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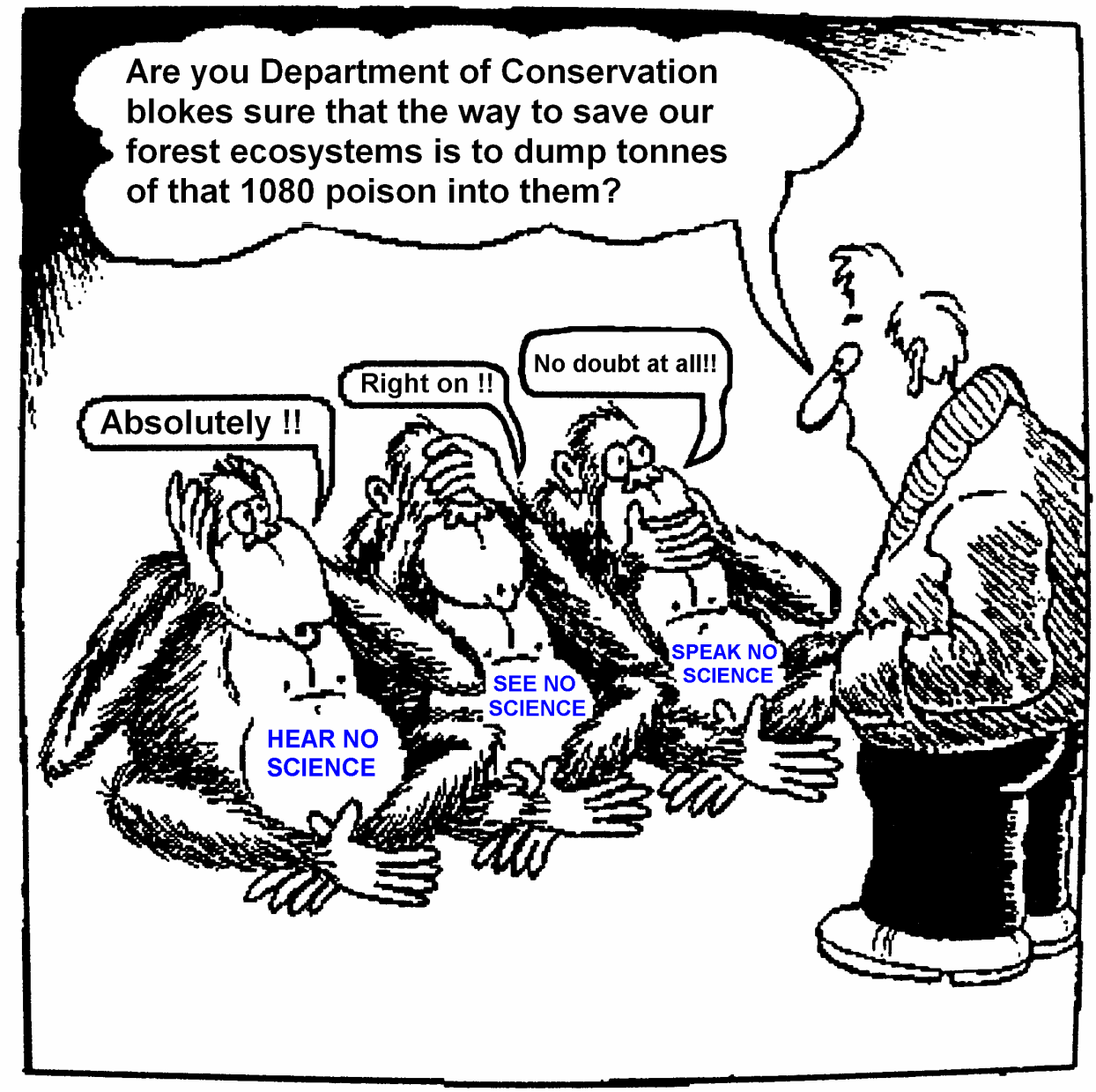
The Department of Conservation and Compound 1080: A Scientific Appraisal

Opinion



On 30 April, the Environment Risk Management Authority (ERMA) announced its preliminary findings from its reassessment of Department of Conservation (DoC) and Animal Health Board (AHB) use of the universal poison 1080 in New Zealand's forests. ERMA's preliminary decision is to permit the continued use of aerial 1080, a finding that we find very troubling.

