THE QUIET FOREST

THE CASE AGAINST AERIAL 1080

Fiona M. F. McQueen

Our minds possess by nature an insatiable
desire to know the truth.
Cicero

How can you reveal the truth
if those to whom you are speaking do not want to hear?

David Walsh, Author.
Seven Deadly Sins. My pursuit of Lance Armstrong

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GLOSSARY

Animal Control Products
ACP was established as a registered company in 1991, becoming a Crown-Owned Company initially and subsequently a State-Owned Enterprise. Its purpose was to manage the importation and storage of toxins required to manufacture bait products for pest control.

Brodifacoum
An anticoagulant poison (second generation)

Compound 1080
Sodium monofluoroacetate

Density
The density of bait sowing is now 2 - 5 kg/ha

Department of Conservation
The public service department of New Zealand charged with the conservation of New Zealand's natural and historical heritage

Dose (bait)
A single 1080 bait (Wanganui No. 7, mean weight = 6.4 g) contains 0.15% 1080 (i.e., 9.6 mg of 1080)

Dose (lethal)
The estimated minimum lethal dose (MLD) in humans is 0.7 mg/kg of body weight

Dose (lethal child)
A 14 kg child would need to consume 9.8 mg of 1080 (one bait) to reach the minimum lethal dose

ERMA review (2007)
The Environment Risk Management Authority was tasked with reassessing the use of 1080 for pest control in New Zealand.

More than 1400 submissions were lodged. The 2007 decision was to approve the continued use of 1080 applying "more stringent controls"

Exposure (daily)
Acceptable daily exposure (ADE) for substances containing 1080 is 0.02 µg/kg of body weight/day.

Exposure (index)
Biologic exposure index (BEI) = 15 ppb – as tested in the urine of exposed workers.

Landcare Research
The research company set up and administered by the Department of Conservation. This organisation administers the New Zealand vertebrate pest research journal, Kararehe Kino.

LD50
This is the dose of 1080 that will cause 50% of animals or insects that ingest it to die. This differs for different species. The dog has a very low LD50 at 0.06 mg/kg and is particularly susceptible to the poison. The LD50 for humans is 2 - 2.5 mg/kg.

Ministry of Primary Industries
The New Zealand government ministry that oversees pest control and food safety

Orillion
Orillion became the new trading name of Animal Control Products Limited in 2016.

OSPRI
Formed in 2013 after the Animal Health Board (AHB) and National Animal Identification and Tracing (NAIT) merged. OSPRI administers the TBfree programme.

Pindone
An anticoagulant poison (second generation)

Pre-feed
Cereal pellets that do not contain 1080 are dropped several days before identical pellets that do contain poison. This is to encourage rats to take 1080 bait.

QuantiFERON-TB Gold
A blood test that can reveal whether an animal (or human) has been exposed previously to TB

Rongoa
Plants used by Maori for medicinal purposes

TB (free status)
If the national herd bovine tuberculosis infection rate for cattle is < 0.2 %, this allows the country to have TB-free status. New Zealand has had a bovine TB infection rate of 0.04% for the last 10 years.

Tbfree
An arm of OSPRI dedicated to eliminating bovine TB

Toxicity (end point)
The toxicological end point is that level that caused no toxicity in test animals dosed with 1080 for 90 days. For rats this is set at 0.075 mg/kg of body weight/day.

Toxicity (LOEL)
The lowest dose (of 1080) that does cause observable effects in experimental animals

Toxicity (NOEL)
The dose (of 1080) that causes no observable effects in experimental animals

Water
The maximum amount of 1080 residue allowed in drinking water by the Ministry of Health is 2.0 ppb

ABBREVIATIONS

1080	Compound 1080
2,4,5T	2,4,5-trichlorophenoxyacetic acid (a herbicide)
ABC	Australian Broadcasting Corporation
ADE	Acceptable Daily Exposure
ACVM	Agricultural Compounds and Veterinary Medicines
ACP	Animal Control Products
BEI	Biologic Exposure Index
CfCC	Centre for Compassionate Conservation
CORANZ	Council of Outdoor Recreation Associations of NZ
DDT	dichloro-diphenyl-trichloro-ethane (a pesticide)
DOC	Department of Conservation
EPA	Environment Protection Agency (United States)
ERMA	Environmental Risk Management Authority
FATE	Farmers Against 1080
GMO	Genetically Modified Organisms
Ha	Hectare
HSNO	Hazardous Substances and New Organisms
Kg	Kilograms
LD_{50}.	The lethal dose for 50% of animals tested (see Glossary)

LOEL	Lowest Observable Effects Level (for sub-lethal poisoning)
MAF	Ministry of Agriculture and Fisheries
MLD	Minimum Lethal Dose
MPI	Ministry of Primary Industries
NZFSA	New Zealand Food Safety Authority
OECD	Organization for Economic Cooperation and Development
OSPRI	Operational Solutions for Primary Industries
P&WS	Parks and Wildlife Service (Australia)
PCR	polymerase chain reaction
ppb	parts per billion
PPD	purified protein derivative (an extract of Mycobacterium tuberculosis)
ppm	parts per million
RMA	Resource Management Act
RSPCA	Royal New Zealand Society for the Prevention of Cruelty to Animals
SMFA	sodium monofluouroacetate (another name for 1080)
TB	Tuberculosis
TCA	Tricarboxylic Acid Cycle (also known as the Kreb's cycle)
UNESCO	United Nations Educational, Scientific and Cultural Organization
VTA	Vertebrate Toxic Agents

CONTENTS PAGE

Chapter 1.	Fiordland	5
Chapter 2.	History and worldwide use	9
Chapter 3.	1080 Poison – how it works	16
Chapter 4.	Insects and other invertebrates	20
Chapter 5.	Caro	29
Chapter 6.	Of robins, tomtits and blue ducks	34
Chapter 7.	Blackmail	45
Chapter 8.	Water and fish	48
Chapter 9.	Dan	59
Chapter 10.	Kea, morepork and rock wren	67
Chapter 11.	James	77
Chapter 12.	Bees and bats	82
Chapter 13	Plants	87
Chapter 14	Jim	94
Chapter 15	Humans	98
Chapter 16.	Mary	105
Chapter 17.	Tuberculosis	111
Chapter 18.	Pamela	121
Chapter 19.	Animal Cruelty	127
Chapter 20.	Deer, (Interviews, Kaylyn and Dick)	132
Chapter 21	Rats	139
Chapter 22	Stoats, mice and possums	146
Chapter 23.	Boundaries and islands	157
Chapter 24.	Psychology and Environmental Fascism	167
Chapter 25	Who benefits and who pays?	175
Chapter 26.	What else can be done?	182
Chapter 27.	Conclusions	193
Epilogue	The Quiet Forest	203
References		207

PROLOGUE

Malcolm arrived on Christmas Day, found on the footpath a tiny, scrawny, featherless entity with a huge appetite. A fledgling of some sort, possibly a myna. He was basically all beak (large, squawking with yellow around the edges) and, behind that, a small balding head with a few wisps of black feathery stuff sticking out the top. He did nothing for the first couple of weeks but squawk, eat and excrete. He lived in a box in the laundry. A tea towel was draped over it at night and the laundry door was firmly shut. Bumping sounds could be heard for a few minutes after lights-out but he would then quieten down until morning when he would start calling out again, needing to be fed.

He was always ravenous and loved pre-soaked cat food, bits of orange and, most of all, honey water. He once tried some pale yellow honey from an orchard and savoured it like a Master Sommelier. But honey that had somehow come into contact with garlic (via a chopping board) was rejected with utter disdain. There was a bad episode when he choked on a piece of orange. He coughed and spluttered, little rib cage heaving. We thought we had lost him. By this stage he was hopping around and disappeared into the neighbour's giant impatiens bush. A vet was really out of the question. We hovered desperately. Then he hopped back into view and with a gigantic contraction, a huge quantity of undigested orange pulp squirted out his rear end. Triumph. His parents had to calm shattered nerves with alcoholic beverages.

Early in his childhood we had a party on the deck – this by now being the middle of summer. Malcolm was put in his box under the house but was not happy with his state of exile and demanded to meet the other guests; a little squawking figure hopping madly up and down, shrouded in the tea towel that had fallen off to envelop him. He came upstairs and sucked honey

water off my finger to everyone's general delight. Then we noticed a sinister intruder. A very large tui was sitting in the stunted little avocado tree we had planted in a pot. It was quite close to the house. Malcolm seemed nervous. It was at that point that we began to question his genetic origins. Finally, after about 6 weeks and once proper feathers started to appear, it became apparent that he was a tui (Figure 1).

Malcolm taught himself to fly. He started by practising in his box. He would jump from one side to the other, then hop up in the air, exhibit a perfect 180^0 turn, and hop back. Initially, like a child learning to swim, he did "widths" but after a while he graduated to "lengths" of the box and then with a few more flaps would get up to the coat hook on the back of the laundry door. In the morning we would find him there listening to the dawn chorus of tuis and other birds in the Grevillea tree outside. After a while he was flying around the kitchen. Then he started to go outside. He was provided with a feeder, made from a small cane basket with a platform between the handles. Malcolm could conveniently perch on one handle and lean forward to sip honey water from his bowl and nibble at tasty morsels left on the tray. He still preferred to feed from my finger (reverting to babyhood) but had to be weaned. He drank awkwardly to start with, using his beak in a funny tilted way, slopping honey water out the side, but eventually he got the hang of it. After a while we discovered that he had an extraordinary tongue. This evolutionary development allows tuis to sup honey from the bottom of the long necked flax flowers of the New Zealand bush. We gained direct knowledge of the tui tongue. He would flick it into the ear (tickling the drum), or up the nose (tickling the brain). The latter was excruciating.

About six weeks after his arrival, Malcolm was living permanently in the Grevillea tree outside the back door. He was also flying quite well. It had not rained for several weeks but one night there was a downpour. In the morning, a poor little drowned

wretch appeared, oozing indignation. He was shivering, so I put my hands around his body as he sat on the perch and made a kind of warm ”overcoat” for him, with his little black head sticking out the top. He stopped shivering quite quickly and we stayed like that for some minutes before he wriggled out and took off. I think that is my favourite memory of him. By this time, Malcolm was as much a family pet as any cat or dog. He would fly down to greet us when we came home. You could feel the love radiating out of his heart like the beam from a torch as he flew towards you. He generally landed on an outstretched hand but sometimes made for the head. Perhaps my hair made him think of nesting materials.

Another favourite trick was sitting on my husband’s shoulder while he (the husband) watered the garden and had a beer. Small flying insects would also be “watered” and Malcolm would fly down and snap them up as they flopped around helplessly, their wings stuck together. Then it was back to his vantage point to watch for further morsels. We also saw him catching insects on the wing with incredible accuracy and speed. There were altercations over territory with other tuis living in “his” tree. One day after work I went out to the terrace and called for Malcolm as usual. I spotted him in the tree but he seemed unwilling to come to me. Then, as he launched himself into the air, a large tui at least twice his size, zoomed in on the starboard wing, heading him off. I squawked in alarm and flapped my hands ineffectually. Malcolm flew into the ground at my feet and staggered up to me on his legs, trembling. Full of fierce maternal instinct, I shouted at the big tui and took Malcolm back to the deck for honey water. After that he must have established his place with the other birds as I witnessed no more acts of aggression.

The day was coming for us to leave Auckland. Malcolm’s behaviour started to change. He would take longer to come when we called and seemed to be keeping company with a couple of

other tuis. He wouldn't play the insect-catching game any more and was away for longer spells. When he did deign to fly to us on the deck it was not for long and he would keep glancing around. "Hi Mum, Dad, can I have the car keys please …?" We must have been embarrassing as parents – wrong shape, far too big, unable to fly. At last he did not come. It was a wrench. A few discreet tears were shed but of course we knew it was much better that he return to the wild.

A year later I thought of Malcolm again when I heard that the New Zealand Department of Conservation (DOC) had dropped aerial 1080 for "pest control" on Auckland's Waitakere ranges, very near our old home. Tuis are not supposed to be susceptible to 1080 as they are nectar-eaters but I later found evidence that this chemical certainly kills insects and insect-eating birds. I remembered the game with the hose. The apostle Luke said, "Are not five sparrows sold for two farthings, and not one of them is forgotten before God?. [1] I am sure tuis are not forgotten either.

CHAPTER 1

FIORDLAND

The subject of 1080 wormed its way into my consciousness in early 2015 after hearing this story from a hunter who had been on a recent trip to the remote Hokuri Creek area, near the Hollyford valley, Fiordland.

"We left the Alabaster airstrip in the Pyke valley and climbed to the top of the Skipper's range at the head of the Hokuri creek. Then we followed this down to Lake McKerrow over five days. There was an almost total absence of birdlife. We saw one woodpigeon and I don't remember any other little birds like fantails or robins. We came across carcasses of red deer, possums and woodpigeons on the ground – in an area where there are no tracks. Almost nobody goes there - I only know of one hunter to have been in that area in the last few years.

The deer carcasses were intact and there was no sign of a hunter removing back-steaks or anything like that. They were lying on their sides with legs extended as though they hadn't died suddenly. You sort of got the impression that it hadn't been quick - their legs might have been flailing around. The carcasses looked like they had been there for longer than a few weeks. They were past the smelly stage. One thing that was very noticeable in the first four days was the proliferation of European wasps. They were everywhere in larger numbers than I have ever seen in 40 years of tramping in Fiordland. Twelve months previously, while camped on the shores of Lake Wilmot in the upper Pyke valley, we had been deafened by birdsong at 10 o'clock at night, just on dark. This was actually commented on by one of the other guys in the party. Twelve months later it was just completely silent."

I decide to find out more about 1080. Matt–the-hunter mentions a film called *Poisoning Paradise - Ecocide New Zealand* [2] made by the Graf brothers. It was an international film festival hit but has never been shown on television in New Zealand. We find it on U-tube and watch all one and three quarter hours with ever-increasing horror. Was this true or just "egregious rubbish" as was the opinion of a close friend. Another comment from a different source (someone with a New Zealand degree in Ecology) was " Don't be too hard on the DOC guys, they do their best…..we seem to be stuck with 1080…. cheapest option …. research into other options is underway … but still a long way off …. there is a worry about invertebrates though ….." The line crackles and I hardly hear the last words uttered *sotto voce*. I resolve to find out about invertebrates.

I go to the Net for an afternoon. I find the name "Jo Pollard" as someone with a PhD in Zoology who is a long time anti-1080 campaigner. After a little difficulty I manage to trace a phone number and call her up. Jo is initially wary of this call from a complete stranger but I convince her that I am simply trying to get to the bottom of the issue. Firstly, I ask whether 1080 can kill native birds (I later find that this is where most people start). Jo assures me that it can. She seems quite definite on this. I tell her that I have looked on the DOC website and found it completely reassuring. She says that it is all PR spin and suggests a few more sources of information.

I ask how experts in the field (scientists) could possibly support a campaign based on shonky science. Jo replies, "There is a disconnect between science and DOC management. DOC seems to have run amok. The actual science shows that DOC's actions are having disastrous consequences. But you can't bite the hand that feeds you – lots of research is funded by DOC." I tell her that I am particularly concerned about keas. Are they vulnerable to poisoning? Could the recent dramatic fall in kea numbers possibly be due to 1080? Jo thinks this is very likely. She

brings up the example of 7 out of 9 radio-tagged kea confirmed dead after a 1080 drop near the small West Coast settlement of North Okarito in 2011. I later source this to an *Otago Daily Times* report entitled, "Seven keas dead in wake of 1080 work". [3] Jo continues, "The awful thing is no-one knows how many kea there are left – an estimate way back in 1986 was 1,000 to 5,000 birds, and 1080 kea deaths have been on-going for decades." I tell her that I can't believe this whole campaign could possibly proceed without strong scientific evidence to support it. I ask about long-term controlled studies. Surely these prove that 1080 is beneficial, even for keas? "Not really, the literature is ….full of ….silly little studies done by DOC people … …..nothing scientific, unbiased, over several years….they put transmitters on birds and watch them and harass them frequently on the nest, and then are surprised when they get eaten by predators … if you're a kea, don't get involved in a DOC study …..…."

I tell Jo I am going to try to write something about this. She is gloomy. She doesn't think I will get anything into the mainstream New Zealand media. Anti-1080 campaigners have apparently been trying for years with little success. I resolve to dig down to the bottom. I want to get some answers that I am happy with. There is obviously controversy and people with strong opinions on both sides. I am not interested in opinions. I want to find out the truth or at least as close as I can possibly get. I am not an ecologist but have read and critiqued scientific papers for many years in a variety of medical fields. I will give it my best shot.

A List of Questions

What is 1080, how does it work and what is its history?

Does it kill native birds, insects or fish? If so, which ones?

What happens to bird populations long-term after repetitive 1080 drops?

How does it affect pest (rat, stoat and possum) populations?

Is it dangerous to humans?

Does it get into water and could it pose a risk to people drinking this water?

Is 1080 necessary to deal with bovine TB?

Who benefits from the aerial 1080 programme and who pays?

If we can't use aerial 1080 for pest control, what other options are there?

How could everyone be so wrong?

To find out the answers to these questions and relay them on to you, Dear Reader, is the purpose of this book.

CHAPTER 2

HISTORY AND WORLDWIDE USE

Compound 1080 goes by several different names. Known in New Zealand simply as "1080", its correct chemical name is sodium monofluoroacetate. Sometimes that is abbreviated to SMFA. It was first synthesized in Belgium in 1896 but was not recognized as a "useful poison" until 1927 when it was patented in France as an insecticide, specifically to kill moths. [4] The same chemical was recognized to be present naturally in a number of plants native to Africa and Australia including varieties of acacia and the "poison pea" plant and is said to have been used by African natives to poison the wells and water supplies of hostile tribes.

The name "1080" came about as it was the "one thousand and eightieth chemical scrutinised during the course of a World War Two project to identify effective rodenticides". [5] During the war in the Pacific, soldiers were at risk of developing a number of tropical diseases, among them scrub typhus which is caused by certain bacteria known as *Rickettsia.* These bacteria are transmitted by lice, which are in turn often borne by rats. Elimination of the rats by 1080 was therefore beneficial to the war effort.

