects and the seeds of plants, thus competing with native species. The project is a collaboration between the DOC and partners such as the World Wildlife Fund and the Morgan Foundation. Though the website is very detailed, little is mentioned about how precisely the mice are removed. A flier states that the plan was to distribute 65,000 kg of rodent bait by helicopter over 2045 hectares through two bait treatments in 2016. Only when clicking an image of the treatment area, one can see in light gray that this bait contains 20 ppm brodifacoum, which I have highlighted above as an extremely inhumane poison.[88] As of 2018, the entire mouse population of 200,000 has been killed – though seen as a conservation success, this clearly came at a tremendous, unmentioned cost in terms of suffering.[89]

Unfortunately, the threat to New Zealand's native fauna and flora seems to go way beyond possums, rats, stoats and mice. Many other species have been introduced, intentionally or accidentally, in New Zealand and are considered a threat for native species. Species that are mentioned by Jan Wright and others include hedgehogs, cats, deer, pigs, goats, ferrets, weasels, rabbits, hares, wasps and dogs. Clearly, rats, possums and stoats are only the tip of the iceberg of species that the New Zealand authorities want to eradicate.

Ethical Alternatives for Saving Native Species

Are we facing a grueling dilemma in New Zealand between either using poisons to conserve native species or protecting introduced animals? Ethical alternatives exist and new methods can

[84] Brown *et al.*, 2015: 4, 7 and Wright, 2017: 45.
[85] Ibid., 2011: 75. See also ibid.: 54.
[86] Armstrong *et al.*, 2010: 272.
[87] http://milliondollarmouse.org.nz/.
[88] See http://milliondollarmouse.org.nz/first-treatment/ and http://milliondollarmouse.org.nz/second-total-bait-treatment/.
[89] Office of the Minister of Conservation, 2018.

be developed, but this requires that humans recognize that animals are sentient beings too and that their interests matter as well.

I plea to define key conservation areas to protect New Zealand's native species, habitats and biodiversity. Due to the conflict between introduced and native species, New Zealand should create a network of ecosanctuaries that are protected by various methods, such as (i) natural or artificial fences, (ii) birth control methods and (iii) translocations.

As a matter of priority, we need to get clarity on what areas need protection in order to conserve New Zealand's native species. Unfortunately, even after many decades of conservation efforts, this still remains largely unclear, as the DOC admits in a 2015 report: "We don't know how big an area needs to be managed to achieve protection of many of our threatened species. To date, little work has been carried out to determine minimum areas required for species persistence (MASPs). We need estimates of MASPs so we know the size of the area we must manage to ensure species persistence."[90]

Linklater and Steer plea with John Parkes and colleagues 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."[91] New Zealand is already building a growing **network of ecosanctuaries**, many of which are located on private land and interest is high.[92] However, the total area of ecosanctuaries is still limited to only 61,750 hectares or 0.2% of the New Zealand land area.[93] Besides finding out what surface is required for effective species conservation, I also plea to shift towards ethically sound methods to separate introduced from endangered species where needed.

How can endangered species be protected against predation within and around ecosanctuaries? Nearly all alternatives to poisoning would be less cruel. Apart from mentioning it, Jan Wright unfortunately did not give any further consideration to the option of adding painkillers to poisons. Also, other methods kill predators faster, such as automatically resetting, piston-driven killing traps.[94] However, we should raise the bar way higher and apply a combination of non-invasive methods, such as barriers, birth control and translocations.