About a year ago we learned that the New Zealand DoC was routinely and indiscriminately dropping food laced with tonnes of a universal poison, compound 1080, into New Zealand's forest ecosystems. 1080 poisons all oxygen metabolizing organisms by blocking the conversion of food into energy. Officially, this aerial poisoning of our forests is being done to control possums (although the rationalizations and claims of DoC often go well beyond that). DoC asserts that only possums and other so called "pests" are significantly poisoned. As scientists and life-long environmentalists, we were struck that this contention appears to violate the most fundamental ecological principles as well as common sense. Is it plausible that one could drop high protein, high carbohydrate food mixed with a poison that kills all animals into a semi-tropical ecosystem and only negatively affect possums and other "pests"? Scientists have a saying, "Extraordinary claims require extraordinary evidence." Thus, we resolved to determine whether the extraordinary claims of DoC have the weight of extraordinary evidence behind them. The answer is unequivocal: ***they do not***.

After months of investigation, we found that DoC's 1080 research sustained five truly astonishing conclusions[*]. First, there is not a single scientifically credible study showing that use of aerial 1080 on the mainland is of net benefit to any species of New Zealand's native fauna … not one. We have challenged DoC to produce even one scientific study in even one species that supports their claims for the benefit and necessity for 1080. They have yet to respond.

Second, there is overwhelming evidence from DoC's own research that aerial 1080 is killing large numbers of native animals, including birds, insects and other invertebrates, and our only native mammals, three species of bats. In addition most native vertebrate species and thousands of invertebrate species are entirely unstudied.

Third, there is not a single ecosystem level study showing lack of harm from repeated 'treatments' of mainland forests with aerial 1080, let alone one showing the overwhelming beneficial effects that DoC claims.

Fourth, it is probable that possums, if left unchecked by natural predators, would over time do substantial damage to our forests, but the degree of that damage is unknown, and whether that damage is being controlled with aerial 1080 without concurrent unacceptable and irreversible damage to the forest ecosystem is entirely unaddressed by DoC's research.

Fifth, DoC's 1080 research, in addition to its generally poor scientific quality, is biased and does not actually prove what DoC claims that it does.

In short there is nothing in the scientific record that remotely would justify the following statement from DoC's May 14 press release: "Without 1080, the price New Zealanders would have to pay in the loss of their unique species and habitats is too awful to contemplate." In fact, DoC's own science tells a grim story quite to the contrary.

DoC habitually, publicly and aggressively misrepresents what its research shows. A typical example recently occurred on the national radio programme Radio New Zealand. Al Morrison, Director General of DoC, stated that if we want to have kiwis, then 1080 is the price. This assertion

[*] We do not expect readers to accept these conclusions on faith, but rather the authors urge every one to review the evidence for himself or herself. A detailed and referenced report with hyperlinks to the actual papers is available from us by writing pwok@alumni.caltech.edu.

borders on the absurd. There is not one stitch of scientific evidence showing that applications of aerial 1080 benefit kiwis, and there is a sound scientific argument that they may be profoundly harmful.

In another example, DoC claims in its ERMA submission "that robin nesting success more than compensates for any robin losses from 1080". This is not born out by the evidence. The study that DoC cites (1) showed increased nesting success in 1 of 3 years, but even that single success failed to translate into increased robin population success -- the real bottom line. The study also showed that 54% of banded robins died in the 1080 poisoned area compared to none in the un-poisoned area.

DoC claims that the tomtit, a ground feeding native bird, is not affected by aerial 1080 bait, and cites a study done by Westbrooke in 2005 (2) to prove that. However, the data in the published paper actually shows that substantial numbers of tomtits could be being killed even by low concentration cereal baits, and much more important it shows that about 40% of tomtits died when exposed to low concentration carrot baits! Yet this is never mentioned by DoC (or by the Forests and Birds organization, DoC's principle apologist), nor is it mentioned in the Abstract section of the paper. Carrot bait is still in widespread use by DoC.

DoC claims that bats are unaffected by aerial 1080. However, a well done 2002 study by Lloyd and McQueen (3) showed that bats were clearly poisoned secondarily by eating affected insects. The study gave a "best estimate" that 14% of bats would be killed in 14 foraging flights in a 1080 poisoned area, and who knows what the long term sublethal effects would be of the repeated exposures to which DoC subjects them.