After the war, 1080 began to be used in the US to eliminate gophers, squirrels, rats and later coyotes and rabbits. [4] Its use in bait stations peaked in the 1960s but in 1972 President Nixon

issued Executive Order 11643 banning the use of poisons to control predators on federal lands. Compound 1080 was subsequently completely banned by the Environment Protection Authority (EPA) in 1985 for three main reasons:

(1) lack of an antidote (in cases of accidental human poisoning)

(2) high toxicity to non-target mammals and birds

(3) a significant reduction in populations of non-target organisms and fatalities amongst endangered species (EPA 1985) [4].

A small amount of 1080 remains in use in the United States today in the form of livestock-protection collars, worn mostly by sheep and goats, to poison attacking coyotes. These tend to attack prey of this size with a crushing bite to the neck. In 2007 a petition was presented to the EPA by 11 US conservation groups, including the Sierra Club, the Animal Welfare Institute and the Western Wildlife Conservancy, calling for deregistration of 1080-containing livestock protection collars in view of their potential to poison native and endangered species, including gray wolves, golden eagles, bald eagles, ocelot, badgers and bears. [6]

In Australia, 1080 was first employed to control rabbit populations in the early 1950s and has been used since against dingoes, feral cats, foxes and pigs. Its effect on dingoes has been particularly controversial, especially in view of a report written for the British-based organisation, Universities Federation for Animal Welfare, by Dr Miranda Sherley, scientific officer, Royal Society for Prevention of Cruelty to Animals (RSPCA). [7] Her claim that death by 1080 poisoning could not be considered "humane" and is in fact likely to entail appalling suffering, described by witnesses as "horrific", was widely reported in the Australian news media in 2007. Despite this, and the fact that the dingo is listed as a threatened species in Victoria, that state's

Department of Primary Industries have obtained an exemption to use the poison for pest control, specifically aimed at dingoes. [8]

Even more controversial has been the use of 1080 for control of foxes in Tasmania. [9] This could only be described as an appalling case of scientific error, compounded by media-fuelled pest-eradication mania. A decade-long, multi-million dollar, publicly funded campaign was set up to eradicate European foxes (*Vulpes vulpes*), which were claimed to be causing terrible damage to native fauna. However, an independent scientific review, published in 2014,[10] found no evidence for foxes ever living or breeding in Tasmania at all.

The whole cascade of events was triggered by a 2001 report claiming that around 19 foxes had been released onto the island. Evidence was gathered from analysis of "fox" scats using special technology (the polymerase chain reaction or PCR). Later this DNA was found to have come from other species. PCR analyses are notorious for this weakness in medical and forensic settings. Dr Clive Marks, the lead investigator of the 2014 report, commented, "Here is an example where you can propose that something exists when it doesn't ….and if you follow that narrative with a suitable amount of media and spin doctoring you can get a good proportion of people believing it." According to the news media (ABC) much of the information, "seems to have come from Parks and Wildlife Service (P&WS) personnel, the Australian equivalent of DOC, who have relied on rumour and probably guesswork."

Were there any negative consequences of the phantom-fox 1080 campaign? Very likely. The Tasmanian devil, an endangered native species, was shown to be very interested in 1080 baits (pellets) in a 2011 study before the whole scandal broke. [11] The authors noted that a 6 kg devil would need to consume around nine baits to receive a lethal dose, "… an amount well within the devil's capability at one meal". They also made a comment that I was later to find repeated again and again in the 1080

literature on both sides of the Tasman. "(Fox) eradication efforts on the mainland usually achieve a net benefit for native species despite a certain amount of non-target species mortality" (*my underlining*). [11] These words are ominously familiar to those well versed in the New Zealand 1080 literature, with their implication that "you can't make an omelette without breaking eggs". In this case the omelette (saving native species from foxes) was never made, but the eggs (non-target animal deaths) remained broken.

New Zealand's use of 1080 began in 1954 for control of rabbits that were deliberately released in the 1830s for both food and sport. [12] Subsequent rabbit plagues were associated with economic losses estimated at NZ$50 million per annum in 1999. Subsequently, the introduced Australian opossum (possum) became targeted for control using 1080, primarily because of its *perceived* role as a TB carrier constituting a threat to NZ's burgeoning dairy industry (more on this later).

In the 21st century, 1080 has become the weapon of choice for a grand attempt by DOC to eradicate rats and stoats throughout the nation, aiming for New Zealand to become "predator-free by 2050". Aerial drops began in the 1950s and light planes were used initially, but for the last three decades drops have been carried out by helicopter.

The amount of 1080 being dropped has been enormously ramped up since 2006, both in terms of tonnage and area covered. In January, 2015, the "Stuff" NZ news website reported, "DOC 1080 campaign drops 825 tonnes",[13] [*over 3 months*] and covered "about 550,000 hectares of conservation land". A special helicopter bucket has been developed to facilitate the distribution of bait pellets [14] and changes have been made to bait constituents (cereal or carrot as a base), colour (green) and flavour/odour (cinnamon).

These measures have been aimed at improving its acceptability to "target species" and warding off consumption

by “non-target species” and have met with varying degrees of success. The 1080 concentration in each bait pellet is currently 0.15% or 1.5 milligrams (mg) of 1080 per gram (g) of bait. The density of bait sowing is now 2-5 kilograms per hectare (kg/ha). New Zealand has for many years been the world’s greatest 1080 consumer. We use more than 80% of the total world supply. Writing in the Australian Veterinary Journal, Goh et al. stated that 1080 sowing rates in New Zealand were over 1,000 times higher than rates in Australia”. [15]

So where is 1080 actually made? The answer to this question was, for many years, the Tull Chemical Company situated in Oxford, Alabama, USA. This used to be the sole world supplier of 1080 and is probably still a major one but times are a’changing. The manufacture of 1080 occurs in New Zealand through a Government-owned company, Animal Control Products Ltd. This company changed its trading name to Orillion in 2016 and is physically situated in the North Island town of Whanganui. The facility is reported to produce 5 tonnes of 1080 per year. Orillion is a state-owned enterprise, 50% being owned by the Minister of Finance and 50% by the Minister of Primary Industries. Wikipedia (2016) went on to mention that “The largest number of manufacturers of 1080 …. and fluoroacetic acid ….. are now located in China.”

With its simple chemical structure, 1080 is probably not difficult to manufacture. However, this version of the web page has since disappeared and the amount sourced by the New Zealand government from China remains shrouded in secrecy. In 2015, “Stuff” reported that a Canterbury business called Pest Control Research (PCR) was given approval to manufacture and store bait products, including 1080, at a business park in the town of Rolleston, south of Christchurch. [16] An independent commissioner’s report stated that environmental effects of the proposal were considered “less than minor” therefore the consent application didn’t need to be publicly notified. Some

locals disagreed. A Rolleston resident started an online petition against the plant, which drew more than 2,300 signatures. His concerns included the risk of groundwater contamination and possible accidental spilling of bait. He also felt there was "risk to property values because of the plant being located close to the town."

If this sounds faintly worrying there are grounds for even greater concern. 1080 is considered in some circles to be a potential weapon of mass destruction. A paper entitled "Unusual But Potential Agents of Terrorists", published in the Emergency Medicine Clinics of North America [17] begins, "Emergency personnel are tasked with the daunting job of being the first to evaluate and manage victims of a terrorist attack." Sodium monofluoroacetate (1080) is the first of several chemicals to be discussed; others include the chemical warfare agents, diphenylchlorarsine and diphenylcyanoarsine. A very alarming paragraph follows which I have reproduced in full (with permission):

"In November, 2004, Representative Peter DeFazio (D-OR) asked the Department of Homeland Security to halt production and use of compound 1080 because of its potential as a terrorist agent. In May, 2005, a United States report was released that included a photograph (taken May, 2003) of a Tull 1080 can recovered by coalition troops in Iraq. The Federal Bureau of Investigation, US Air Force, Canadian Security Intelligence Service, and US Homeland Security publicly list 1080 as a poison that terrorists could potentially use to contaminate public water supplies. In December, 2005, Representative DeFazio introduced a bill "to prohibit the manufacture, processing, possession, or distribution in commerce of the poison sodium fluoroacetate," as well as to destroy existing stores of the poison. The last action taken on this bill was in February, 2006, when it was referred to the subcommittee on Crime, Terrorism, and Homeland Security."

Is it not rather extraordinary that New Zealand is now in the process of accumulating this same deadly poison, which is colourless, tasteless and odourless, in large quantities? Rolleston is 24 km from Christchurch, famous as the site of two major earthquakes that occurred in 2010 and 2011 and leveled much of the inner city. They were followed by thousands of after-shocks. The "storage facility" seems to be a converted shipping container, which "is water-tight" and therefore, "unlikely to be adversely affected by any seismic event, including water inundation caused by liquefaction, or by sprinkler activations following a fire." Somehow I do not find this comforting and neither I suspect would the good people of Rolleston.

So, to summarise, New Zealand is the prime world user of 1080. We buy the stuff from American and Chinese sources and it seems we may also manufacture some ourselves on New Zealand soil. We pay for it using money that comes originally from the tax-payer, with additional contributions from ratepayers and farmers via a TB-levy on slaughtered animals. This money is funneled through a government-owned company to pay for the cost of the chemical, its manufacture into pellets, its storage and eventual distribution over our native forests by a fleet of helicopters. It is stored in very large quantities (hundreds of tonnes) at two New Zealand facilities, one in the North Island and one in the South Island. Despite international concerns that it could represent a weapon of mass destruction, its use is escalating year by year, and responsibility for managing this is increasingly being devolved from DOC to the Ministry of Primary Industries (MPI). The 1080 industry is on a roll. Should we be worried? Will it really bring back the birdsong?

CHAPTER 3

1080 POISON HOW IT WORKS

1080 interferes with the metabolic pathway known as the Kreb's cycle, named after Hans Adolf Krebs who described it in 1937. He was awarded the Nobel Prize for Physiology or Medicine for this discovery in 1953. The Kreb's cycle is also referred to as the citric acid cycle or the tricarboxylic acid cycle, after the important chemicals involved in the pathway (Figure 2). It takes place in the mitochondrion (or energy factory) of the cell and is a key part of aerobic (oxygen-requiring) respiration. During this process, the energy stored in food is converted into energy for muscle and nerve function as well as growth. Any creature that has muscles, no matter how tiny, will use this cycle to make them work. Thus, it is fundamental to the maintenance of life in all vertebrates (animals with a spinal column) as well as many invertebrates including spiders [18] and insects such as bees and butterflies. [19]

Fluoroacetate (1080) reacts with acetyl coenzyme A – an important carbon transfer molecule – to form fluoroacetyl CoA. This process has been termed as "lethal synthesis" as it results in a dead end chemical (fluorocitrate) and energy production is blocked (Figure 1, red cross). The creature at the sharp (or dead) end, whether human, dog, bird or butterfly, may succumb completely and die within hours to days (there is no antidote). If a sublethal dose of 1080 is absorbed, whether through the stomach or even through the lungs, there are likely to be long-term negative effects on vitality, immune function and reproduction. [4]

1080 is known as a metabolic poison. Normally the Kreb's cycle provides chemical energy to help run the body, which

can be likened to running the engine of a car. There are many different types of engine but all depend on fuel, which is usually petrol. Adding 1080 to the metabolic process is rather like adding sugar to petrol. It will have a bad effect on the running of the engine, no matter what type of car you drive. In some it may be fatal. A dog in this example would have a highly tuned engine and only small amount of sugar (1080) would be fatal whereas a cockroach has a more robust engine as this species is very resistant to the effects of 1080.

The "LD_{50}" is the lethal dose for 50% of animals tested. In other words, if you have 100 rats and you give 1 mg/kg of 1080 to each rat (this is their LD_{50}), then on average 50 of your rats will die. The lower the LD_{50}, the more susceptible your species is. Dogs are very susceptible with an LD_{50} of 0.06 mg/kg. For a 30 kg golden retriever this would equate to 1.8mg. Five times this amount is found in one 1080 pellet. Rats have an LD_{50} of 1mg/kg and are more susceptible than humans at 2.5 mg/kg. Birds are less susceptible; their LD_{50} 's range from around 2.5-3 mg/kg (finches and sparrows) to 20 mg/kg (great horned owl). [4]

We do not know the susceptibility of many endangered New Zealand species such as the kea or rock wren as this research has not been done (or published). It is important to remember that a very small bird such as a New Zealand tomtit is very easily poisoned by 1080 because of its low body weight. Even if it has an LD_{50} of 10 mg/kg (probably an over-estimate), it only weighs 9 – 10 g. Therefore the average lethal dose for an individual bird would only be around 0.1 mg of 1080. A single pellet contains 9.6 mg, nearly one hundred times this amount. If we consider a 70 kg human, you would need around 175 mg of 1080 for a lethal dose (about 18 pellets) but for a 20 kg child it would only be a third of this amount. There is also the "minimum lethal dose" which is considerably less at 0.7 mg/kg as it takes into account individual susceptibility. For the child mentioned above this would equate to only one and a half pellets.

Animals can take the poison into their bodies in several ways. They may eat bait directly (primary poisoning) or the flesh of another animal that has been poisoned (secondary poisoning). They may drink contaminated water, for example from a puddle or stream into which a pellet has fallen (1080 is highly soluble in water). They may eat leaf litter from the forest floor, into which 1080 dust has become impregnated. The word "adsorbed" is used for the way 1080 can become stuck to the cellulose component of plant matter. In one study, investigating the uptake of 1080 by sugarcane, "a high degree of adsorption … to leaf and root tissue (*was observed*) .. as well as to other cellulosics such as filter paper …". In this experiment, "Desorption (*i.e. disappearance of 1080 from leaves and roots*) …. decreased over a 3-month period". [20] There is also evidence that 1080 can be sucked up by the roots of plants and appear in sap, stems and leaves to poison insects feeding on these plants. [21] When 1080 leaches out of bait lying on the ground, it is usually broken down rapidly by soil bacteria, but at cold temperatures it can persist in active form in soil for many weeks (more on this later). [22]

So let's say an animal takes in 1080 in one of these ways. What happens after that? Nothing immediately. There is a latent period of about two hours. Then, it starts to become unwell and if the dose is high enough, death will usually occur in 10 - 48 hours (although there have been reports of animals surviving as long as seven days). [12] Organs with cells that run hot (with a high metabolic rate), such as the heart, skeletal muscle, brain and kidneys, are most susceptible to malfunction. [15] Mallard ducks given a near-lethal dose of 1080 and then sacrificed two hours later were shown to have areas of cell death (necrosis) within skeletal muscle (Figure 3) and many also were shown to have haemorrhages around the heart. [23] As a result of the block in the Kreb's cycle, citrate typically accumulates in the serum of poisoned animals and reaches toxic concentrations. It binds to calcium in the blood causing the electrical system of the heart

to become irritable. The cause of death varies according to the type of animal but damage to heart muscle (palpitations), lungs (sighing and foaming at the mouth) and brain (convulsions) may all contribute. Death in dogs is particularly distressing as it is accompanied by hysterical barking, howling, running in circles and great agitation, followed by convulsions. Unbelievably, this was classified as "humane" in the 2011 reassessment of the use of 1080 for pest control in New Zealand. [24]

All this seems well outside the realm of normal experience for the average city dweller. However, long before I had even imagined writing a book on this issue, I was myself a party to it for a brief period in the summer of 1975, at the end of my second year of medical school. I had a summer holiday job as a laboratory technician within the Department of Pharmacology at the University of Otago and was asked to conduct a small study in mice. This was designed to investigate whether alcohol could act as an antidote to 1080, reducing its ability to kill at various dosages (it could). I have only faint memories of what I actually did during those couple of months. I was 18 and the seventies were in full swing. My priorities were most definitely elsewhere. However, I have an image in my mind of the poor little mice, after their injections of 1080, getting all hunched up and quivering, then convulsing before being euthanised. I could not do the same now if only because, years later, we as a family had pet mice. I got very fond of Spotty, Snowy and Caramel. Nevertheless, I have witnessed death by 1080 at first hand.

CHAPTER 4

INSECTS AND OTHER INVERTEBRATES

Humankind has not woven the web of life.
We are but one thread within it.
Whatever we do to the web, we do to ourselves.
All things are bound together.
All things connect.

Chief Seattle, 1854

Dr Mike Meads was a Landcare research scientist and respected entomologist with a career spanning 27 years and more than 100 publications to his name. He makes a cameo appearance in "Poisoning Paradise" seated at a desk covered in papers, with evidence of his passion on the walls behind him, including a giant spider. Late in his career, Meads was tasked with surveying the Whitecliffs area in Taranaki to determine the effect of 1080 on invertebrates (a group including insects, spiders and other small things that don't have a backbone). His study was declared invalid and therefore never published. Meads's competence was questioned and according to one report his reputation was "stripped to bloody remains". What did he find? Nine and a half tonnes of 1080 were spread by aerial drop over the Whitecliffs area by helicopter during 1991. Invertebrate populations were assessed during and after the operation, (June 1991 to February 1993). Samples were collected in traps and evaluated by hand every two weeks.

To summarise the principal findings which are referred to in "Poisoning Paradise" and more recently a Graf Boys You-

tube clip, [25] the numbers of forest floor insects plummeted and remained low for a year after the poison drop. This would have had effects further up the food-chain for insect predators (birds), which could have starved, but that outcome was not explored. Insect larvae dropped dramatically. DOC Wanganui (in those days there was no 'h") claimed successful killing of 90% of possums and more than 80% of rats but apparently 78% of baits were "still present" and degradation of the 1080 was "much slower than previously thought ….about 25% of the 1080 may therefore have persisted more than three months after the poison drop at Whitecliffs".