A first key alternative for poisons is protecting members from endangered species through **predator-proof barriers**. These may be artificial (fences), but these may also be natural, such as mountains or lakes. An example is New Zealand's Shakespear Open Sanctuary. This 500 hectare peninsula is mainly surrounded by sea, so it sufficed to erect a fence of only 1.7 km long in order to prevent access from the mainland.[95]

Where needed, an area may be completely fenced in order to create a ring-fenced sanctuary. Sanctuary Mountain Maungatautari is the largest ecosanctuary surrounded by a predator-exclusion fence. In total, some 3400 hectares are surrounded by a 47 km fence. The sanctuary offers a safe haven to many endangered species of birds, bats, frogs and reptiles. Various native

[90] Brown *et al.*, 2015: 25.
[91] Linklater & Steer, 2018: 4.
[92] http://www.sanctuariesnz.org/, https://www.sanctuary.org.nz/, Thornber, 2020 and Wright, 2017: 6.
[93] Ross & Eason, 2021: 38.
[94] Franklin, 2013.
[95] https://www.sossi.org.nz/the-sanctuary/the-fence/

bird species have been reintroduced in this sanctuary, such as takahē, kākā, hihi (or stitchbird), kiwi and kōkako.[96]

Another example is Zealandia, which is an ecosanctuary in an urban environment. This 225-hectare sanctuary in Wellington contains forest and freshwater ecosystems and is surrounded by an 8.6 km fence. Zealandia offers a home to more than forty bird species (such as the hihi, kākāriki, kiwi and tūī), besides many insects, reptiles, amphibians, plants and trees. Zealandia was the first ecosanctuary to be protected by a multi-species exclusion fence, which was constructed in 1999. In 2017, New Zealand counted over thirty fenced ecosanctuaries.[97]

Besides fences, innovative barriers need to be developed around biodiversity hotspots, such as predator-proof moats or collars that can be attached to the trunks of trees where endangered birds nest. This is not wishful thinking, as conservation efforts for the Critically Endangered Regent Honeyeater in Australia demonstrate. The Regent Honeyeater was nearly driven to extinction mainly because of habitat loss. As one of the conservation actions, polycarbonate 'possum collars' were fitted at the base of nesting trees, to prevent possums and squirrel gliders from climbing trees.[98]

Poisoning strategies over time are way more expensive than fences. It has been calculated that predator-proof fences may cost NZ$646 per hectare over a period of 50 years, whereas trapping costs around NZ$224. Aerially distributed poisons are seen as way cheaper than both of these methods and may cost as little as NZ$20 per hectare.[99] However, I have explained that according to John Parkes and colleagues real-life scenarios, involving the need of *repeated* distribution of poisons for multiple species eradication, learn that the *minimum cost* for removing predators from the main islands of New Zealand would be NZ$1200 per hectare.[100]

Though their efficacy has been disputed, fenced ecosanctuaries clearly prove their value from a conservation perspective. A study of New Zealand sanctuaries by Sara Bombaci (Colorado State University) and colleagues showed that most native bird species had "significantly higher population densities in fenced sanctuaries than in reference sites" and concluded that the efficacy of fenced ecosanctuaries has been demonstrated in a compelling way.[101]

The positive impact of fenced ecosanctuaries is also confirmed through research by Andrew Tanentzap (University of Cambridge) and Kelvin Lloyd (Wildland Consultants). They note that the tremendous success of island restoration projects has proven to be difficult to replicate within unfenced mainland areas, but that fenced ecosanctuaries allow for similar achievements. The focus of their research has been on the Orokonui Ecosanctuary, which is surrounded by a two-meter tall, 8.7 kilometer long predator-proof fence. Benefits for flora and fauna were detected not only within the sanctuary, but also in its surroundings. Mammal-sensitive trees increased both within the reserve and within 500 meters in its surrounding, unfenced landscape. Native frugivore animals were on average 33% more abundant within the sanctuary and immediately outside the fenced boundary. This research delivers evidence of a positive biodiversity spillover effect into the surrounding landscape.[102]

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[96] https://www.sanctuarymountain.co.nz/home. Brown *et al.*, 2015: 16.
[97] https://www.visitzealandia.com/. And Wright, 2017: 24.
[98] Ingwersen *et al.*, 2019.
[99] Russell *et al.*, 2015: 523.
[100] Parkes *et al.*, 2017: 157.
[101] Bombaci *et al.*, 2018: 1 and 7.
[102] Tanentzap & Lloyd, 2017: 119-120 and 122-125.