There is even substantial evidence that **DoC has suppressed critical research** unfavourable to its aerial 1080 agenda. This research on invertebrates, the category of animals that includes insects, worms and spiders is perhaps the most disturbing. In 1992, M Meads (4) completed a study for DoC that showed approximately 50% mortality among forest invertebrates from a single aerial 1080 "treatment". DoC refused to allow the resulting paper to be published. At the same time they commissioned a similar study which was structured to have virtually no chance of detecting the high mortality seen in the Meads study. The resulting poorly designed and analyzed study remains the sole evidence that New Zealand's indiscriminate use of a poison originally developed as an insecticide is not devastating our forest invertebrates. The implications of this are truly disturbing given that invertebrates are the backbone of forest ecosystems and given that DoC is mandated by law to protect native species and biodiversity. In fact DoC's use of aerial 1080 over the intervening 15 years has probably already done irreversible damage to the diversity of our native invertebrates. If there were no truth in the rest of this article, this point alone should be enough to bring an immediate halt to the poisoning of our forests with 1080.

The misrepresentation, distortion, suppression and biased reporting live in a hierarchy. To illustrate this we will analyze a claim in considerable detail, more than is desirable for easy reading, but it is essential to make the point tangible. We could have picked any of hundreds of such claims but this one is typical both in respect to the quality of the science and its relationship to the claims made for it. Consider an assertion that we recently received by email from a member of the F&B Society:

> *"…without 1080 we have lost parakeets, kaka, kokako, blue duck and at least 5 native forest plants at Aongatete in the Kaimai. With 1080 we have recovered kokako, kaka, parakeets and blue duck at Pureora and kaka at Whirinaki … anybody advocating against 1080 at this juncture is putting our natural heritage at risk. To do so is hypocracy [sic] at the best and sabotage at the worst."*

So let us start analysing this claim by looking at relevant study. We could find only one study that deserved the name and that examined the effect of aerial 1080 on the populations of kaka and

kereru (also known as kukupa) in Whirinaki Forest Park (5). In the study Powlesland et al radio-tagged the birds and used one poisoned area and one unpoisoned control area and tracked these birds over three breeding seasons following poisoning in one area and observation only in the single control area. Hence from its basic design, this study contains a fatal statistical error, namely lack of replication and/or randomisation of study and control areas*. In addition, when the authors reported on the nesting success and fledgling survival for the radio-tagged birds, **incredibly, the authors did not distinguish the data from the poisoned and unpoisoned areas.** Instead they only reported the combined results from both the treatment and non-treatment areas. Thus, this study demonstrates absolutely nothing about the impact of aerial 1080 on the nesting success or populations of kaka and kereru. Despite this the authors (who were, as usual, sponsored by DoC) go on to conclude in the last sentence of the paper's abstract.

> *Effective control of introduced mammalian predators … should benefit these bird populations.*

On the other hand, there were some interesting observations derivable from the study's reported data that shed considerable doubt on the rationale used by DoC to justify their $80 million per year pest control efforts. One observation was that rat population numbers recovered within 14 months of the poisoning relative to the non-poisoned area. This is, of course, expected given the remarkable reproductive capacity of rats, but it flies directly in the face of DoC's claims that populations of birds will benefit from triennial poisoning of the forest with aerial 1080.

Another observation was that mustelid (stoat) numbers actually seemed to increase in the treatment area. Why this happened is uncertain, but the phenomenon has variably been noted in other studies. Of course, one can imagine scenarios wherein poisoning of the forest might result in such a result, e.g., dead bird carcasses provide easy food for mustelids or competition for food from rats and possums is decreased. Regardless, more mustelids would not seem to bode well for native birds as mustelids are known to be major predators of native birds and their eggs.

With perspicacity, Zavaleta (6), a respected international ecologist, pointed out the principle grammar school student of the essentially cybernetic nature of ecosystems (a characteristic all but ignored in DoC's simplistic, univariate view):

> *When exotic predators and prey co-occur, eradication of only the exotic prey can also cause problems by forcing the predator to switch to native prey. In New Zealand, introduced rats R. rattus and possums Trichosurus vulpecular are an important part of the diet of the stoat Mustela ermina, an exotic mustelid (7). Efforts to remove all three species by poisoning the prey species had an unexpected result: the stoat populations were not eliminated by either the prey eradication or the poison application and, in the absence of abundant exotic prey, the stoats switched their diets to native birds and bird eggs.*†

Or as Murphy et al (8) put it:

> *Stoats shifted between eating rats and birds, depending upon the abundance of rats. Thus successful rat-poisoning operations resulted in higher bird consumption than unsuccessful ones. Combining the numerical and functional responses of stoats into a 'bird predation index' showed that stoats are likely to have the greatest effect on birds after successful 1080 poison operations.*

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* By no means should this statement be taken as non-essential pedantry. Going back to the work of Sir Ronald Aylmer Fisher on agricultural plots which formed the foundation of modern statistics and statistical inference, randomization and replication of plots have been known to be essential to proving causal relations in complex multivariate systems. Today no conclusion about the effects of medications is considered valid, or indeed even worth serious notice, without randomized clinical trials. It is one of the two or three most important, and possibly the most subtle, discoveries of the 20th Century. Thus, we have Sir Ronald and his idea of randomized replication in experiments to thank for a substantial proportion of clinical progress in the last half century.

† The underlining is ours.

So how did Powlesland, et al react to their and others' evidence of increased numbers of stoats? Essentially, they ignored it, but this did not prevent LCR employee John McLennan from claiming in a NZ Herald article (9) that 1080 is "having marked success in controlling rats and stoats and helping kiwi populations grow." Of course McLennan cited only an unpublished, unrandomised, unblinded, statistically moot "study" which did not pretend even anecdotally to show a differential effect on kiwi populations.

Returning to Powlesland and the kaka and kereru, the authors, unable to claim success in showing the desired effect, cited other studies as showing native bird population benefit from aerial 1080. One of these studies claimed population improvement for the kereru but did not look at the kaka. This study by Innes et al (10) looked at twelve bird species, both native and non-native. However, the study was flawed in several ways. First, the study design is such that statistically valid conclusions are impossible. There was only one control and one treatment area, which means that any observed population differences between control and poisoned areas might have been simply due to inherent differences between the areas studied, a fact that the authors all but admit in a single sentence in the methods section of the paper, but otherwise ignore. Second, the treated and control areas were very different. This is substantiated by the very large differences in populations of the studied birds in the two areas. Third, the author's main analysis of the results used the wrong statistical model -- they used an area/year interaction term as an independent variable that is thus unable to distinguish area effects.

Lastly the authors misrepresented their own results. The title proudly proclaims the native population benefit, but they fail to note that populations of **two species of native birds decreased significantly**, according to their analysis. However, we don't need to pay any attention to that as such since their analysis was incorrect anyway, but the point is that the authors selectively reported their results to support the boss's agenda. The authors presumably did not know that their study was fatally flawed in design and they had used the wrong statistical technique.

In summary, not only did the design of the Powlesland and Innes studies preclude valid conclusions, but the authors incorrectly analyzed their results and even then cherry-picked the answers ignoring their own evidence of damage to at least some native species. Taken together the studies show how one bad study references and misquotes another even worse study so that in the end they become one big self-reinforcing rumour that has no basis in scientific evidence whatsoever.

Another measure of the degree of DoC's misinformation on 1080: Combine the above examples with dozens like them and it becomes clear that DoC is not being straight with the people of New Zealand. To test this conclusion, we systematically reviewed 40 randomly selected pages from DoC's 1080 reassessment application submitted to Environmental Risk Management Authority (ERMA) in October 2006. We found that fully 58% of pages contained serious distortion, misrepresentation or other errors of various kinds. Of these, 36% were outright misrepresentations (typified by the previously mentioned examples), 23% were factual errors, 20% were misrepresentation by omission, and the rest were unsupported claims.

The misrepresentation lives in a hierarchy of increasing distortion and biased reporting. First, the researchers, who are dependent on DoC for their jobs, conduct what are often marginally designed studies to (as one paper put it) "prove the benefits" of 1080. Second, they analyze their data with what appears to be bias. Third, the Abstract and Discussion sections of their papers almost never mention facts adverse to DoC's 1080 promotion agenda, i.e., they cherry-pick the results. When one reads the actual papers this becomes evident (as in the case of the kaka detailed above). Fourth, DoC takes this distorted and biased view of what the research actually shows and spins it almost beyond recognition. Fifth, the public and the press, who in most cases actually believe what they have been told, take the final step of accepting and repeating totally unsupportable claims such as that 1080 has saved numerous native birds from extinction. The truth

thus proceeds from bad research by tainted researchers, into the DoC bureaucracy which distorts the information to suit its bureaucratic agenda, which then passes it off at considerable expense to the New Zealand public through an all too willing and uncritical press. Thus it is not surprising that we have a goodly supply of New Zealanders who in all sincerity state such claims as if they were true.