The Whitecliffs report [26] was peer-reviewed and approved on five occasions by Landcare research scientists. However, a sixth review conducted by an un-named scientist led to the survey being branded as invalid. That scientist remains a shadowy, backroom figure to this day. [27] It was proposed that the control site could have been contaminated by 1080 due to heavy rain (always an issue in New Zealand). It was also implied that Meads had tampered with the data by moving baits that had not fallen correctly, closer to the pitfall traps, thus invalidating the results. The overall outcome was that Meads was publicly (within scientific circles) humiliated. He himself concluded, "I was able to prove that 1080, by air, was damaging in the long term to the forest and undoing what they were trying to do. They are just wantonly killing invertebrates". Ten days before Meads was scheduled to present his report to the Royal Society of New Zealand at an international symposium on 1080 in Christchurch, he was made redundant. He described himself as having been "naïve". "It did not dawn on me that these things go on in politics".

Reading through the Meads report, which is available on-line, [26] I was struck by its clarity and apparent scientific rigour. It is disturbing, describing in unemotive language the decimation of insects in the 1080-drop zone. To quote directly: "The insects

associated with breakdown of the leaf litter were the most severely affected by 1080, which adsorbs to cellulosic leaf-litter and persists in litter for at least 3 months." Although breakdown of 1080 takes about 30 days at 23^{0}C it occurs much more slowly in winter when leaf litter temperatures vary between 4.3 and 10.6^{0}C. [28] I remember walking into the Caples Valley in July 2015, almost a year after the massive 1080 drop of 2014 into the Routeburn, Greenstone and Caples valleys. Icicles were everywhere. Those deep valleys see very little sun during the winter, meaning freezing temperatures for months on end. 1080 could take a very long time to degrade. When we dragged in wet and rotting wood to try and light a fire (with limited success), I remember noticing there were no spiders. Was that significant?

More recently, on a trip to the Routeburn Flats hut, our party was surprised (and pleased) by the lack of sandflies, usually present in great clouds in the Routeburn and Dart valleys. Could there be any link with the 1080 drops nearby? Mosquito larvae are apparently extremely sensitive to 1080 and a U.S. study quoted in Appendix C of the New Zealand Environment Risk Management Agency (ERMA) review of 2007, found 15% mortality even at the very low 1080 concentration of 0.025 mg/L. [29; 30] I learn that 1080 has been used experimentally as an insecticide in the United States and according to Notman et al. "the few insects studied so far have been found to be very susceptible to it". [31]

Immediately following the near-release (and then suppression) of the Meads report, Landcare commissioned a different scientist, ornithologist Dr Eric Spurr, to perform another study [32] using similar methods to monitor populations of all sorts of insects in a poisoned area versus a control area. Dave Hansford in his recently published book "Protecting Paradise" mentions the paper and uncritically reports that "post-drop the researchers found no meaningful differences in the numbers of amphipods, ants, beetles, weevils …". [33] While this statement is

true, Spurr's study has been labeled as seriously flawed by others. I refer now to the results as seen through the eyes of Drs Pat and Quinn Whiting-O'Keefe, who audited DOC 1080 research in 2007 and produced an 88-page monograph reviewing more than 100 scientific papers entitled "Aerial Monofluoroacetate in New Zealand's Forests. An appraisal of the scientific evidence." [27]

The Whiting-O'Keefes hail from the United States but have been New Zealand citizens since 2002. Dr Quinn Whiting O'Keefe is by an extraordinary coincidence, like me, a rheumatologist but is also qualified in statistics, mathematics and chemistry. Previous positions in America included a stint as Associate Professor at the University of California, San Francisco (UCSF), where he held dual appointments in Medicine and Medical Information Science. He has extensive experience in analysing scientific methodology, in other words working out whether scientists are using the proper experimental and statistical techniques when they report the results of their experiments.

The Whiting-O'Keefe team cast their steely gaze over the Spurr study and pointed out that control areas were 4 km and 7 km away from poisoned areas, so may not have been directly comparable. More concerning, the numbers of insects counted before and after poisoning were so low that the study could only have detected an effect from 1080 if more than half of the insects had died. [32] Spurr himself acknowledged this weakness. [27]

Reading the original version presented in Christchurch in December 1993, [34] another flaw becomes obvious. Insect populations fell dramatically between 3 and 6 months after the poison drops, even in the non-poisoned areas. These were the months of June to September 1992, so we are seeing the normal die-off of insects in response to winter temperatures. Such a major fall (to almost no insects at all in some instances) due to a powerful outside influence (the cold) would have completely camouflaged any difference between control and poisoned areas.

The study finished there and did not extend to the following spring and summer, when numbers would be expected to bounce back and when a comparison between 1080'ed and control areas would have been most meaningful. Spurr himself comments in the discussion, "sublethal doses of 1080 may have delayed effects on the reproduction …. that would not be detected 3-4 months after winter poisoning operations". He concluded, "Further research is required ….."

Another paper describing in detail the effects of 1080 on insect life, comes from Lloyd et al. This was published in 2000 in the New Zealand Journal of Ecology. [35] The area studied was a region of beech forest on the southern slopes of Mt. Ruapehu in the central North Island. The aim was to investigate whether secondary 1080 poisoning might occur. Would it be possible for insectivorous birds such as tomtits and robins and also short-tailed bats, to consume sufficient quantities of insects containing 1080 to acquire a lethal dose? The answer was unequivocally, "Yes". Insects in the pitfall traps were examined and found to include *Ctenognathus adamsi, Saphobius squamulosa,* and *Gymnoplectron tuarti.* These impressive sounding creatures are otherwise known as beetles, weevils and wetas. They contained 1080 at concentrations ranging from 14 to 130 ug/g. A tomtit would only need to eat 1.3 g of poisoned insects (15 % of its daily intake), to take in a lethal dose. Short-tailed bats, an endangered native species, would be at even greater risk because, as mammals, they are more sensitive than birds to this poison. They would only need to consume 0.04 g of poisoned insects, representing less than 1% of their daily food intake.

This study has been referred to in several other more recent papers and therefore seems to be regarded as a reliable source of information. [36] The findings support Meads who found that the most severely affected groups were beetles, springtails, flies and harvestmen spiders. Interestingly, wasps were relatively resistant. The Hokuri Creek hunters of saw a lot of wasps three

months after 1080 was dropped in that remote Fiordland valley. Does 1080 confer a survival advantage to wasp species? Just another of the many unanswered questions surrounding the effect of 1080 on invertebrates.

What other information is there about the susceptibility of insects to 1080? A 2005 study by Powlesland et al. took place in the Whirinaki Forest Park (now the Whirinaki Te Pua-a-Tane Conservation Park), North Island, about 100 km southeast of Rotorua. [37] The abstract concludes, "Our results, and those from two other similar studies, suggest that aerial 1080 poison operations are unlikely to have a detrimental effect on invertebrates that occupy cavities above ground." This struck me as a rather odd statement. We are really most interested in forest floor insects, i.e. those dwelling on or under the ground. Baits will fall through the forest canopy directly on top of them and their small dwellings. As they tend to live in leaf litter, 1080 stuck to leaves and twigs (or "adsorbed" as described by Meads) could be lethal. Powlesland's methods explain that artificial refuges were built and attached to trees about 1.5 meters off the ground. Each refuge was 0.65 m long and contained 10 cavities, including one large one at the top to accommodate harems of Auckland tree weta (!).

Invertebrates found most frequently in these artificial refuges were cave weta, tree weta, cockroaches, spiders and slugs. An area poisoned with 1080 was compared with a control area. What did they find? According to the authors, 1080 had no detrimental effects on invertebrates. However the Whiting-O'Keefe team found huge flaws in study design and reporting including extremely small numbers per group and ridiculously large confidence intervals (used by statisticians to describe a range of values within which the true value should lie). They concluded that the study was so badly done that it was "totally meaningless and should be ignored …". [27] This, combined with the fact that only insects high up in the trees were studied and that weta are

peculiarly resistant to 1080 anyway (with an LD_{50} of around 92 mg/L) [38] and therefore almost certainly not representative of insects overall, means that I remain unconvinced.

Dr Sean Weaver (PhD), senior lecturer in environmental studies at Victoria University in Wellington has written about the problem of sub-acute poisoning in insects that survive a 1080 drop. He states that "short term mortality data ……is a net that would not necessarily be capable of catching any evidence of harm". [39] What might happen to weta or weta offspring after 6 months, 1 year or 5 years? Nobody knows because nobody has looked at this question. What about other insect species? A further dig around in the literature reveals a study from Sweetapple et al. on the effects of 1080 on populations of ground-dwelling invertebrates including beetles, spiders and weta in the Mokau region near Taranaki. [40] Two years after a 1080 drop, their numbers in the "possum control zone" (*poisoned with 1080*) plummeted to near-zero levels (Figure 4). There was also a dramatic effect on rat numbers, which soared. The authors concluded that, "possum-only control may have negative long-term consequences for robins and ground invertebrates." However, when contacted, Peter Sweetapple added a rider, "just be aware that the data has a fairly small sample size, has not been robustly analysed, and has not been peer reviewed."

In summary we have the following evidence to balance up: a study providing strong evidence that insects in the drop zone contain concentrations of 1080 which are likely to poison the birds that feed on them, a banned survey from a very reputable scientist that suggests a sweeping massacre of insects in 1080-treated forests, two hopelessly underpowered negative studies with major methodological flaws (one of which focused on highly artificial above-ground "tree refuges"), a study proving that weta may accumulate high levels of 1080 after an aerial drop, and a study of common ground-dwelling insects that shows a massive fall in numbers, two years after poisoning. This

is not all the insect literature by any means but it is enough to indicate that opinions are deeply divided. Whom do we believe?

To help me make up my own mind I searched for information from other parts of the world. Unfortunately, 1080 has not been used as an insecticide for several decades so I could find nothing recent. However, I was able to unearth an old paper written in 1950 for the very prestigious journal Nature entitled, "Sodium fluoroacetate (*1080*) as a systemic and contact insecticide". [41] Despite being 66 years old, it is still relevant. The basic components remain the same today; 1080 (which is still the same chemical), aphids (which are still aphids) and broad beans (ditto). The experiments were carried out in a greenhouse. 1080 was found to be highly effective as a contact insecticide when applied to the leaves of the bean plants so that, "the lowest concentration giving a complete kill (*of aphids*) was 0.001% w/v" (*weight in grams per 100 mls*) and this was effective after two days. A more concentrated solution was effective for five days. In other words, 1080 dust raining down through the forest canopy and coming into contact with water droplets, will splatter over the leaves of shrubs and trees and sit there, remaining poisonous to many insects, for up to 5 days. But there is more. Under a subheading "Absorption from roots" we learn, "Tests made in plants growing in soil and in sand-culture showed that (*1080*) was a highly effective systemic insecticide. As little as 1 mg added to a 3 ½ inch diameter pot containing about 400 g of soil, freed the plant from aphids in 5 days. In sand, 0.1 mg was effective. The treated plants remained toxic to aphids for ten days or more..". Even more effective was adding "1080 water' which was happily sucked up by the bean roots. Complete kills were obtained on plants "supplied with 100 ml of 0.00005 % w/v solution; that is a maximum of 0.05 mg per plant weighing 10-15 g". When you think that a single 1080 pellet contains 9.6 mg of chemical it is apparent that any aphid-like insect feeding on the sap of plants resident in a 1080-poisoned forest is extremely

likely to succumb. Maybe that's why there were no sandflies at Routeburn Flats last year.

Bill Benfield, environmentalist and author commented, "Insects can be by many times the greater part of the forest wildlife than animals and birds. It is likely that there would be around 60 to 80 kg/Ha of native worms. To that must be added the beetles, grubs, maggots, wasps, flies, cicadas, leaf eating stick insects, weta, centipedes and the wood borers …". He goes on to note that the effects of cyclically poisoning this mass of insects would "increasingly jeopardise the health of the whole forest". [42] New Zealand's unique and fragile ecosystem, like all biological systems, comprises wheels within delicately balanced wheels, as complex as a Swiss watch. Plant, insect and animal species interact and interlock with grace and accuracy. Except when *homo sapiens* comes clumping in with great heavy boots, aiming to "improve" things.

CHAPTER 5

CARO

Caro is a force to be reckoned with. An attractive blonde woman, just turned 40, she has a permanent tan from an outdoors lifestyle and strong opinions about the environment. She is tough. Her small cabin is off the grid. She gets power from a windmill and some solar batteries but that's not enough for hot water heating. She has an outside bath heated by portable gas canisters. This all sounds idyllic in the middle of summer but winters here are cold, -10^{0}C for more than a week on end in July 2016. She was born and grew up in Germany and first decided she wanted to travel to New Zealand around the age of 16, when she learned of what she calls "its beautiful nature" from pictures in travel magazines. But it remained "a far away land - a dream, yet to come true". Caro studied in Germany during her twenties, exploring interests in nutrition and health and entering the career path of marketing and communication. At the age of 30 she packed up and moved permanently to New Zealand to create a new home. After travelling for some months, trying to find her perfect place, she settled on the West Coast of the South Island, and moved into a beach hut at Hari Hari, near Hokitika. She recalls her fascination with the Coast, "It was wild, no people there, nature completely in charge over humans". She made connections with locals; bushmen, fishermen and gold-miners.

Caro remembers how she first became aware of the use of 1080 and its environmental impact.

> C: "I was just settling into my new lifestyle on the West Coast - living on a remote beach with a couple of locals, who were mining for gold. I had only been in New Zealand for approximately five months and was amazed by the

natural beauty of the native fauna and flora, pure, wild and clean…with plenty of space, my new home. To get to the beach where we were living and mining, we had to drive though 20km of bush, along abandoned forestry roads. The native bush had claimed back the land, and the loggers and machines had left a long time ago. I was fascinated by the narrow drive along the remote coastline to the beach. The rainforest was rich and lush, totaras, rimu and kahikateas. After living there and absorbing my new surroundings for a few months, I had to go back to Germany to finish off some ties. The moment I returned I was excited, and couldn`t get back to my beach fast enough.

I remember it like yesterday, the goose pimples on my body, the happiness followed by a deep scare and sadness…..We turned off the main highway onto the forestry road, taking us deeper into the bush towards the beach…but I could feel that something was not right. It all felt exhausted, sick and sad… a weight on the once flourishing aura surrounding the bush….I kept looking for anything that could describe my sudden feelings inside, absorbing what was rising within me…trying to understand why the trees were so sad and in pain….I quietly asked my friend who was driving, ”What happened since I have been away? “He asked me, “What do you mean by that!” I explained that I could tell - with my own emotions - that the forest had changed, that there was something invisible that made the trees sad and tired……We only needed to take another turn on the gravel road and for the first time I saw the signs: “1080 POISON, Do NOT touch baits, do NOT eat animals from the area, Poison baits are DEADLY to dogs!” A sudden rush of pain and sadness crept over my body. I did not understand. I did not believe that New Zealand was poisoning the forest! Trees, the water, the life of everything….and nobody seemed to even realise that

it affects the plants! Of course I now wanted to know all about it and my questioning started…. Over the years I have done extensive research, sourcing different papers from both sides, and talking to individuals who have lived in poisoned areas for many decades. I have watched the actions taken by the New Zealand government in spreading 1080 and I have talked to people who work for the Department of Conservation. I am not an activist but I am curious and deeply concerned about the level of general ignorance. It is undeniable: 1080 kills everything!

Caro's organic and spray-free garden in Glenorchy is well known to locals. Her fresh green peas are a gastronomic treat - hard to stop eating once you start. Her veggies really do taste so much better than the hydroponic ones from the supermarket. Why? Here is her explanation:

"Even a tree can feel your aura. Gardening is an exchange. You are having a relationship with the plants, the same as you do with people – it is two-way. You give to the plants and they give back to you. Working with plants, the environment and health on a daily basis has allowed me to learn about and experience the connection between the micro- and macro-cosmos. Modern science and ancient knowledge combine to shed light on the subject of poisons and how they affect the balance of nature. To me, it seems the government is ignoring those facts, in order to establish dominance over nature. This infringes upon the basic human right to live in a clean environment. People underestimate the impact of 1080 poison. It will have long-term consequences. The same mind-set leads people to believe that GM food is safe for human consumption, and that for example glyphosate and the neonicotinoids (*another form of insecticide*) don't do any harm. The question that we need to ask ourselves and the government

> is: Why are we not prepared to change how we view these things? Is it because of fear? Why not acknowledge Gaia as a whole living being? I believe we should try a completely new approach; a path of understanding and acceptance, incorporating a deep respect for the environment. Isn`t it foolish to try and establish ourselves as rulers over Nature; disrupting her balance in order to exert our own control?"

Many would dismiss Caro's concepts of "energy fields" surrounding plants and permeating the environment as New Age thinking, but these ideas have currency with some established scientists. Rupert Sheldrake and his theory of morphic resonance [43] has made its mark on modern western consciousness. New ways of thinking are opening up and increasingly they are coming under the umbrella of "science".

Recently, quantum physics has provided some fascinating insights into plant biology, taking as one example, the way chlorophyll works. This magic molecule catalyzes the transfer of light energy from the sun into chemical energy within all green plants. The mystery centres around how this could take place so rapidly and perfectly. Biophysicists have now proposed that energy moving from the "light receptor" area to the "reaction center" of the chlorophyll molecule, must exist in a quantum superposition state, traveling along all molecular pathways simultaneously. [44] This phenomenon is known as quantum coherence [45] and is best imagined as an expanding wave, moving outwards in all directions at once, like ripples on a pond. Once the fastest road is found, the system adopts this route, so that all the energy takes the shortest path every time. It is a concept that steps outside the bounds of traditional biochemistry.

If such "coherence" does exist, why would the wave stop at the boundaries of the plant itself? Why not permeate through to insects that live on the plant, animals that eat them and indeed ourselves? This accords with the Gaia hypothesis formulated

by the chemist, James Lovelock, [46] and co-developed by microbiologist Lynn Margulis in the 1970s, [47] which considers all life-forms to be part of one single living planetary being. It is also found in the ancient Hindu vedas. According to those teachings, "prana" is the original life force that pervades every physical manifestation of life, taking different forms as it passes through different densities of matter that vibrate at different speeds. Caro's garden is living proof that being "kind to the earth" results in delicious vegetables and herbs. The practice of spreading poison throughout the environment is diametrically opposed to this and according to Gaians is very likely to result in harm, with consequences for ourselves as well as other species.