Secondly, a highly promising area of development is **birth control** for introduced species. Various American cities such as Chicago, New York, Vancouver and Washington D.C. are trying out birth control for rats, as poisons become less effective due to the building up of immunities and cause rats to migrate towards safer territory. Indeed, research has revealed that in some areas in the West and South of England more than 70 percent of rats are immune to conventional poisons, as a result of genetic resistance (built up due to naturally occurring mutations).

Though more time is needed to evaluate the birth control approach, positive progress has been reported in a city-wide fertility control programme in Washington D.C. The Arizona company SenesTech is using a product called ContraPest. This is a liquid contraceptive which is spread in a similar way as poison. ContraPest reduces ovulation in female rats to few or none and inhibits the production and maturation of sperm in male rats. Studies show no negative behavioral impact on the rats and by using bait stations, risks to non-target species are minimized. An urban environment is considered as highly challenging for controlling rats, but evidence based upon automatically taken photographs shows a 77% drop in the ratio of juvenile rats compared to adult rats. President Mick Fetty of Avant-Garde Pest Management emphasizes the value of developing humane methods, as he was surprised how many people preferred to live with rats rather than trying to kill them through poisoning.[103]

An alternative birth control approach under investigation is controlling rodent populations through a gene drive, for example by using the CRISPR gene-editing tool to generate infertility in offspring. Successful laboratory research with mosquitoes – resulting in infertile female offspring – suggests that this may help to eliminate mosquitoes that spread malaria in Africa. Similar research is occurring with mice, but faces more practical challenges (such as not always copying the mutation correctly). Concern has also been expressed about such an approach – what if for example genetically manipulated possums would find their way to native Australian populations?[104]

Immunocontraception to induce female infertility in possums sounds promising according to researcher Weihong Ji (Massey University). Vaccination through injection reduced fertility with around 75% in possums. Ji proposes to consider feeding possums with transgenic plants containing contraceptive vaccines. Research with transgenic potatoes shows that this is possible, and Ji suggests working with carrot baits. She concludes that this could provide "a relatively cheap, humane, and safe alternative for possum management."[105]

A similar, non-invasive solution could help prevent the spread of bovine tuberculosis from possums to cattle, which has been a major motivation for the prosecution of possums in New Zealand. Research by Daniel Tompkins (Landcare Research) and colleagues demonstrates a vaccine efficacy of 95% in possums, which should be more than sufficient to eradicate tuberculosis from wild possum populations.[106] Research by Graham Nugent and colleagues has confirmed the feasibility of the aerial delivery of vaccines in bait form to wild possums. Sachets with vaccines can be dropped from a helicopter flying at low speed, even in steep terrain that is in other ways difficult to access. A survey undertaken one year later showed a markedly lower

[103] Anonymous, 2021, Filippino, 2018, Fleischer *et al.*, 2019/2020, Fogarty, 2019 and University of Huddersfield, 2012.
[104] See Callaway, 2015, Callaway, 2018, Deavoll, 2019 and Owens, 2017: 150.
[105] Ji, 2009: 22-24.
[106] Tompkins *et al.*, 2009.

prevalence of tuberculosis in possums living in vaccinated areas compared to unvaccinated areas and a vaccine efficacy of 81%.[107]

Thirdly, **translocations** can be used to restore the balance. Members of endangered species can be translocated towards the safety of sanctuaries. Translocation allows us to bring birds to a safe haven and to increase genetic variation between small, isolated populations, which may suffer from inbreeding. For example, the population of black robins is highly inbred, as all surviving birds descended from a single female bird, named 'Old Blue', and her mate 'Old Yellow'.[108] There are now more than 250 black robins living on two islands, Mangere and Rangatira. Inbreeding has resulted in reduced breeding success, deformed beaks and poor plumage. Moving just a few birds between both islands every few years would increase the genetic variability and thus the population health.[109]