New Zealand is unique in the world in its use of aerial 1080. No other country is doing or has done anything remotely similar to what New Zealand's Department of Conservation is doing, that is, dropping food laced with tonnes of a universal toxin discriminately into semitropical forest ecosystems. New Zealand uses over 85% of the world's supply of 1080, a poison that is toxic to all animals, a poison that is banned or severely restricted in most countries, and a poison that is classified "extremely hazardous" by the World Health Organization. In response to this, DoC asserts that New Zealand is in a unique ecological position, but this is simply not true. For example, the State of Hawaii has an almost identical problem with feral mammals threatening native birds, and we learned that Hawaii would not even consider such a practice. As Miles Nakahara, Forest & Wildlife branch manager on the Island of Hawaii, commented to us, "You are pretty cavalier using a poison like that … you will be destroying the forest … you will lose the very thing you are trying to save," Nakahara's forecast is the very concern that led to our opposition to DoC's policy.

There are other trolls under the bridge. First, there are hundreds of native species for which there is no information at all. Even the advocacy research sponsored by DoC has not been done. Second, research indicates that 1080 in sublethal doses can cause reproductive dysfunction, hormonal dysfunction, and mutations in several vertebrate species. DoC has not seen fit to investigate the extent to which these may be affecting native species via chronic exposure even though its stated intention is to "treat" our forests with 1080 poisoning every two or three years into the indefinite future. We can only speculate on the long term and chronic effects of these sublethal doses of 1080 on our native species (not to speak of potential human effects). It is an act of colossal hubris on the part of DoC bureaucrats to assume that these are negligible. Third, with apparently unashamed arrogance, DoC actually managed to have Richard Sadlier, who was director of DoC research when the Meads paper was suppressed in the 1990's, appointed to the ERMA review committee for aerial 1080 as its only biological scientist. Thus, the man who was as much as anyone responsible for creating and promoting DoC's current use of aerial 1080 is being asked to judge the validity of that policy.

As previously suggested, **the scientific quality of DoC's research is shockingly shoddy**. Most of it only reaches the lowest levels of control quality. There is not one randomized or blinded experiment (the minimal design considered acceptable in modern clinical research). Most studies have no control groups at all. Statistics are often poorly done, absent or selectively reported. Results are frequently misrepresented and distorted, often with clear bias. The studies are short term and narrow in scope. There are numerous errors of statistical inference. None of the research is published in international journals. Roughly half of the studies are only published internally by DoC or Landcare Research (LCR). None of the research addresses the potential consequences to native fauna of chronic toxicity although sub-lethal doses have been shown to lead to changes that could result in chronic toxicity in a number of species including birds. Finally, the entire lot, excepting one or two papers, has been produced by scientists who are dependent on DoC's goodwill for their jobs, which means that these papers' results are inherently tainted by the lack of financial and career independence of the researchers. It is important to recognize that some of the research is of excellent quality, especially from a biological stand point, for example the paper of McQueen and Lloyd (3). However, most of the research fails to meet modern standards of study design and analysis, making it particularly vulnerable to the biases of the researchers and thus the sponsoring agency, DoC.

The bottom line is that DoC's advocacy research supporting its practice of the repeated poisoning of our forest ecosystems with aerial 1080 has a very low probability of producing truth. Indeed it is not exaggerated to say that the strongest argument supporting DoC's use of aerial 1080 is the cacophony of advocacy persistently emanating from DoC, which of course is at considerable public expense.

Do possums need to be controlled? The answer is likely yes. However, the evidence is inconclusive and often suffers from obvious researcher bias. The theoretical argument that possum numbers will be limited to some extent by food supply in the absence of predators suggests that certain species of trees may be adversely affected and in the long term may be replaced by species more resistant to possum predation. In one large study, possum numbers declined naturally after about 20 years of infestation without intervention. The hyperbolic statements by DoC that the forest is about to collapse in the absence of aerial 1080 are patently false.