CHAPTER 6

OF ROBINS, TOMTITS AND BLUE DUCKS

The Te Ara encyclopedia of New Zealand features information about the devastation wrought by introduced animals and pests in this country. [48] The opening page quotes the journal entry of botanist Joseph Banks, who travelled with Captain James Cook on his first New Zealand expedition of 1769. Banks was describing the dawn chorus, as heard from Cook's ship the *Endeavour*, while it lay at anchor in the Marlborough Sounds.

> "This morn I was awakd by the singing of the birds ashore from whence we are distant not a quarter of a mile, the numbers of them were certainly very great who seemd to strain their throats with emulation perhaps; their voices were certainly the most melodious wild musick I have ever heard, almost imitating small bells but with the most tuneable silver sound imaginable to which maybe the distance was no small addition."

The young botanist, standing on the deck of his ship, was transfixed by this most amazing sound, which evidently went on for some time as the birds,

> "begin to sing at about 1 or 2 in the morn and continue till sunrise, after which they are silent all day like our nightingales.'".

Things have changed and not for the better. Te Ara continues, "These forests are mostly silent now, as predators such as rats and stoats have exterminated many bird species." So, the logical conclusion must be that all good, thinking people should support

the aerial 1080 campaign to rid ourselves of rats and stoats and "bring back the birdsong". It sounds as enchanting as "The Sound of Music". Accordingly, our forests have been heavily bombarded with aerial 1080 for more than two decades in the name of pest control. Is there deafening birdsong now? This depends on whom you believe, as encapsulated by the following two letters sent to the Waikato Times in 2009, [49]

> Correspondent 1. "I am keen to take Murray Dench (Waikato Times letters, November 18) to an area in the Pureora Forest to hear the amazing dawn chorus…. (*which is*) loud and long.."
> John Davies, Cambridge.
>
> Correspondent 2. "In my observation as a regular visitor to the Pureora Forest, the effects on birdlife have been absolutely catastrophic. The small birds, such as the fantail, robin, tit, bellbird and wren, have to all practical intents and purposes been wiped out."
> Mike Holmes, Hamilton.

Who is right? John or Mike? Could 1080 actually be killing the birds?

"By-kill" is what the United States Environmental Protection Agency (EPA) terms "the killing of non-target organisms". This was one of the concerns that led the EPA to cancel registration of 1080 as a pesticide in America in 1988. The official report states "sensitive non-target mammals and birds may consume lethal quantities of 1080 from poisoned baits or from consumption of organisms fatally poisoned with 1080". The DOC rationale for ignoring this warning is that New Zealand (unlike America) does not have native mammal species, apart from bats. Birds are significantly less susceptible to the poison than mammals. So the million-dollar question becomes "Does 1080 kill native birds?" The answer is unequivocally, "Yes". Even the official

DOC website admits this as follows: "Tomtits and robins are the most vulnerable native bird species, but as they are prolific breeders they recover quickly and thrive as a result of the reduced predation that follows successful 1080 operations." Note the word "thrive". Where does the information about tomtits (*Petroica macrocephala*) and robins (*Petroica longipes*) come from?

In "Aerial Monofluoroacetate in New Zealand's Forests. An appraisal of the scientific evidence", the Whiting O'Keefes described, "The egregious case of robins and tomtits". [27] To understand why the authors felt this was egregious, it is necessary to briefly review the relevant scientific papers. Three studies by Powlesland et al., published in 1998, 1999 and 2000 [50; 51] are of exceptional importance to the whole 1080 debate because; a) they are frequently cited as evidence for the benign and indeed beneficial effects of aerial 1080 and b) they are amongst the few long term studies of the influence of 1080 on bird populations. If you looked up Wikipedia (1080 – sodium fluoroacetate) during 2015/2016 (the entry has since changed completely), you would have found the following:

> "On the other hand, many native New Zealand bird populations have been successfully protected by reducing predator numbers through aerial 1080 operations. Blue duck…… tomtit, [56] South Island robin, [57] North Island robin, [58]…… have all responded well to pest control aerial 1080 operations, with increased chick and adult survival, and increases in population size."

References 56 and 58 are the Powlesland studies. Unfortunately they are confusing and hard to read. One reason is that the "1080 treatment" region, used for the first year of observations in 1996, was then changed to being a control area for the 2nd year of observations in 1997. Thus, the 1080 dropped during the first year could have led to a reduction in control bird numbers for the

2nd year, muddying the results. If we ignore that serious design flaw, the findings were as follows:

1) There was significant by-kill of robins in 1996 and 1997
    a. In 1996, 12 out of 28 robins (43%) disappeared 2 weeks after the poison drop compared with none out of 24 robins in the control area. Some of these robins were autopsied and muscle samples revealed 1080. One of the autopsies revealed the gizzard to be full of insects (but 1080 levels in the insects were not measured).
    b. In 1997, 3 out of 35 robins (8.6%) disappeared from the poisoned area compared with one out of 42 robins (2.4%) in the control area.
2) There was also significant by-kill of tomtits in 1997
    a. 11 out of 14 banded tomtits disappeared in the "treatment" area compared with none out of 9 banded tomtits from the control area
    b. Three dead un-banded tomtits were found and autopsied. Muscle samples (wing and leg) tested positive for 1080.
3) During the 1998 season no birds in the poisoned area were recorded as having died. The authors attributed this improvement to a change from carrot to cereal based-bait (although that seems odd as one might expect birds to be more interested in cereal). Much less bait was sown per hectare. In 1997, the dose of 1080 was 8 grams per hectare (g/ha) but in 1998 this was halved to 4 g/ha (*2-3 g/ha used currently*).

The PR take on this is as follows: "Old studies used doses that were too high. The new pest-control dose (*note the term "1080" is now usually omitted*) is 'safe for birds'." This might

sound reassuring but is reminiscent of arguments from cigarette manufacturers that their product is safe if nicotine levels are reduced or they are smoked with a filter. There is no "safe number" of cigarettes that will eliminate the risk of chronic airways disease, heart disease or lung cancer. Similarly, a 1080 pellet, landing at the feet of a native bird and eaten, will likely cause it to die. One of the hunters from Chapter 1 commented: "We saw dead deer up the Hokuri creek. If its enough to kill a deer, its enough to kill a tomtit". Too true. It is also important to consider that reducing the number of pellets per hectare would have less effect on targeted species (killing rats being the whole point of the exercise). Therefore rat numbers might bounce back more quickly than expected. The evidence that this does in fact happen appears in a later chapter.

To return to the Powlesland studies, another factor that was felt to contribute to the high bird by-kill of the 1997 operation was the large amount of "chaff" (small fragments) in the carrot baits used. Cereal baits can also crumble and produce "1080 dust". Wright et al. studied how this dust could drift over the edges of the poison zone. [21] They commented, "While the 1080 concentration found in the bait dust was much greater inside than outside the treatment areas, results were less clear for the soil, leaf litter, and plant samples. In some of these cases, similar concentrations of 1080 were found outside as inside the treatment areas. These results indicate that bait dust can drift outside the boundaries of a treated area up to and possibly more than 1,000 metres (*my underlining*)." Makes you wonder about the safety of operations on a windy day.

The second major conclusion of the Powlesland studies was that aerial 1080 was associated with improved nesting success for the tomtits and robins. Many recent publications on the effects of 1080 in New Zealand also use nesting (or fledging) success as a measure of outcome. [52; 53] It is a sure-fire winner for those who want to show benefits.

Rat populations are always knocked right back by 1080 and this will usually lead to improved bird nesting success over the next 6 – 12 months, as there are fewer rats to eat the eggs. However, nesting success is only an interim measure and cannot be used to indicate long-term effects at a population level. It is artificially improved when bird numbers are low (as may be the case if many have been poisoned) because there will be less competition for nest sites and more food for chicks. More importantly, it does not capture the poorly studied consequences of sub-lethal poisoning of chicks and adult birds. Thus, information about bird populations is critical and this is why the Powslesland studies are so important. So what did they find? Amazingly, population data are not even mentioned in the abstracts of these papers (which is often as far as people researching the literature will get). Nevertheless, with persistence you can find the answer. 1080 application **did not improve bird survival at a population level**. Thus, the quote from Wikipedia, that "tomtit… and North Island robin …. have responded (to) aerial 1080 operations, with ……. increases in population size" was true but misleading. Robin populations were checked before and one year after each poison drop. Prior to the 1997 drop, there were 49 robins in the control area. One year later there were 57 robins. For the 1080 area, there were 35 robins pre-drop and one year later there were 48 robins (no significant difference between groups). [27] Thus, there were increases in population size in both poisoned and non-poisoned areas but no relative advantage in the poisoned area. Why not? Because it is more complicated than just nesting success.

The hypothetical effects of 1080 on bird numbers are illustrated in Figure 5. After the poison drop (A) there is a fall in the bird population due to direct poisoning. This is followed by another fall (B) due to secondary poisoning as birds feed on poisoned insects or the carcasses of poisoned deer or possums. Both (A) and (B) depend on the LD_{50} of the bird species

involved, their weight, their diet and how much food (and bait) they consume. Subsequently, there may be a positive effect on the population (C) due to improved nesting success as predators such as rats are knocked down and populations respond to culling by the poison. Then, lastly (D) there may be a late fall in the bird population if sub-lethal poisoning means that adult birds cannot reproduce and replace themselves when they die (1080 is a reproductive toxin in some species, possibly including birds). [54; 55] As rat numbers bounce back (usually after 1-2 years), their numbers often escalate to reach very high levels [56] resulting in increased predation and a further loss of birds.

Birds that are omnivorous (such as the kea) may be victims of both direct and indirect poisoning. Those that are carnivorous (like the morepork) are most at risk from eating poisoned carcasses while those that are insectivorous (like fantails, tomtits and robins) could consume poisoned insects. They may also pick directly at cereal baits (as shown in Poisoning Paradise). [2; 57] If a massive insect kill occurs (as suggested by Meads), that would lead to a calamitous reduction in food supply resulting in starvation of many species. Each of these factors would operate to a varying degree depending on the species involved. Species 1 in Figure 4 could be the tomtit or the robin, having a large capacity to reproduce and regain numbers after primary and/or secondary 1080 poisoning. By contrast, Species 2 has a very limited reproductive capacity. Examples could include the kea, (the female will usually lay a single clutch of 2-5 eggs each year) and the kiwi (1-2 eggs per year). Compare this with the reproductive capacity of the rat. A breeding pair can produce more than 800 offspring in a year. They contribute to the late fall in bird numbers as their numbers leap up as early as 10 months after the 1080 drop, [56] at a rate vastly greater than the birds.

The reproductive toxicity of 1080 remains almost wholly unexplored in New Zealand fauna. Some birds will almost certainly receive a sub-lethal dose. Could this lead to infertility?

Weaver et al., commented, “Any close scrutiny of the 1080 science literature will find that the majority of studies on the risks of 1080 to non-target animal populations have focused on acute and severe effects”. His 2006 paper focused on chronic poisoning and the possibility that breeding could be interfered with long-term. [39] He cites evidence for:

1) Damage to the testes in rats - from a miniscule quantity of 1080 at 6 parts per million (ppm) [58]
2) shrinkage of the testicular cell layer that contains the spermatogenic (sperm-forming) cells in skinks [59]
3) greatly reduced plasma testosterone levels in skinks [59]
4) Abnormal foetal development (teratogenicity) in rats, with skeletal deformities, including bent ribs and forelimb abnormalities [55]

It is worth noting that when new drugs destined for human use are tested for foetal toxicity and teratogenicity, this is usually done in the rat. This has been common practice since the thalidomide scandal of the 1950s when that drug caused limb deformity in babies born to pregnant women who took it for morning sickness. Of course the precious birds of the New Zealand bush (including the kiwi) have not been the subjects of any studies investigating the reproductive toxicity of 1080. Nothing has been done along those lines at all. It all reminds me of the fundamental medical precept of Hippocrates (460 - 377 B.C.), “Primum non nocere”, or “First do no harm”. This is advice that DOC might do well to heed. In the words of toxicologist Charles Eason, “Considerable care must be taken when using 1080 to ensure that the risks of its use are outweighed by ecological benefits achieved”. [12]

The Powlesland studies were termed “egregious” by the Whiting-O’Keefes for a number of reasons. [27] These include the following: the “Abstract” sections cast study findings in an overly positive light (many people only ever read the abstract

so this part of the paper is particularly important), there were major flaws in the use of statistics (in some instances P values were omitted altogether) and "bad news", such as the terrible bird mortality from direct 1080 toxicity, was often relegated to small paragraphs buried in the middle of the "Results" sections. Many of these problems are mentioned by Ben Goldacre in his book "Bad Pharma", [60] which critiques the skewed reporting of medical drug trials as practised by drug companies deliberately seeking to cast their product in a good light. The preferential reporting of positive results is common and not restricted to drug-company funded clinical trials. My own experience as a reviewer and editor within the world of medical academia over the last two decades certainly confirms that many authors write their papers this way, and those journals that do not have a strict review process let them get away with it.

Are there any newer long-term studies of tomtits or robins? Go to the website "1080 facts.co.nz" and look under the heading "Case Studies". The following appears (*quoted verbatim*):

> "Researchers found that aerial 1080, applied in the Silver Peaks region in Otago, shows that the pre-fed 1080 operation at Silver Peaks had no negative effect on the robins, 1080 knocked the possum and rat numbers down to almost zero, and robins' [*sic*] experienced relatively high breeding success when predator numbers were low."

This sounds reassuring but a closer look reveals a few problems.[36] Firstly the number of robins banded and then re-sighted one year later was extremely small; 19 birds in the 1080'ed area (all of which survived the poison drop) and 15 birds in the non-1080'ed (control) area. So this study suffers from the problem of low numbers and can hardly be used to suggest that aerial 1080 is safe for birds country-wide. Secondly, the 1080 drop was not shown to boost the population of robins at Silver Peaks. Results of an "ongoing 5 year study" are not yet available. It

should be recalled that rats typically bounce back 1-2 years after a 1080 drop [56] with predictable effects. The scientists writing the paper make these points quite humbly and urge that "further replication is necessary". However, the results were spun in a gigantic PR candy-floss machine so that the headline becomes "Robins thrive after 1080 drop, study finds". [61] Trouble is, when carefully examined the good news seems to disappear almost entirely, leaving only a bitter taste.

How then would I sum up the case of the robins and tomtits? Egregious or its Oxford dictionary definition as " shockingly bad" is indeed a suitable descriptor. It is definitely egregious that these happy little chappies, which alight on trampers' boots so trustingly and often feature in holiday snaps for that very reason, should be poisoned in such an ugly and agonizing way. Even the name "tomtit" sounds light-hearted and slightly silly but there is nothing silly about death by 1080. Must they be poisoned at all? DOC workers would gravely affirm that their sacrifice is necessary for the greater good and only soft-hearted (and soft-headed) greenies could possibly question this.

The official line is that 1080 confers a population benefit, despite initial by-kill, because of a reduction in predators, but this is not borne out by a careful inspection of the evidence provided by the Powlesland and Schadewinkel studies. The medium-term result for the birds (as far as it can be gleaned from the limited information available) is "No gain". What are the long-term effects? Unknown. Obfuscation, or "the obscuring of intended meaning in communication, making the message confusing, willfully ambiguous, or harder to understand" is another word that could be applied to this debate.

The 2016 Wikipedia claim that dropping 1080 onto the forest is advantageous to bird populations included a reference to the endangered blue duck (*Hymenolaimus malacorhynchos*) or whio. It takes me a very long time to find out what they are talking

about. The trail takes me to a paragraph in a 1997 paper that states: "…blue ducks are potentially at risk from prey-switching by predators such as stoats and cats after large reductions in rodent numbers after 1080 application." [62] This is not reassuring. It basically means that, when a stoat can't find a nice juicy rat for dinner (because all the rats have been killed by 1080), he may direct his predatory gaze towards a blue duck. I do eventually find one study from August 1994 (although not published until 1998). This states, "all 19 radio-tagged blue ducks survived for at least four weeks after aerial application of carrot bait (15 kg/ha, 0.08% 1080) in Waihaha, Pureora Forest Park." [63] That figure of 15 kg/ha is a staggeringly high concentration of 1080 to be dropping on a forest and is in itself quite shocking. The reference to "four weeks" means the study duration was ludicrously short and the numbers again were extremely low.

I try to find more work by Greene et al. on the blue duck but reach a dead end. There was a publication in the Maniapoto Hunters' Newsletter – which is no longer available. None of this proves that no harm will come to the whio from the application of 1080, not by any stretch of the imagination. Mallard ducks poisoned with 1080 develop muscle necrosis (Figure 5). [23] Isn't it very likely that something similar could happen to the whio? Meanwhile, the campaign grinds onwards and ever upwards. More helicopters, more DOC staff involved, more forest areas being "opened up" for "treatment".

CHAPTER 7

BLACKMAIL

New Zealand is indeed a small place. It turns out that I know the most notorious pesticide criminal of our age, Jeremy Kerr. His late wife was a dear friend of mine. She died tragically of disseminated breast cancer a few years ago. Much too young at 45. Jeremy was very quiet after that until he burst into the collective New Zealand consciousness with his crime of trying to blackmail Fonterra by sending them an envelope containing high strength 1080 powder and threatening to put it into infant milk powder, much of which was bound for China. A threat to our main export industry, which according to some estimates cost the country NZ$37.5 million, a threat to relations with China, which seem to underpin much of our economy, and a threat to our "clean and green" image. [64] The motive remains a mystery. According to the Christchurch *Press*, it was money. Jeremy ran a company making cyanide pellets - an alternative to 1080 for pest-control. He himself claimed that he had been suffering poor mental health at the time and "cracked". To me that seems likely. It would have been about two years after his wife's death. He was devoted to her.