Translocations could also be undertaken in order to move remaining predators outside ecosanctuaries. Rather than using cruel methods such as 1080, brodifacoum, leghold or killing traps, remaining predators in ecosanctuaries can be caught by means of live traps and moved outside the sanctuaries. Wireless technologies allow to send instant warning messages when animals have been caught in live traps, so that these can be located at once. Such an innovative, combined animal welfare and conservation approach will require research regarding what locations are suitable for moving predators into, like areas remote from human populations and containing alternative food sources such as suitable plants, fruits and seeds, or prey animals from non-endangered species. Ideally, these areas will themselves have barriers that avoid predators from further spreading to other areas in combination with birth control measures.

None of these methods are written in stone. The first thing that we need is a **shift in ethical values**. Only when we appreciate that introduced animals are sentient beings that matter for themselves will sufficient means be made available to develop alternative technologies and innovative solutions that respect the interests of all involved.

Tourism and Poisons

Jan Wright is well aware of the financial challenges that the PF 2050 poisoning strategy is facing. Therefore, she recommends that the government investigates new sources of revenue for bird conservation, such as imposing a Nature border levy upon tourists and charging visitors further for the provision of infrastructure and services in parks.[110]

Some three million tourists visited New Zealand in 2016 and predictions expect this number to grow further.[111] Over recent years tourism has become the most important source of income for New Zealand and has bypassed the revenues from agriculture.[112] **Tourist contributions** are thus indeed likely to become a crucial asset for conserving New Zealand's fauna and flora.

However, I doubt tourists will be enthusiastic about paying for New Zealand's poisoning strategy through 1080 and brodifacoum. Sensitivity for animal welfare is increasing globally. Animal advocacy organizations have a growing impact in obtaining welfare legislation. I have mentioned that visitors of national parks are less likely to support the use of poisons.

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[107] Nugent *et al.*, 2016: 1.
[108] Goodall, Maynard & Hudson, 2009.
[109] Wright, 2017: 90.
[110] Wright, 2017: 107-108.
[111] Norton *et al.*, 2016: 177.
[112] Owens, 2017: 149.

I predict that tourists will prefer supporting less controversial and more ethical strategies, such as a network of fenced ecosanctuaries, rather than partake in a never-ending and cruel poisoning strategy which causes a lingering and gruesome death for millions of animals and which are not without risk to human visitors.

Conclusion

Unfortunately, the PF 2050 poisoning campaign has a one-sided focus on introduced species in order to conserve native species. The government of New Zealand has embarked on an unethical, unrealistic and unnecessary project by aiming to completely eradicate possums, stoats and rats from New Zealand by 2050. Their poison strategy creates intense and prolonged suffering for millions of animals. This suffering goes beyond the targeted animals and includes members of endangered species and companion animals, in particular dogs. The PF 2050 strategy fails because it does not manage to (i) permanently remove the targeted animals, (ii) reinvasion from other areas and (iii) the replacement of introduced species. Therefore, this strategy results in a never ending cycle of suffering of animals, high financial costs and environmental costs. The use of the insidious 1080 poison and its twin poison brodifacoum, must stop. I call for an immediate moratorium on these poisons.

Instead, the New Zealand authorities should focus on defining key biodiversity areas for conserving endangered species. Research needs to be undertaken to determine what areas need to be conserved and where habitat needs to be protected or restored. The detrimental impact of humans, in particular through intensive farming, must be addressed. Key biodiversity areas should be protected through the establishment of a network of (fenced) ecosanctuaries and further supported by alternative methods, such as birth control techniques and translocations. I predict that international tourists will prefer contributing to such a compassionate conservation strategy rather than funding a cruel poisoning campaign. This will only benefit all stakeholders involved – members of native and introduced species, companion animals, the environment, international tourists and the people of New Zealand.

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