If one accepts the (unproven) contentions that possums must be controlled and that aerial 1080 will do the job, critical questions still remain. **Is there a safer alternative** than subjecting the fauna of our forest ecosystems to triennial aerial 1080? The answer here is absolutely yes. In 2003, a comprehensive Animal Health Board-funded study (11) showed that even in the roughest terrain, ground-based possum control is possible for a $20-per-hectare differential in cost. Nationally, this translates into about $36 million annually. Is it worth $36 million per year to protect our forest ecosystems from repeated assaults with a universal poison which is killing thousands of native birds, 50% of invertebrates, and 14% of our unique native bats? We say unquestionably yes. DoC and its apologist, the Forest and Birds Society, apparently do not think so. There are other possibilities as well such as developing species specific bait stations and traps, and encouraging a domestic possum pelt industry.

But what about AHB's concerns regarding bovine Tb? AHB's own research has shown that spread of the disease by possums to cattle can be controlled effectively by concentrating on controlling the possum population at the forest pasture margins. Possums once infected may die too quickly to sustain a reservoir of 1080 in the deep bush. Control at the margins is most effectively and safely done using ground control techniques. Hence, we believe that ERMA's claim that our $8 billion dollar export market is threatened if aerial 1080 is banned is without support in either reason or evidence. In any case, as noted above, the entire area now being poisoned with aerial 1080 can be protected with ground-based baiting for an additional $36 million over the $80 or so million now being spent.

So why is DoC doing this -- after all it is the Department of "Conservation"? The answer is difficult to know with certainty. Undoubtedly many DoC employees sincerely believe the company line. The mantra that 1080 is virtually a magic elixir for our forests has become an integral part of New Zealand culture. It is evident that most do not know what the research actually shows and many are apparently ignorant of what constitutes valid scientific evidence.

However, there are other possibilities. DoC is a bureaucracy, and having the word "Conservation" in its name does not make it immune to the forces that drive bureaucracies, and that, to put it in a single phrase, is discretionary budget. As it was put by bureaucracy expert at the Rand Corporation (a U.S. think tank): "While agreeing that bureaucrats hold a variety of personal goals, each of these goals is attainable through increasing the agency's discretionary budget. Thus, it is in the bureaucrat's self-interest to work toward **budget maximization**. It is assumed that by doing so the bureaucrat will be able to attain a variety of subsidiary goals, such as increasing salary, perquisites, reputation, power, patronage, productivity, convenience, and ease of management". In the early 1990's, DoC got a budget bonanza from the New Zealand Parliament in the form of an additional NZ$50 million dollar grant to fight possums. Coincidentally, it was about then that the tone of DoC-sponsored 1080 research changed from neutral investigation to advocacy. It was also then that the Meads paper was suppressed. The possum control budget today probably exceeds NZ$80

million although it is difficult to tell exactly how much is being spent. (The NZ$80 million figure certainly does not include the relentless propaganda campaign funded at public expense.) Most important to the bureaucracy, it is all discretionary. They can spend the money with whomever and in whatever way they wish. As such, aerial 1080 control is a bureaucratic motivator with irresistible force.

In essence DoC appears to be riding high possum scare tactics to larger and larger budgets. "Pest" control is to DoC what the "War on Terror" is to the Bush administration. The war will go on forever. Despite the massive use of aerial 1080 since 1995, we still, according to DoC, have the same number of possums, 70 million. The war is not being won or lost. There is no credible evidence that all the costs and risks are of net benefit and there is credible evidence that it is doing real harm. Worse, New Zealand's use of aerial 1080 may quite possibly be as damaging to our forest ecosystems as Bush's invasion of Iraq was to the effort to reduce the risk from radical Islamic fundamentalism … and certainly is as poorly justified by evidence.

Save our forests for future generations. The scientific evidence produced by DoC, while biased, misinterpreted, shoddy and tainted by researcher sponsor-dependence, indicates that we may be doing substantial, and possibly irreversible, damage to our precious forest ecosystem by an unprecedented, inherently anti-environmental practice. What can be done? We need hard facts, not vacuous promotion of a potentially disastrous practice. So we think it is time to stop. It is time that DoC stop propagandizing us with infantile unsupported sound bites that pander to our emotions. It is time to produce the extraordinary evidence to support this extraordinary practice. It is time that every New Zealander demands the truth from DoC. It is time to stop the use of aerial 1080 until its real effect on our forest ecosystems is demonstrated to be positive by competent and independent scientific research. Our forests, our unique forest ecosystems and our international reputation as an environmentally sane nation are at stake.

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The completely referenced scientific report supporting the material in this article is available from the authors at pwok@alumni.caltech.edu.

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