The television news shows our police chief proudly claiming that the case has now been closed. "We started with over 2,000 suspects and narrowed it down to one." Accurately identifying DNA from the tiny quantities that must have been present in the envelope was clearly a forensic triumph but was there really any need to investigate so many suspects? According to reports, the 1080 powder in the envelope was industrial strength and could only have been obtained by someone close to the source of supply, who had access to its actual production. This should have narrowed it down to a few dozen at most. All the other

"suspects" seem to have come from the ranks of those who have ever expressed an opinion that is anti-1080, including people who made submissions to the Environmental Risk Management Authority (ERMA), for their 2011 review on the use of 1080 in NZ. Those targeted included a Takaka couple, Rolf and Ute Kleine, who run a vegetarian teahouse and bakery in the beautiful South Island Golden Bay region. They have been outspoken in their opposition to 1080 but have always been 'complete pacifists" with no history of any criminal conviction either in this country or previously in their native Germany. According to a press release, [65] they were "reeling" after a police raid conducted in March 2015. Each was taken to a separate police station and intensively questioned for four and six hours respectively. They then learned of an earlier secret search of their home during which computer information was copied and DNA swabs taken from toothbrushes. Rolf Kleine is reported as saying it was "such a strange feeling" to know the police had opened the door to their home and searched it, taking some items without their knowledge.

The blackmail attempt has been used as a smear campaign against the anti-1080 lobby group. According to an article in the *National Business Review*, the phrase "eco-terrorism" used by our most senior politicians in early 2015 was widely circulated to the world media and picked up by the BBC, CNN and the ABC. [66] The article goes onto describe how New Zealand Infant Formula Exporters Association chief administrative officer, Chris Claridge, "slammed" the Ministry of Primary Industries for "giving oxygen" to what was probably a hoax. "Wacko threats came in weekly", he said. "Why was this one being publicised?" Press conferences were called at short notice, and the media went into a frenzy. Hardly any attention has been devoted to the fact that real anti-1080 activists universally decried the blackmail threat. According to the *Tasmanian Times*, Laurie Collins, convenor of the "Sporting Hunters Outdoor Trust" (SHOT), felt

the case had been deliberately "used as a vehicle to smear the thousands of New Zealanders opposed to government's policy of dowsing public lands with an ecosystem poison." [67]

"Clean and green" has become a much-derided mantra of late. Many of our rivers are now horribly polluted by waste from intensive dairy farming and urban waste. These rivers, which once produced huge brown and rainbow trout, sought after by fishermen from around the world, have in many cases themselves become brown, with coliform counts too high even for swimming. A friend, who spent his childhood in Gore, recalls how he used to wander up the banks of the Mataura River on sunny afternoons, fishing. "Not possible now", says Murray, "You would be electrocuted." Electric fences reach right to the edge so that cows' hooves dig mud and manure right into the water, hardly even a slap-on-the-hand-with-a-wet bus-ticket for farmers who fail to plant the river edges to preserve them. As for green, there is too much green in places that should be golden brown. Giant irrigators suck water from high country streams to make more green grass for cows in marginal areas such as Athol, Tarras and Cardrona, valleys that would only just sustain merino sheep before the irrigators marched in. More milk, more profits, but there is a cost and that is water quality.

CHAPTER 8

WATER AND FISH

There is a great deal written about aerial 1080 and how its residues may or may not pollute water. The easiest way to start on this topic is to visualise a helicopter hovering over some native forest and opening its specially designed hopper so that 1080 pellets rain down. Although watercourses are supposedly avoided, pellets do commonly reach streams and rivers. [68] The Waikato Regional Council recently added the following to their 1080 warning signs, "Poison baits or carcasses may be present in waterways". So what happens next? Can the 1080 dissolve in water? Does it persist or is it immediately broken down? The DOC website, [69] states categorically that "Biodegradable 1080 naturally breaks down in the environment and does not leave residues in water, soil, plants or animals or build up in the food chain".

In 2007, the Environmental Risk Management Agency (ERMA) reviewed all the evidence for and against the use for 1080 for pest control in New Zealand. [70] In 2011, the Commissioner for the Environment, Dr Jan Wright, finally ruled that, "not only should the use of 1080 continue (including in aerial operations) to protect our forests, but (that) we should use more of it." [24] What does that report say about water?

Firstly, I can confirm that 1080 is highly soluble. It dissolves in water and forms a solution. How long might that solution be capable of poisoning susceptible animals or for that matter, humans? Review of the ERMA report yields the following information, "Sodium fluoroacetate (*1080*) is hydrolysed (*broken down*) very slowly in water at neutral pH (*neither acid nor alkaline*) in the absence of biota (*living bacteria and other*

small organisms)…… the half-life would be expected to be at least 4 years." [71] Four years! However, the key word in this statement is "biota" meaning the tiny organisms like bacteria that live in water. In other words 1080 breakdown does not happen spontaneously but relies very heavily on the effects of bacteria and other microorganisms in that water. These creatures produce enzymes that cut a carbon-fluoride bond in the 1080 chemical structure, thus inactivating it (shown by a red cross in Figure 2). The process is called biodefluorination. What is left of 1080 include fluoride ions (yes the same stuff that is added to water to strengthen our teeth) and glycolate. The microorganisms that make this process happen include bacteria called *Pseudomonas.* They generally live in the soil and are well known to doctors as they can cause nasty infections in people whose immune systems are not functioning properly.

A form of fungus called *Aspergillus* is also able to act in this way to break down 1080. What is important to understand about biodefluorination is that firstly, it only works if these specific bacteria/fungi are actually present in water or soil where 1080 lands. Secondly, these BF-bacteria (to invent a short hand) like to work in warm temperatures. They do not like the cold and when it is cold they do not do their job. This is key to understanding the confusing and conflicting information about 1080-in-the-water and also tells us about how quickly 1080 disappears from pellets that land on the ground.

Professor Charles Eason has been at the forefront of 1080 research over the last two decades. His work has frequently appeared in the NZ Journal of Ecology. He studied the effects of 1080 in an aquarium that also contained plants and invertebrates. [72] After four days, 1080 was no longer detectable in the water. It was sucked up into plants (yes this definitely happens), stayed around in plant tissue for about a week but had disappeared by 14 days. However, another source, C.J McIlroy, an Australian scientist who completed a comprehensive series of studies on the

effects of 1080 in Australian wildlife during the 1980s, [22] found something completely different as follows, ”1080 solutions prepared in stagnant algal-laden water did not lose biocidal properties (*killing ability*) for 12 months”. I am now concerned about the breakdown of 1080 in cold, algae-infested water. Last winter I witnessed the entire floor of the Caples valley, near Lake Wakatipu, locked in ice including large areas on either side of the river. This gave rise to spectacular visual effects, as water flowed over ice and then became frozen itself, like a cake that had been iced then re-iced by an over-zealous cook. This very cold water was in the shade of the beech forest and I am sure would have contained algae. Mountain tarns also contain very cold, still water. 1080 pellets could sit on the bottom for a long time and might (if McIlroy is to be believed) remain poisonous for months.

My research uncovers another New Zealand study investigating the effects of 1080 in stream water containing a common aquatic plant.[73] Measurements were made at two temperatures, 11^0C and 21^0C. No 1080 was detected in the warmer water after six days but around one third of the initial dose was still present in the cooler water. I am quite alarmed. When I have briefy ducked into streams for a wash on various tramping trips I recall that the water was COLD!!! There are other factors to bear in mind. 1080 dropped from the helicopter is not in the form of fine grains that would release the chemical quickly, but is bound up into pellets. The carrier used (for New Zealand aerial drops) is most frequently cereal but in Australia 1080-meat has been used to poison dingoes.

Meat is a pleasant home for many BF-bacteria, meaning the breakdown of 1080 will be fairly rapid. However, cereal is not as good, so the poison takes much longer to disappear. One report stated: “The percent of 1080 defluorinated from various bait materials after 30 days as a result of microbial action, ranged from 0.0 to 7.2% in cereals …. (*to*) 14% in kangaroo

meat and 71% in oats". [74] Thus 1080 in cereal baits could well remain active for a surprisingly long time. Very dry and cold conditions on land also slow down the activity of BF-bacteria. Baits can remain poisonous to dogs for more than 32 days during winter. [75] In one study, the length of time for 50% of the 1080 to be rendered non-poisonous was 43 days at 5^0C [28] while in another study it was 80 days. [76] Thus, in the words of Dr Sean Weaver PhD, an ecologist who has sounded the alarm about the widespread use of this poison, "significant quantities (e.g., 30–50% of the original concentration) of 1080 may persist for three to four months (and possibly longer)." [39] These results bear out what the Australians have found, namely that far from being "rapidly biodegradable", 1080 in cereal pellet form that has been dropped into semi-alpine areas during winter, is likely to retain its activity as a poison for many months.

There have been numerous studies of 1080-in-water that are reassuring, as summarised in "Protecting Paradise". [33] To quote Hansford, "imagine squeezing 2 drops of ink into a municipal swimmming pool. You just added 2 ppb, and that's all the fluoroacetate the Ministry of Health will allow in drinking water". All well and good. Humans are certainly at little overall risk from 1080 in streams or lakes unless they happen to be drinking water downstream from a recent drop. But it is a different story for birds, bearing in mind that there are few municipal swimming pools in the New Zealand bush, but there are a lot of puddles.

If a single 1080 pellet were to fall into a 250 ml puddle, and dissolve completely, then the concentration in that puddle would be high. A tomtit weighing 11 g, would need to consume less than half a teaspoon to receive a lethal dose. Dr Ronald Eisler, author of a U.S. National Biological Service report entitled "Sodium monofluoroacetate (1080) Hazards to fish, wildlife and invertebrates: a synoptic review" concluded, "More research on 1080 persistence in aquatic environments seems needed". [4] This

would seem to be particularly apt for the cold southern regions of New Zealand.

If 1080 does hang around in cold water for weeks, wouldn't it poison fish and/or aquatic insects? In one experiment, 1080 baits were dropped into a stream and levels were measured in the water and in fish nearby. The authors (Suren et al.) [77] were reassuring, "Analysis of water samples collected during the fish experiment showed that 1080 was detected only for 12 hours, and at low concentrations, despite the large number of baits placed in each stream." They continued, "No fish died after addition of 10 baits, suggesting that all …were tolerant to dissolved 1080." Unfortunately, scientific results are only reliable if the experiment is done properly. Many feel that Suren's stream experiments were flawed.

Bill Benfield in his book *At War with Nature* [78] warns, "The study wasn't set up to find the answer. The baits were in bags, and the fish were in cages, 10 meters and 100 meters below where the bags were moored. At no time were the subjects ever directly exposed or in contact with the toxic baits as they would be if baits fell into streams". As a tramper, I have filled my water bottle from these same streams, believing that I was drinking pure mountain water. What would happen if I drank water the day after a 1080 drop and a pellet was lodged under a rock just upstream? People are allowed to tramp New Zealand's "Great Walks" such as the Kepler and Routeburn, very soon after 1080 has been dropped directly onto those tracks and adjacent streams. In fact they are only held back at the huts for one day. Do any of those trampers drink stream-water the day after a drop? Could they become ill?

Suren et al. went on to study the effects of 1080 on native crayfish (koura) [68] in a simulated outdoors stream. Small cages containing cobbles, leaf litter and invertebrates were placed in different sections of the stream. Crayfish were placed in the

cages. After four days, a single 1080 bait was added to each of 40 randomly allocated cages. Non-toxic baits were added to 10 control cages. The results were interesting. The crayfish ate the baits – all had typical green fragments in their stomach contents - but none died. This might mean that they were relatively tolerant to the poison, but another possibility is that the experiment finished before death-by-1080 actually occurred (for the blue-tongued lizard this may take up to 3 weeks). [7] Researchers found 1080 at 5 mg/kg in the tail muscle of one large crayfish four days later. This poison does not simply disappear! Levels of 1080 were also measured in the water and were initially low but increased during the first 12 hours as the chemical leached out from baits into the water. Levels then decreased but a second peak of 1080 rather unexpectedly occurred 48 hours later, due to crayfish excreting it out into the water. This gives us a real-time picture of what happens when 1080 drops into a stream. Not only does the chemical dissolve, creating 1080-poisoned water, but it is also taken up by plants and eaten by animals such as the crayfish. These then incorporate it into their muscle tissue, where it lasts for who knows how long. They also excrete some back into the water.

Another part of the 1080-in-the-water problem is the possibility that predators might consume contaminated crayfish and themselves be poisoned. Such predators could include humans. To kill a human it has been calculated that 40 kg of 1080-poisoned-crayfish tails would need to be consumed at one sitting. That would obviously be most unlikely, although the ERMA report (Appendix. M "Exposure and risk assessment: human health" page 689) did note that if a child consumed 200 g "an unacceptable risk level might be possible". [79] Nevertheless, native bush food is now served at some of our more famous restaurants. Would diners be happy to be served crayfish that had ingested 1080? I doubt it. Jo Pollard states in her authoritative critique, "A Scientific Evaluation of the Parliamentary

Commissioner for the Environment's view on 1080" written in 2011, "Nothing is known about the effects of 1080 on frogs or reptiles, and the very small amount of information on aquatic environments and terrestrial invertebrates indicates that 1080 may have severe effects on them." [80]

I find myself wondering about fish such as trout. Could they possibly contain 1080 in their flesh? The headwaters of many trout streams are located within aerial 1080 zones (such as the central North Island which happens to be the catchment for one of the most famous trout fishing rivers of the world, the Tongariro). During a mast year, masses of beech seed are released, stimulating plagues of mice, which are gobbled up by these fish (it is not uncommon to find up to ten in the belly). If some mice were poisoned with 1080, could the chemical pass into the fish? Could those fish be poisonous to humans? In 2014 the *Nelson Mail* carried an article headed, "Tests reveal risk in 1080-zone trout". It warned that preliminary results of research, undertaken by the Cawthron Institute at the behest of DOC, showed trout 1080 levels "exceeding New Zealand Food Safety Authority limits." Later DOC authorities dismissed this report as "scaremongering". Was it?

The document is now available.[81] To summarise, rainbow trout were given 1080 via a tube down the throat. The dose chosen represented the amount that might be contained in 30 mice, if all of them had died from 1080 poisoning. Then at a trout post-mortem, the 1080 concentration was measured in fillets taken from the fish. 1080 was definitely present within these fillets. The amounts were significant, initially at around 4.7 mg/kg. After 5 days they were down to 3 mg/kg but 1080 remained present right to the end of the experiment. In other words, levels were persistent. The trout did not die (until they were euthanised), therefore they could potentially have been swimming around in the river and been caught, and eaten by a fisherman. Would a human eating one of the trout from this experiment be harmed?

Let's work it out. They would be unlikely to die as the human LD_{50} is 2 mg/kg and that means a 70 kg man would need to eat 140 mg of 1080 for a fatal dose and each trout in this experiment contained roughly 3 mg of 1080. Thus, 47 of these trout would be required to kill the man. However, the acceptable daily exposure (ADE) for substances containing 1080 is much lower at 0.02 µg/kg of body weight /day which for our average man would be 1.4 ug/day. Each trout contained 3,000 ug (3 mg). Therefore the dose is 2,143 times the acceptable daily limit. Bill Benfield, who is co-chairman of the Council of Outdoor Recreation Associations of New Zealand (CORANZ) argued that flesh of the trout in this experiment should be considered "a human health hazard". I have personally eaten fish from the Tongariro River, smoked on the riverbank. I don't know whether it contained 1080-poisoned mice, but the possibility that human poisoning could occur this way seems incredibly real. Especially as rainbow trout and brown trout can live for more than 10 years.

It is interesting to see how the news media and DOC handled this whole scare. A DOC report [82] quotes the "toxicological end point", which is the level that causes no toxicity in rats, as 0.075 mg/kg/day." [83] The flesh of the poisoned trout mentioned above contained 4.7 mg/kg. If a person consumed 400 g they would be eating 1.88 mg of 1080. For a 70 kg man this would represent an intake of 0.027 mg/kg, which is "about a third" of the toxicological endpoint. According to the aforementioned document, this "strongly indicates that consumption of wild caught trout from areas that have had 1080 applied will not pose a food safety risk to humans." Actually I am not so sure. The New Zealand Food Safety Authority limit for 1080 is set at the lowest level that can reliably detect <u>any</u> 1080 and is 75-fold lower than the toxicological endpoint. Reproductive and especially testicular toxicity may occur at these very low levels and has been demonstrated in several species as summarised in Chapter 6. [58; 59] What about risks during pregnancy? Skeletal abnormalities of

the forelimb developed in the foetuses of 1080-dosed pregnant rats. [55] Should fishermen/women hoping to start a family be warned not to eat riverbank trout in New Zealand? Somehow the whole wild food thing is losing its appeal….

There is something else that needs to be considered when one is imagining what could be the consequence of a 1080 drop and whether the poison persists. This is the whole issue of secondary poisoning. Deer carcasses, for example, can remain on the ground slowly decomposing for months as observed by the Hokuri creek hunters. These carcasses may continue to poison insects feeding upon them as well as scavengers such as hawks and the New Zealand falcon. If kea, weka or kiwis are around they will very likely have a peck as well. How rapidly does 1080 break down in these carcasses? This was studied by collecting 32 dead possums which were the victims of a 1080 operation in the Wairarapa region. [84] The dead possums were covered by wire cages to prevent scavenging of the carcasses, and were left lying directly on the ground. Breakdown of 1080 was studied by taking samples of the stomach and viscera. Mean 1080 concentrations were 30 mg/kg at 25 days and had fallen to around 5 mg/kg after 75 days. These levels are very high. The authors commented "It is clear that the processes which facilitate the metabolism of fluoroacetate (1080) in live possums do not function in possum carcasses. Defluorination of fluoroacetate present in stomach contents continues after death (as a result of microbial activity), but at a relatively slow rate". They concluded that an average sized dog would be seriously at risk if it consumed 200 g of toxic offal containing 1080 at the concentration of 7 mg/kg. This was the level found in 4 of the 10 possum carcasses sampled at 75 days and that was the end of the experiment. Thus, poisoned carcasses serve as a potent reservoir of 1080 that may last several months.

In Australia, where 1080 baits are laid by hand for control of rabbits and dingoes, the rules are very different. The New

South Wales Department of Primary Industries states on their website (http://www.dpi.nsw.gov.au/content), "At the conclusion of the baiting program, collect and destroy any remaining 1080 baits either by incineration or burying in a 1 meter deep disposal pit. Buried baits must be covered with at least 500 mm of soil. Reasonable steps should be taken to collect the carcasses of poisoned wild dogs. The carcasses should be collected for up to 14 days after the laying of poison baits has ceased. Destroy carcasses by incineration or burial in a 1 meter deep disposal pit covered with a minimum of 500 mm of soil." In New Zealand, a recovery and burial programme would be unworkable as aerial drops cover thousands of hectares of dense native bush, so this is simply not done. And nobody knows about it so nobody makes a fuss.

To summarise, 1080 pellets continue to be dropped into waterways, lakes, tarns and indeed small puddles and could have a significant effect on creatures that live in these places such as fish and other aquatic organisms. Pellets may fall into the streams that flow next to popular walking tracks but tourists are not informed about this at all. Not exactly an image that New Zealand tourist operators would favor but one that is graphically depicted in the Graf brothers' 2015 You-tube video entitled, "1080 Poison - Risk in Water - EPA". [85]

The DOC pronouncement that, "1080 is biodegradable, dilutes quickly in water and does not build up in the food chain" is only half-true. Certainly 1080 is biodegradable, but that depends on BF-bacteria being present in the environment and being active. There seem to be plenty of situations where this may not be the case especially when it is cold. If pellets are dropped into snow, 1080 will probably remain active for months. We also know that 1080 builds up in the muscle tissue of creatures such as crayfish and trout that consume the pellets. How long does it remain there? Nobody knows. Any creatures consuming plants or animals containing 1080 will receive a dose

of the poison themselves. Whether this does them any harm depends on how much is consumed, the susceptibility of their species and their weight. Aquatic creatures may excrete it back out into the water, perpetuating the cycle. To me this sounds very like "building up in the food chain". And I haven't even touched on other worries such as the potential build up of the toxic 1080 metabolite, fluorocitrate (which in animal studies was shown to be 100 times more toxic than its parent compound), [86] or for that matter fluoride itself. Suffice to say that I will be very much more wary of drinking from clear mountain streams on future tramping trips and native trout and koura remain off our family's menu.

CHAPTER 9

DAN

Dan Lane is a Kiwi. He has lived on the West Coast (the Coast) for 28 years, most of that time in Harihari, a small hamlet near Hokitika, with his wife and two children. They have an accommodation business on an acre of land with "a couple of lodges - mainly for backpackers …". He has also diversified into beekeeping, woodworking, metal-working, hunting and fishing. As Dan says, "typical Coast". I asked when the 1080 issue first made an impact on his life. He recalls, "This would have been 18 years ago". A friend came to him; "A man who had worked with it, throwing it out by hand in the Arahura valley – they used to do that back then - no restrictions. He was a possum hunter. He was … you know … disturbed … he felt it was killing birds indiscriminately". Dan started what he calls, "Some Investigations". A little while later there was a 1080 drop near his home in Harihari. He recalls events as follows:

> "There was a lady lived up on one of the hills near here, the Karnbach ridge. She was an elderly lady. On her own. Her water supply comes from the catchment up there. One day I went for a walk up this hill to the top – I came across lines of 1080 across the hill (1080 bait stations; usually laid 25 metres apart, in lines 25 metres apart). I rang the regional council. I said, "Hey listen, you've spread this poison over the face of the Karnbach!" The guy I spoke to said that they had not tried to avoid her water intake. I said, "Why not?", and he said that she hadn't complained. And I thought, "How dare you! You don't care!" This lady, she has no one to help her out, you know, she's lost her husband, and that's what started me

off on my campaign to follow them around and find out what they are doing. Its become a bit of a crusade."

Dan has used the court system to investigate the legality of dropping 1080.

> "Philip P had a court case. A lady brought a couple of wood pigeons out to him. They were found dead on the ground after an aerial drop. She put them in the freezer to start with and then they got a toxicology report showing that the birds contained 1080. But it was kicked out of court because they couldn't prove that it was the 1080 that killed the birds!" The judge said "If you can find a Point of Law, then you can bring it back to the court-room." After that we found the best way in was to concentrate on the issue of breaching consents. We said, Right, Bugger it. Every 1080 drop that happens on the West Coast – we are going to follow these people around and find out (whether they have breached) the consents and all the conditions. Every drop, they make mistakes. The Ministry of Health and the Department of Conservation breach the conditions of their consents. You want specific examples? One would be – like the lady on the Karnbach - if they drop 1080 into the catchment area of a person's water intake. Another example – if they were loading helicopters while people were standing nearby, on public land. Or, dropping 1080 into areas where there is no signage. But there is always an excuse. "

One that sticks in his mind is the Okarito drop of 2011. This involved kea, New Zealand's endangered native parrot (Figure 6). They are famous for being one of the most intelligent birds in the world and were the subject of a highly amusing David Attenborough documentary, "The Life of Birds", made in 2009, where his wildlife team tried to devise increasingly difficult tests, using Heath Robinson-type apparatus, to see if they could

prevent the kea from winning the food treat. They couldn't. One test even required team support (from another kea) but was overcome by the wily and greedy birds. In the 1960s and 70s, kea were plentiful in the South Island alpine regions, and were in fact a pest to trampers and tourists as they would eat anything, including the rubber out of windscreen wipers on cars. They can dismantle a tramper's boots left foolishly outside the hut overnight, so that there are just a few scraps of leather and some laces the next morning. Over the past decade, numbers have plummeted, especially since aerial 1080 drops have occurred regularly in their mountain habitat. It has been estimated that there may only be a few thousand remaining. A 2013 report from the *Greymouth Star* stated, "In 2008, seven (kea) died in the Franz Josef and Fox Glacier area, and in 2011 seven more died at Okarito". [87]

Dan was involved in the Okarito incident. He recalls,

> "This was a Department of Conservation drop. They monitored 10 keas in the area - they were going to do a drop. I was not allowed to be part of the kea conservation team. I was upset. I told them, "You will kill the keas if you drop (1080 baits) all over the forest cut", where there was open ground exposed. But they dropped over the cut – you could see all the green baits – the keas all flew down and seven died. They (DOC) didn't want to have anything to do with it. They had already killed kea in Franz Joseph / Fox area. They just weren't listening."

Dan applied for more information via an Official Information Act request and received photographs of dead kea and a map showing where they were found. These are reproduced in Figures 6a and 6b. Sadly, decimation of kea does not end there. In 2013, 5 out of 39 monitored birds died of poisoning during a DOC field study using a bird repellent in an aerial 1080 operation near Arthur's Pass. A DOC representative said, "Losing five

birds is naturally disappointing but overall the benefits to kea populations from pest control continue to outweigh the loss of individual birds to 1080" [88] - sound familiar? The current DOC website (2016), states, "Of the 150 kea that have been directly monitored, 20 (12%) have died after having ingested baits". [89] Do any other countries in the world directly drop poison into the habitat of endangered animals or birds? You can find fluffy kea toys on sale at Queenstown airport for the tourists, but the reality is that they are systematically being wiped out.

Dan and Mary Molloy (a local farmer) took DOC to the Environment Court over the 2011 kea incident. Dan explains;

> "Our grounds were that the effects on the environment were more than minor. We got kicked out on Section 17, Part B of the Resource Management Act. That is engraved on my memory. Look it up. It states: "*No person or entity – working under the duty –* (in this case the pesticide management strategy) - *is enforceable under the duty* …..". They had three highly paid lawyers against us. So we said, "What is going to happen if your study shows that your operation kills keas – what if the rats and possums come back again, more strongly than before the 1080 drop? Your native species are almost wiped out and then the pests come back!" But we got kicked out on a technicality.
>
> In 2009, there was a massive drop down the West Coast and in Harihari. We had a big meeting. We decided to monitor it with video cameras. We walked on site, the morning of their drop. We camped up there for a couple of days to try and stop them because we knew that if there is a person on site who is not authorized to be there – then the site has to be shut down and they can't go ahead with filling the helicopter's monsoon buckets. So what happened was they shut down the drop. Then the

police arrived. They said "You have to leave – get in the paddy wagon - you are under arrest for trespass". I said, "You can't do that. You can only arrest us if we go back on (the land)!" But we were arrested anyway. I knew the sergeant. Great bloke – like gold – I've known him for years. They took us to Greymouth jail. Halfway down the road we had a puncture; six of us trying to fix it. You know, typical Coast. We got there and a lawyer turned up."

"I can get you out on bail".

"What am I charged with?"

"Trespass and the Biosecurity Act."

"What section am I charged under?" And they didn't know so I said,

"False arrest, this will be a false arrest!"

And they said "Look Dan. Shut up. We are serving you lunch. Then get out!"

"We were family, you know, and were treated well by the cops. The biggest thing was that we made the media. Showed the rest of the country that there were people that didn't like it. Opened up the public to wanting to learn about 1080. The trespass thing finally went to court in 2010. There were six of us. I represented myself. We won our case – they dropped the trespass claim under the Biosecurity Act and Aviation Act. We won. Hands down. There was no proof that we had done anything wrong. We had costs awarded to us – but only for accommodation. Because I was not a lawyer I could not charge for indemnity costs – all the hours I had put in reading through the legal stuff. Got about $600.

> The people of the West Coast put in a petition. They surveyed all the ratepayers. It showed that 92% overall did not like 1080. They wanted to ban 1080. We had a big march in Hokitika – over 300 people. The district council took it to parliament in Wellington. But the word was, "Nothing we can do". So some people got a bit crazy. Someone kidnapped a helicopter pilot ……"

(*This reminds me of a story I heard from Brian (not his real name), a Queenstown local, concerning a friend of his who lived on the West Coast. This fellow was out hunting with one of his friends, a landowner who was very anti-1080 and upset about it being dropped on his land. They were both outside as the drop started. The landowner lifted up his gun and shot at the helicopter. There was a police manhunt. He was picked up and got seven years – but as Brian commented cheerfully, "But, you know, out in four!" Brian's friend hid in a bush and escaped.)*

Dan continues:

> "We are trying to do it within the law. We have come up with over 200 breaches. We have signed affidavits. We have now got a lawyer, who is taking this to the Environment Court for us. Its costing us a fortune. Turns out we have to come up with $15,000.00 as "Security of Costs", to be retained if we win the case, forfeited to the opposition if we lose. So we have to have that money to even get it to court."

The court demands up-front costs of $5,000 per entity and there are three entities they are filing against, including the Department of Conservation, the Regional Council and OSPRI. The Animal Health Board evolved into TB-free NZ and OSPRI. They are now an incorporated society. According to Dan this is "Charity running on government money"; $50 million a year from government; $50 million a year from Federated Farmers and $60 million a year from donations.

> "We put it on the web under "Give a Little". Its called, "Te Whare o te Kaitiaki Ngahere (Guardians of the Forest) stop 1080 Court Fund" - and we have come up with $13,000 so far. Which is great. So we are going to take these three entities to court. But they are all tied up together; the drops have always been on DOC land."

Before I hang up the phone, I ask Dan what he had meant last time we talked, about 1080 being dropped into his own water supply. I remember him saying that he and his family felt "violated".

> **"**OK. This is around 2009/2010. They dropped 1080 into Harold Creek – above the exclusion zone. This is our catchment area, we get our water from the creek and there are five other houses up there. We rang up the District Council because that's who we pay our water rates to. We were upset. There were that many baits in the creek – you could see them, green in the water. There must be 1080 in that water, it can't be under two parts per billion (*limit of safety for human consumption*). Well, a group of locals went up there and videoed the amount of bait in that creek. This ended up with the Ministry of Health. The Ministry people admitted that there were too many baits for what would be a safe level. Then they came down and just went into the creek and picked up as much as possible and threw it into the bush! I went to the District Council office (*in Hokitika*). I said, "I am not leaving this office until I get an alternative water supply!" Well, we had to shut our water off. They ended up giving us an alternative water supply. And do you know what it was? Had to go to the pub and shower myself and my family there. And then we were given 2 x 20 litre drums for cooking and drinking water. This went on for about four weeks, until 100mm of rain had fallen. After that it is safe because all the 1080 has leached out of the pellets. But it was quite dry that year so it took a while. If I hadn't

kicked up a fuss, nothing would have happened. We were all living in that house, drinking that water…...

I HAVE KIDS …. YOU KNOW? …….YOU JUST SEE RED……. Especially when we got the map showing the flight-path for that helicopter. It was just straight up the creek! They have dumped tons of poison up there."

The West Coast has seen more aerial 1080 drops than most other parts of the country with four in the last decade. Anti-1080 campaigner, Carol Sawyer related her take on this in a Facebook post in October 2015:

"SILENT SPRING

This time last weekend I was walking around the shores of beautiful Lake Matheson in South Westland, having stayed at Fox Glacier overnight en route to the Ban 1080 Party AGM in Pukekura. Nearly half a century ago, this area was home to me for a while. No alarm clock needed in those days. Dawn meant an army of Keas stomping all over the tin roof. Aerial 1080 poison has wiped out these armies, and many thousands of other birds besides. In my three days in South Westland I encountered one lone, half-blind, leg-banded Kea, prizing open the top of a rubbish bin. My one hour walk in Lake Matheson's rainforest was eerily silent, except for a couple of Paradise ducks on the lake and a Grey Warbler or two, and a lone Tomtit. BAN 1080 NOW!

Carol Sawyer 2015.

CHAPTER 10

KEA, MOREPORK AND ROCK WREN

After talking to Dan I decide to find out more about kea. What turns up is startling. At least some members of the New Zealand ecology establishment seem to be well aware that 1080 is poisonous to kea. To quote Cowan et al. (Landcare Research, the research wing of DOC), [90] "a risk assessment in 2011 of aerially applied cereal bait containing the toxin 1080 (sodium fluoroacetate) identified an unacceptable risk of exposure for kea (Nestor notabilis)". The 2016 Wikipedia 1080 entry (no longer available online) concurred: "……7 of 38 tagged kea, the endemic alpine parrot, were killed during an aerial possum control operation in Okarito Forest conducted by DOC and AHB in August 2011." [3] This source continues: "Because of their omnivorous feeding habits and inquisitive behaviour, kea are known to be particularly susceptible to 1080 poison baits, as well as other environmental poisons like the zinc and lead used in the flashings of backcountry huts and farm buildings." The latter statement somehow has the effect of diluting the former. It refers to a 2010 study, which revealed high lead levels in 26 of 38 kea blood samples tested. [91] What can we take from this? Keas are parrots and will investigate (and often eat) unusual looking objects. However, lead has been present in back-country huts for the last 100 years and is being phased out in newer buildings.

The devastating fall in the kea population, from a situation where these birds were so numerous that farmers shot them as pests, to the present day where only a few thousand birds remain in New Zealand (and the world), has only taken place over the past two decades. This corresponds to the period that aerial

campaigns have dropped 1080 directly into their habitat. There is no doubt that 1080 kills them (although nobody seems to have derived an LD50 for their species) so maybe both 1080 and lead are to blame. Which one can we eliminate straight away? 1080.

I find an unpublished DOC report by Fairweather et al. (2014) on the Net. [92] It is a mother lode of worrying 1080 stuff that is obviously not meant for general consumption (given that it has never actually been published in a scientific journal). Interesting facts pertinent to kea include that 20 kea are recorded as having died after 1080 drops. It is important to remember that, if there are 20 lethally poisoned kea, there are likely to be many more sub-lethally poisoned. If we speculate that the LD_{50} for the kea is similar to that of the Australian parrot at 4 mg/kg, [4] then it is quite possible that birds dealt a sub-lethal dose, might also suffer damage to their organs, most critically those involved in reproduction. 1080 is known to cause chronic heart muscle damage (cardiomyopathy) and to be as a male reproductive toxin in several bird species (damaging the tubules of the testes) [12]. If birds were affected in this way, their numbers would remain stable until those individuals died, whereupon the population would crash, as there would be no next generation.

I have heard it said that the kea deaths witnessed by Dan at Okarito were caused not by the 1080 itself but by a bird repellent that was being trialed. To my amazement there is an official DOC proclamation about this from 2013 [93] – abridged version as follows: "Date: 21 August 2013: The Department of Conservation will continue to investigate ways to protect kea during 1080 operations after disappointing results from a recently tested bird repellent. ….The first field study using a bird repellent in an aerial 1080 operation near Arthur's Pass earlier this month has resulted in 5 confirmed kea deaths out of 39 monitored birds." The repellent d-pulegone was reported to have shown "promise" in previous trials but "was not effective enough to prevent kea deaths in this field operation." I am left a little

unclear about the cause of death here. Did d-pulegone poison kea or 1080 or a combination of the two? None of these options reflect well on a department charged by the Crown to conserve native species. Sadly, another small study showed that a coating of deer repellent on cereal baits was also ineffective in deterring kea, [94] so its back to the drawing board for the scientists, and back to a habitat that may feature poisonous green pellets for the kea.

There is more information available from the older literature, before repellants were even thought of. During 1964, a paper was written by a scientist called M. H. Douglas, who was then attached to the New Zealand Forest Service, describing the results of a 1080 pest control program in the Dobson valley (Mt Cook/ Aoraki region of the Southern Alps). [95] The target animal was the Himalayan thar, which, not surprisingly, died in large numbers as was carefully recorded. Of relevance is a section entitled, "Secondary Poisoning". To quote: "the area was searched for evidence of animals and birds dying after feeding on poisoned thar. Four dead keas (*Nestor notabilis*) were found over rugged terrain and eight gulls (*Larus dominicanus*) in the Dobson river bed ….. Two of the keas and one seagull were analysed for 1080; one kea and the seagull gave positive 1080 identifications; the second kea classed as 'doubtful'." The author commented, "As keas are omnivorous, they could have been killed by feeding directly on poisoned carrot. One kea was seen to feed on green-dyed toxic carrot off the snow. Only 100 to 700 grains of carrot treated with 3. 8 lb of 1080 per ton (1 grain 1080/590 grains carrot) would be a lethal dose for a kea ….."

So here, in a paper published more than fifty years ago, is definite evidence that firstly, kea are killed by 1080, and secondly that both primary and secondary poisoning are implicated.

To bring things up to date there is a much more recent document entitled, "Aerial 1080 in kea habitat" that is freely

available on the Net. [96] It is an internal DOC memorandum dated 1/02/2016. It comes with a warning:

> *"This document has been written for Department of Conservation (DOC) staff. As a result, it includes DOC-specific terms and makes reference to internal documents that are only accessible to DOC staff. It is being made available to external groups and organizations to demonstrate departmental best practice. As these procedures have been prepared for the use of DOC staff, other users may require authorization or caveats may apply. Any use by members of the public is at their own risk and DOC disclaims all liability in reference to any risk. For further information, please email sop@doc.govt.nz."*

The word "unclassified" is actually written at the bottom of the document. This sounds top secret. What risk, I wonder, are they referring to? Read on. It states, "There is some risk to kea from eating 1080 baits." The article describes how bird survival has been monitored using motion-detection sensors during 14 aerial 1080 drops since 2008. "Of the 199 kea monitored, 24 kea died of 1080 poisoning". A table gives the details for 145 birds. Kea deaths occurred at Franz-Fox in 2008 (7 out of 17), Okarito in 2011 (8 out of 37), and Otira (5 out of 29).

Then the following text appears in black and white, "Of the 24 poisoned kea, 13 died the day after 1080 baits were sown and 7 others died by the fifth day after sowing. All except two of the poisoned kea were autopsied and bright green contents were found in the digestive system, indicating that green-dyed 1080 cereal bait had been consumed." Why does this remind me of the Holocaust's Dr Mengele? DOC are fully aware that they are deliberately poisoning the kea. But they feel it is all worthwhile as there are "Benefits to kea from predator control

via aerial 1080". The villains are the stoats (again) but where is the evidence? "Stoats were identified as the predator in 3 of the 16 nest failures recorded (Kemp, unpublished data)". Kemp's work obviously belongs to the category of "*internal documents that are only accessible to DOC staff".* The only other evidence is purely circumstantial as follows: "(*the*) surge in stoat numbers during the summer following mast seeding …… corresponds with a very high failure rate for kea nests in the post-seedfall year". So there is actually nothing directly linking the massive decline in kea numbers with predation by stoats. The fact that these birds were extremely plentiful right up to the 1980s, despite stoats having been in New Zealand for the previous 100 years, suggests to me that stoats are not to blame. What has been happening since the 1980s and definitely does kill keas (green pellets in bellies), is aerial 1080. It is reminiscent of the U.S. army officer in Vietnam who bombed the village of Ben Tre, saying, "To save the village, it became necessary to destroy it".

The New Zealand morepork (*Ninox novaeseelandiae*) is, according to the doc.govt.nz website, "Often heard in the forest at dusk and throughout the night…..". Its Maori name, ruru, reflects its haunting, melancholic call. It is said to be associated with the spirit world and Maori believe ruru can act as kaitiaki or spiritual guardians with the power to protect, warn and advise. I had a personal encounter with one a number of years ago in Auckland's Waitakere ranges. Glimpsed through the high foliage on a summer afternoon I recall being transfixed by the gaze of this ghostly bird, a laser beam straight into my deepest self. Definitely an other-worldly experience. The much larger laughing owl became extinct in the 20th century. Maybe he had the last laugh, leaving the building before the brave new world of predator-control really took off. Owls are omnivores and eat insects as well as rats and mice. They are at the top of the food chain. This makes them particularly susceptible to secondary poisoning. [57]

Where is the scientific literature about the effects of aerial 1080 on the morepork? There is very little. Eric Spurr mentions the following: "Moreporks have been found dead after 1080-poisoning operations using carrot and cereal-based baits …. Presumably the birds died from secondary poisoning because they are not known to eat vegetable matter." [97] He went on to describe the outcome of a 1080 possum control operation in Pureroa Forest Park in 1996; "Of six radio-tagged moreporks exposed to aerial application of screened carrot bait, … one was found dead one month later, probably having died a week previously. Analysis of muscle tissue from this bird revealed 1080 ….." This was actually during the first Powlesland study of "Tomtits and Robins" fame. [50] Inexplicably it does not refer to any moreporks containing 1080. The only comment was "Too few radio-tagged moreporks were available during each of the three aerial possum control operations to state with any confidence what impact the operations had on the populations". Spurr elaborates, [97] "Two dead moreporks were handed in and a further six were reported dead following aerial application of ….. cereal-based baits (5 kg/ha, 0.08% 1080)" ….. "one bird analysed tested positive for 1080 (C. Speedy pers.comm.)."

A more serious attempt to monitor ruru at a population level was undertaken within the Waitutu Forest in the southeastern corner of Fiordland National Park in 2009/2010. [98] Using mist nets, 34 ruru were captured and radiotagged, which involved mounting a transmitter on the tail. One wonders whether this could have compromised their survival as unfortunately 18 birds were found to have died before the poison operation even got underway. However, the deaths were blamed on a "severe weather event". Of 11 ruru with functioning transmitters, pre-1080, all were located six months post-1080. One was found dead but did not contain 1080. Although the authors were upbeat about their results, I do not feel reassured. The numbers remain incredibly small. It is also clear that these studies are very hard to do.

Fernbirds (*Bowdleria punctata*) are also insectivores and in common with many native bird species, they are poor fliers. They tend to "scramble" through dense bush, though occasionally fly short distances with their tails hanging down. Their numbers are declining and they have been classified as at risk. A study published in 2012 [99] described what happened to 36 radio-tagged fernbirds after a 1080 drop in the Wanganui area of the North Island. Cereal-based bait was dropped at a relatively light 2 kg/ha. All birds were banded to allow individual identification and "transmitters were tied on the upper side of the two longest tail feathers with dental floss and glued with …. superglue gel." I wonder what that felt like. "Four fernbirds were found dead on days 3, 8, 10 and 15 following the toxic bait application ….Laboratory assays confirmed the presence of 1080 in the muscle tissue of three of these birds". The fourth bird had trauma to the neck, i.e. it had been attacked by a predator. Could the transmitter on its tail have had anything to do with that?

The authors performed some statistical analysis and came up with a figure of 9.4% mortality from 1080 (there was no attempt to measure the effects of sub-lethal poisoning). My reading of this would be that 1080 is not good news for the fernbird. However, the ever-cheery party line was that actually the fernbirds were lucky to be rained on by toxic pellets, and then have a diet of poisoned insects, because, "the benefits of using aerial 1080 are still considered to outweigh the costs because wildlife populations recover from their predator-induced declines". In the words of a recent popular advertising campaign, "Yeah Right".

The rock wren (*Xenicus gilviventris*) is another story, but sadly it runs along very much the same lines. I have come across these little birds myself while walking the track between the Young and the Wilkin valleys in the southwestern region of the South Island. We arrived at the Young Hut pretty exhausted after six hours tramping. An immediate trip to the outside loo was required but unbeknownst to us the rock wren had made

this small building part of its habitat. While seated inside, my husband was surprised to find a tiny bird fluttering past his face, heading upwards to a gap in the ceiling. It had come in through a similar gap in the floor and seemed completely unfazed by its close proximity to a human being. The rock wren is part of an ancient family of New Zealand wrens, and has certain interesting characteristics. They are shy creatures and, like fernbirds, do not fly well. They tend to hop around instead and build nests on the ground out of snow tussock and moss, lining them with feathers. Thus, they are easy targets for introduced predators, although their subalpine habitat shields them to some extent.

1080 is being used by DOC to "protect" this species, using the rationale that knocking down rats and stoats will achieve great gains overall. I search for relevant population studies demonstrating these benefits. There is nothing. These birds are passerines like fernbirds, tomtits, robins and mohua, so they are again insectivorous and susceptible to secondary 1080 poisoning. [35] They are also at risk because of their cold sub-alpine habitat where 1080 breakdown is slow, potentially retaining killing-ability for as long as 6 months. [100] There are ominous anecdotal accounts to suggest that dropping 1080 on our endangered rock wren could decimate the species. The "Ban 1080" party leader, Bill Wallace, is quoted as saying, "25 of 39 tagged New Zealand rock wren (were) wiped out in the Kahurangi National Park last year as a result of 1080". I cannot find anything on this from scientific databases but reporter Rhys Chamberlain, of the *Otago Daily Times*, obtained relevant Official Information Act documents in January 2015 that stated "25 tagged rock wren were unable to be located after a 1080 drop". [101] If we seek answers from the "1080-the Facts" DOC site, [102] we are told,

> "Following a 1080 operation in the Kahurangi National Park in November 2014, 30 of the 39 monitored rock wren in the Grange Range were sighted.

> Several weeks later, following heavy snow fall, 14 rock wren were sighted
> 25 rock wren are unaccounted for. No rock wren have been found dead"

So was it the snow? Surely they must be used to that! Despite the lack of any scientific evidence whatsoever, DOC initially seemed quite confident that a broad spectrum metabolic poison delivered by helicopter directly into rock wren habitat would pose no risk to these tiny, endangered birds. However a note of uncertainty has crept in since the first posting. An update on the site explains:

> "There is still no clear evidence as to why rock wren being monitored in Kahurangi National Park went missing after unseasonable weather and snow and the pest control operation last spring. While some birds were probably lost to 1080, early counts indicate the high nesting success due to stoat control has already balanced this out with 61 birds estimated in the area after the operation was carried out compared with 49 birds beforehand. The full effects of aerial 1080 pest control on rock wren won't be known until the end of next summer when the birds have another chance of breeding with reduced stoat numbers. "

It doesn't seem to matter how much harm is revealed, 1080 always comes up smelling like roses. The plight of the missing rock wrens makes me think of "Les Disparus" otherwise known as "The Missing", referring to the approximately 30,000 people suspected to be socialists or political dissidents, who simply disappeared between 1974 and 1983, when Argentina was under military rule. [103] To their families, each missing person was a tragedy. For the rock wren, each individual lost takes the species closer to extinction.

A biophysicist and ecologist (PhD) called Alexis Pietak lived in this country between 2005 and 2011 and left as her contribution

to our culture a document that may be found on the Net entitled "A Critical Look at Aerial-Dropped, Poison-Laced Food in New Zealand's Forest Ecosystems". [57] This is an erudite and highly critical review, castigating DOC, the government and in fact the entire scientific community for the ongoing use of aerial 1080. The final sentence in the abstract states: "The potential for widespread poisoning of New Zealand's large number of endemic and threatened/endangered omnivorous, insectivorous, and carnivorous bird species by the uncontrolled distribution of poison-laced food throughout an entire ecosystem is a serious issue worthy of international concern and immediate action." By careful analysis of the literature (as of March, 2010, when the manuscript was completed), Pietak concluded that scientists have predominantly studied the least likely group of birds to be affected by 1080 poison drops, namely those that are (like the kokako), predominantly nectar, fruit, and foliage feeders. Those species at highest risk include our national bird the kiwi, the weka, the morepork and indeed the kea.

To sum up, our native birds are unique. We are poisoning them with 1080, either directly or indirectly. Although reducing predators doubtless helps to improve nesting success for some species, there is really no long-term controlled evidence that bird populations actually benefit. For many species there are no studies at all and my investigations do not allow me to feel reassured that no news is good news. Meanwhile we know that numbers of all our rare species continue to fall while 1080 drops are being ramped up. In her May, 2017, report, the Parliamentary Commissioner for the Environment, Dr Jan Wright, concluded that native bird species were in a "desperate situation" and more must be done to stop their decline". [104] One third of all species are apparently in "serious trouble" and nearly half "in some trouble". So the answer as usual is more and more 1080 over an ever-expanding area. We seem to be caught up in a great collective delusion.

CHAPTER 11

JAMES

James Veint lives in Paradise. Literally. And I do not mean that he has passed through the Pearly Gates. Paradise is the name of a region encompassing the lower Dart valley, a few kilometers northwest of the town of Glenorchy, which is situated at the head of Lake Wakatipu in the South Island. It is one of the most beautiful places in the world. The Veint family has been farming here since 1943 and James recalls spending many hours as a boy helping his father work cattle in the Dart valley, as well as hunting and generally enjoying the bush. He continues to farm here and quarry rock. He is also a successful artist. He recalls how plentiful the birdlife was around Paradise, right up until about ten years ago:

> "There were great flocks of mohua (*or yellowhead, now an endangered species, distinguished by their bright yellow head and breast*) - between 60 and 80 birds together. They were boisterous and would move in groups through the mid to upper canopy of the bush. They were not rare at that time, in fact I would say they were almost "common'. What was fantastic about the mohua – and you would often get parakeets with them – was when you saw them in the deep green, mossy bush. I remember seeing a mohua and parakeet together – just the brightness in the dark bush was an incredible experience. The parakeets, or kakariki, were also very common. This changed soon after DOC started up what they called "Operation Ark" with the first 1080 drop on our doorstep in 2006. Their idea was to preserve the large numbers of mohua. Many areas [*of NZ*] had had 1080 for years, for

example the West Coast, but we had managed to avoid it. DOC said that it was for the rats. But there were no rats in the Dart! I had spent my life taking cows up the Dart valley to Cattle Flat – I had never seen a rat. There were mouse plagues from time to time but no rats. So, we were wondering why we had to have 1080? But they said we did and so the first drop went ahead in 2006. After that it was 2009 and 2014 and we are due for another one in late 2016 (*which went ahead, and another is planned for late 2017*). [105] Around that 2009 time, suddenly there were all these rats. I can't explain it. Rats can't come into the upper Dart over the mountains – they must have come up the valley. Unprecedented. In 2014 – DOC said there was a "rat plague" like the Germans invading England – "We've got to stop them….We can fight them on the beaches…. Well there were no rats originally - before the 1080 - and there were plenty of mohua and parakeets and white-tails…"

I asked James what effect he though 1080 drops had had on wildlife in the Paradise area.

"Well, for the mohua, they have just basically disappeared. By 2011 DOC was saying, 'We have to do another drop – there's just one breeding pair left', so they did. And now I haven't seen any for a year. I feel that DOC are directly responsible for their deaths. The whitetail deer also used to be quite common. We would go into areas in the Dart valley – and we might see 14 or even as many as 25 deer. Red deer, but also the white-tail. We had a hand raised white-tail buck. He came in 2012. I found him as a fawn, alone in a storm – near the road at night. He was staggering around. I took him home and fed him on milk. He was always free to roam and joined up with the wild whitetails but would come back and see us. We named him "Blazer". He was so tame he would come

right into the house for feeds. He disappeared after the 2014 drops. From our observations, 90% of the whitetail died after last drop. Now you are lucky if you see one or two in this area."

James waves his hand at the vista just behind his house. The lower slopes of Mount Earnslaw covered in native beech forest are indeed just on his back door. Out the front door is a breath-taking view of Diamond Lake, Mount Alfred and the Humboldt range. He has been so incensed by the loss of wildlife in the region that he tied his colours to the mast and stood as the Clutha-Southland candidate for the "Ban 1080" political party at the 2014 General Election. He is not backing down.

I do some research to see whether this story stacks up. The mohua (*Mohoua ochrocephala*) are recognised as an endangered species. A DOC website [106] tells us that "Mohua nests were twice as successful after 1080 treatment than without" [sic]. A graph reveals that in 2006, stoat trapping and aerial 1080 resulted in an improvement in nesting success from 47% to 89%. In 2009, it was 18% to 58% and in 2014/15 (post-1080), nesting success was quoted as 89% (with no control data). Unfortunately, there are no scientific papers yet available to document the detailed research that would be necessary to make sense of these figures. How many mohua nests are we talking about here for example? I perform a Scopus search using "mohua" as my key search term and discover a few papers that are relevant. I learn that mohua have been suffering from a malaria-type illness. [107] Eight of these endangered birds were captured by DOC for "captive-breeding purposes" and then died of this disease, but in two, the cause of death was ascribed to the trauma of being captured (which is a different sort of worry……).

I find a paper entitled, "Quantifying the benefits of long-term integrated pest control for forest bird populations in a New Zealand temperate rainforest". [108] I wonder at the slant of

this, the implication seeming to be that benefits can be taken for granted, the only question being how great they are…. The study was undertaken in the Landsborough Valley, Fiordland, where "predator control" was underway with stoat trapping and aerial 1080 from 1998 to 2009. On first glance the results look reassuring and even impressive: "Annual counts of nine species showed significant increases during the 12-year study period. ….. mohua counts ……increased from a low of 14 birds encountered when the count stations were established in 1992 …… to a cumulative sum of >300 birds recorded on the five-minute counts during 2007-2009". But looking deeply at the data it is apparent that there are major methodological problems, most tellingly,

- there was no control!!!
- there were no pre-1080 bird population counts
- five minute bird counts were used (this method has been discredited as inaccurate)
- Mohua numbers were highly correlated with beech seedfall during mast years (indicating a boost in the population because more food was available) but without a control group you can't tell whether 1080 provided additional benefit
- "predator control" included aerial 1080 (some years) but also stoat trapping and ground-based cyanide application. Any of these could have been responsible for reducing predator numbers

The plight of the mohua remains perplexing. So many things simply do not add up. Even with its inadequacies, the Landsborough study sounds very encouraging when the figures are trotted out. I know these data have been used to convince many ardent bird-lovers and DOC workers that aerial 1080 is the mohua's only chance for survival. But how to square this with James Veint's personal testimony of the near-total wipe-out of the population in Paradise? Why are these birds becoming

increasingly rare? Why, with all the improved nesting success, are we not seeing great increases in their numbers? Instead there are hardly any birds at all. The questions just keep piling up. Why, for example, are mohua population data from off-shore islands used as part of the justification for 1080 drops, when predator elimination there can be enduringly successful (no repopulation due to the water border) in a way that could never be possible on mainland New Zealand? Why do no DOC websites mention that mohua, being passerines, are insectivorous and therefore almost certainly susceptible to secondary toxicity from 1080-poisoned insects? Their Northern Hemisphere relatives, the sparrow and the finch, are highly susceptible to 1080 with LD_{50}'s of around 3 mg/kg. Why do we have no properly controlled, before-and-after population studies on the effects of aerial 1080 in this species? Are the Landsborough numbers actually wrong (the phantom foxes of Tasmania spring to mind) and is DOC rapidly, albeit with the best of intentions, exterminating the species? Where does the truth lie?

CHAPTER 12

BEES AND BATS

"If the bee disappeared off the face of the earth, man would only have four years left to live."

Maurice Maeterlinck, The Life of the Bee

The bee is very susceptible to chemicals, even in miniscule amounts. An article from the Phys.org website, dated April 29, 2016, states, "German agrochemicals and pharmaceuticals giant Bayer was presented Friday with a petition of more than one million signatures urging it to stop manufacturing pesticides that are blamed for the decline in the world's bee populations". [109] This refers to the neonicotinoids, a class of chemicals that act as systemic insecticides. Since 2012, the EU has restricted their use on flowering crops such as corn, oilseed rape and sunflowers, because of concern that these chemicals, when incorporated into plants, may poison bees. In 2015, *The Guardian* ran an article entitled, "Nearly one in 10 of Europe's wild bee species face extinction, says study". [110] 1080 is a pesticide and insecticide that works in a different manner to neonicotinoids but has the potential to be at least as damaging. Bees use their tiny muscles intensely when flying and so could well be at risk from this chemical that blocks muscle function. The aphids-on-beans experiments indicate that 1080 can be taken up into plants [41] and a hovering and pollinating bee could well receive a dose.

There are different opinions on the matter. One paper from 1964 investigating the effects of 1080-mixed-with-jam baits is reassuring. The authors were "unable to find evidence of mass mortality of honey bees (*Apis mellifera*)". [111] However, a 1991 study reached exactly the opposite conclusion, warning that,

"large bee kills have been reported recently in areas where opossum poisoning programs have been conducted." The authors continue, "Of four samples of dead honey bees tested, three have been found to contain 1080 (3.1, 3.8, and 10 mg/kg bees, unpublished test results)." The LD_{50} was measured at 0.8 mg/bee. [112] Acute bee intoxication caused "vigorous shaking and inability to hold onto the substrate (*jam baits*)". Bees do not die for several hours and this is of concern as poisoned bees can make repeated trips to the baits. The practice of laying pre-baits (standard DOC practice) could make things worse, as forager bees are likely to become conditioned to visiting the initially non-poisonous baits, and be more likely to return with their friends and relatives. These researchers were at pains to reassure the science community that they had the answer. 1080 mixed with jam can be rendered perfectly safe for bees if oxalic acid is incorporated into the mix. Initial trials with molasses worked to some extent but pure oxalic acid was better. This repels most bees.

The bee literature seems to be full of these quirky little details – all to do with what bees like to eat. It reminds me of "What Tigger likes for breakfast". [113] All the same, I am left wondering about the aerial 1080 (without oxalic acid) which is now being distributed far and wide, its dust capable of being transmitted up to a kilometer from the drop zone. Isn't this likely to affect the bees? What about hives in the Dart valley, for example, or on the West Coast? What about the honey from them? At least one organic beekeeper appears to share my concerns. In 2014, the *Otago Daily Times* ran a story under the heading: "Renowned West Coast beekeeper Roy Arbon is moving his main hives to the North Island to ensure his bee products stay organic". [114] I find a statement from him (in a blog) saying that his honey was rejected as an organic export to the U.S., not because it contained 1080, but because it was sourced from a region where 1080 had been dropped. In the article he is recorded as saying,

"1080 is dropped in the winter time and the bees pick up the residue on the rata vine and take it back to the hive. No chemical company will test for it .....". At the time of the interview he was intending to move his bee-keeping operation to Ruatoria (east coast of the North Island) so that he could "ensure the bees are in a 1080-free area".

What about bats? One of the reasons given by DOC that 1080 can purportedly be sprayed all over New Zealand with impunity is that we have very few native mammals, so non-target deaths should be minimal. However, bats are mammals and the New Zealand short-tailed bat is endangered. In 1994, B. D. Lloyd et al. published a report commissioned by DOC entitled: "Evaluating the potential hazard of aerial 1080 poison operations to short-tailed bat populations". [115] Apparently our bat represents the "sole extant species of the ancient New Zealand endemic family *Mystacinadae*", and is Category A, indicating the highest priority for a threatened species. Short-tailed bats probably emigrated from Australia more than 16 million years ago, and have since continued to evolve in New Zealand, developing unusual habits such as foraging for food on the ground like small rodents. They are regarded as a biological oddity [116] and, although perhaps harder to love than some cuddlier creatures, they are nevertheless unique inhabitants of our native land and eminently worthy of protection.

So what did Lloyd find? He begins with a discussion of bat habits and includes information about their low fecundity (one batling or "pup" per year) and high longevity (up to 30 years). They are therefore at risk as a species from poisoning, as even healthy populations of bats may take a long time to recover. Their susceptibility to 1080 remains unknown but can be guessed at from information on the American big brown bat, which is killed by very small quantities. A field trial on Codfish Island (which is located to the west of Stewart Island/Rakiura) involved exposing bats to non-toxic cereal baits that had been impregnated with

fluorescent tracer dyes. There was no evidence of fluorescence in bat droppings, implying that the bats did not eat the bait. So far so good, perhaps the risk of direct poisoning is low. The rest of the paper focuses on the possibility of secondary poisoning from eating poisoned insects. Bats have what is described as "a broad diet" which includes beetles, cockroaches and spiders, but most especially weta.

Lloyd states, "Compound 1080 was originally patented as an insecticide but has not been approved for general use as an insecticide because of its high toxicity and persistence…." Obviously, at the time of writing (1994), the official DOC line that 1080-is-not-poisonous-to-insects had not been set in stone. He then goes on to quote the banned work of Meads citing "significant disruptions of food chains as a possible consequence of 1080 drops." The impression given is that Lloyd regards Meads as a reputable source of information. He comments "1080 residues were detected in cave weta, tree weta and cockroaches for up to four weeks after the operation. …. Weta concentrations averaged 12 ug/g (*12 mg/kg*), and reached a maximum of 46 ug/g (*46 mg/kg*)." Those are high levels. Nasty little packets of poison to be consumed by bats or anything else that eats insects, including birds such as the morepork or kea. Lloyd concludes with the following, "A single moderately sized (3-4 g) weta which had ingested a sub-lethal dose of 1080 (15 ug/g) within the previous 24 hours would be sufficient to kill a short-tailed bat." So from a bat point of view, the problem is not so much with the insects that are killed by 1080, it is with those that have been sub-lethally poisoned. Poisoned weta scurrying, or perhaps staggering, around could provide a lethal meal for a sensitive mammalian bat.

In the book *Protecting Paradise*, 1080 advocate Dave Hansford states that Lloyd et al. "caught 269 bats in the following days, and checked them for 1080 poisoning, not one showed any adverse symptoms". As with much of Hansford's analysis, this

is a skim over the surface. The paper in question was in fact from 2002 [117] (and not 1994 as erroneously quoted). The authors were far more circumspect in their conclusions and commented that they found the failure to detect evidence of 1080 poisoning in any of the 269 bats caught, surprising (note they did not actually measure blood levels). They went on to discuss how the latent period for 1080 (the time between ingestion and the onset of symptoms) remains unknown. So, in fact those bats could have gone on to exhibit signs of 1080 poisoning after their release 48 hours later, leading to very different conclusions. They also noted that a heavy fall of snow eight days before the poison operation could have invalidated the results as it could have caused insects such as weta to become "inactive" and perhaps therefore not be eaten by the bats. They concluded that, "several replicate trials would be required in a variety of circumstances before a valid generalised conclusion could be drawn about mortality of short-tailed bats during aerial 1080 operations." There is no convincing evidence that these recommendations have been acted upon in the 15 years since that publication appeared.

CHAPTER 13

PLANTS

The sower may mistake and sow his peas crookedly:
the peas make no mistake, but come up and show his line.

Ralph Waldo Emerson

My first inkling that 1080 might affect plants as well as animals came while I was watching the Graf Boys' "Poisoning Paradise" film. [2] There was a Maori gentleman talking about puha and watercress. If these native plants, which typically grow near or in forest streams, were to absorb 1080 from contaminated water, could they become poisonous to human puha or watercress gatherers? Puha, also known as the "sow thistle", is a plant of cultural importance to Maori. Pork and puha is a quintessential dish often made as a "boil up" or stew. Watercress grows wild in many parts of New Zealand, including near the Karamea end of the famous Heaphy track, a welcome fresh salad for the vege-deprived tramper. However, like many aquatic plants, it is very susceptible to contamination by toxins. The Heaphy has been heavily bombarded with 1080 over the last 10 years. How safe would it be to go foraging now?

A relevant study is from Lincoln University. It is entitled, "Uptake of 1080 by Watercress and Puha – Culturally Important Plants Used for Food". [118] For the watercress part of the study, single 1080 baits were dropped into wire mesh cages within a stand of watercress in seven sections of stream and three non-toxic baits were dropped upstream as controls (note the exceedingly small numbers). Watercress plant tissue and water samples were collected at baseline, and then after 30 minutes, 1

hour, and 1, 3, 7, 10 and 17 days. Results revealed that 1080 was detected in 3 of 56 "treated" watercress samples. The maximum concentration was 63 parts per billion (ppb) on Day 7, while the maximum in water samples was 7 ppb after 1 hour. The puha study was performed on the shores of Lake Waikaremoana in the central North Island, with specific permission from local Maori iwi. Once more, single 1080 baits were placed in small cages at the bases of eight puha plants. Two non-toxic baits were placed at the bases of two plant controls. Puha tissue was sampled for 1080 levels at intervals up to 38 days after the baits had been placed, using gas chromatography. Results showed that there were measurable levels of 1080 in 9 of the 10 puha plants sampled. The highest 1080 concentration was seen on Day 3, at 15 ppb, from a single sample. On further analysis of the raw data, very low concentrations of 1080 were observed in 59 of the 60 puha samples, including those taken before the addition of toxic baits. What do these figures actually mean?

The puha study shows that 1080 (fluoroacetate) occurs naturally in this plant but at extremely low concentrations. The experiment showed that 1080 did get from the pellet into one puha plant leading to a measurable but tiny concentration (15 ppb). Only 3 of the 56 watercress samples contained 1080 but in one of them the amount was 63 ppb. The following is included in the Discussion to reassure the general public: "With the highest 1080 concentration seen from watercress …… a 70 kg person would have to consume 2.2 tonnes of affected plant material to receive an LD_{50}." My conclusions are a little different: The acceptable threshold concentration of 1080 in water for human consumption is 2 ppb. Looked at in this light, 63 ppb is not ideal. What if two 1080 pellets were stuck together as they fell out of the helicopter and lodged just underneath the watercress mat? Here is the opinion of the late Dr.Peter Scanlon (Accident and Medical Practitioner MBChB, BHB, BSc, DipCEM, F.AMPA) as part of his ERMA oral submission (2010), including his preface:

> "I nga wa o mua" – The past informs the present. Foresight should be sought as hindsight is dearly bought.
>
> My concern is not with the large amount of 1080 calculated above that is needed to cause severe health problems or death but relates to a different issue, namely, whether chronic or episodic exposures to sub-lethal or even very low doses (< 3.5 ppb) pose any health risks to humans? What about the rural pregnant Maori woman who consumes large amounts of watercress after an aerial 1080 drop?"

Sadly, Scanlon has since died and so could not be interviewed for this book. No doubt he would be concerned to know that no further controlled studies have been done to explore these questions. In the meantime puha and watercress within or downstream of 1080 drop-zones must remain suspect.

Plants provide food for birds (seeds and fruit) as well as ungulates such as deer and possums (leaves). 1080 delivered by air may fall onto open ground or the forest floor. Could it be taken up by plants and native trees through their roots and have harmful effects on the food chain? Notman, [31] writing in "*New Zealand Entomologist*' states: "Sodium monofluoroacetate (*1080*) in the soil may be taken up by plants, where its extremely effective systemic action poses a threat to insect populations." He references work by Dr W. David of the Unit of Insect Physiology, Agricultural Research Council, Cambridge, UK, mentioned in Chapter 4, who showed that 1080 could be sucked up by the roots of beans and be poisonous to aphids living on their leaves. [41] 1080 applied directly to leaves was also an effective contact insecticide.

A New Zealand group looked into the same issue using rye grass and the native New Zealand broadleaf (*Griselinia littoralis*). [119] They state, "The toxin (*1080*) was rapidly taken up into ryegrass, the mean maximum concentration measured was

0.08 ppm at 3 days ….. Toxin elimination from ryegrass tissue was equally rapid, …. approaching baseline concentrations after 7 days exposure." It was taken up more slowly into broadleaf and persisted longer. "The mean maximum concentration measured was 0.06 ppm at 10 days (*and then*) the 1080 concentration steadily decreased, being near the analytical limits of detection after 38 days." No 1080 was present in any of the controls. Thus, one can only conclude that despite DOC rhetoric to the contrary, there is clear evidence that 1080 is assimilated by plants through their roots and reappears in their leaves and sap as a potent poison. It does enter the food chain and persists for a variable number of days to weeks. The maximum length of time that 1080 residues persist in plants was shown in experiments conducted by Oglivie et al. to be 38 days. [119]

Another part of the 1080-and-plants story is more confusing. A friend framed this as follows: "If its OK in Australian plants, and acts as a natural deterrent to pests, why shouldn't it be used (i.e. applied by man) in New Zealand?" Potassium fluoroacetate (as opposed to sodium fluoroacetate which is sold as 1080 pesticide) occurs naturally in at least 40 plant species in Australia, Brazil, and Africa. It was first isolated in South Africa in 1944 from the gifblaar plant (*Dichapetalum cymosum*).

It is also present in several other plants native to Africa, Brazil and Western Australia. One of the most famous is the Swan River Pea (*Gastrolobium celsianum*). These plants are poisonous to many animals of European origin. This had disastrous consequences when livestock were first introduced into Western Australia in the 1840s. Farmers were forced to 'scalp' their land, meaning removing poison pea seed-containing topsoil, and replacing it with topsoil sourced from elsewhere. Unfortunately, the poisonous Swan River pea plant would often re-emerge phoenix-like from the ashes after bushfires and cause a whole new cycle of cattle deaths. However, native brush-tailed possums, bush rats, and western grey kangaroos, which

have existed for thousands of years alongside these poisonous plants, have evolved an efficient chemical detoxification method to inactivate fluoroacetate and are not affected. Plant levels of fluoroacetate can be extremely high and leaves of the box poison plant (*Gastrolobium parviflorum*) contain up to 2,600 mg/kg. [120] If the possums now living in the New Zealand bush were originally from Western Australia, they would be well and truly immune to 1080, but that is not the case so one must assume they originate from other regions and have evolved separately to these special plants.

Does this mean that 1080, being an organic poison, will somehow be fine for New Zealand wildlife? Not at all. Fluoroacetate, which belongs to the chemical group known as organofluorines, whether occurring naturally in a Western Australian plant or chemically synthesised by man (and as its sodium salt, re-labelled 1080), will kill any bird, animal, insect or reptile that relies on the Kreb's cycle for metabolism, as long as that creature consumes a sufficient dose and does not have a specially evolved system for detoxification. None of our native creatures have such a system. However tolerance to 1080 can be made to develop in *some* animals if they are fed small amounts of the chemical over and over again. This induces detoxifying enzymes in the liver in the same sort of way as drinking small amounts of alcohol can induce enzyme systems that break that down. [121] One study in rats showed that resistance to 1080 can be made to develop using exactly this strategy. [122]

There are other ways that 1080 might adversely affect the plant kingdom. For example, if it kills forest floor insects that normally degrade leaf litter, then decaying plant material could accumulate in excessive amounts around the bases of trees. This could change local temperature and humidity. Might it interfere with root function? Could fungi be adversely affected? Yeasts are susceptible (according to Eisler) [4] so this is on the cards. Dr Suzanne Simard, Professor of Forest Ecology at the University

of British Columbia's Department of Forest and Conservation Sciences in Vancouver, Canada, is known for her research into forest networks. [123] Often this involves an interaction between fungi and roots (called mycorrhizal symbiosis).

All trees, especially the ancient trees found in the great Douglas fir forests of North America, depend on these networks. The plant takes some of its hard-earned carbon from photosynthesis and sends it to the fungus. The fungus links the whole forest together. A single tree could be linked up to hundreds of other trees. In the below-ground network, biochemical signals are transmitted back and forth, allowing self-organisation of the ecosystem. Not only plants interact in this network, but insect and animal species are fundamental as well. It seems similar to the neural network of the human brain. There is a new movement in plant biology exploring the resulting interconnectedness in "interspecies webs". [124] This seems highly relevant to the issue of 1080 use in New Zealand. Large quantities of lethal poison with indiscriminate effect are being dumped onto our forests, some of which are particularly ancient, with species dating back to Gondwanaland. What life-giving networks are being disrupted? Is this why the forests seem so devastatingly silent and lacking in any form of life or energy immediately post-poisoning? This "sad silence" was referred to constantly in submissions from the New Zealand public to ERMA as part of their 2007 review entitled "Reassessment of 1080". Here are a couple of them below:

Evaluation and Review Report: Reassessment of 1080 (HRE05002), Appendix T: Summary of Submissions

I have been in Stoney Creek valley after a 1080 drop and it is like a morgue – deathly silent. In contrast on the morning of the same day, I had been in an adjoining valley which had not had 1080 dropped (the Waitahu) just a few kilometres away – and the bird life was prolific. 9261

I recently went to Pureora for the first time in 15 years – the bush felt eerie and devoid of life. In fact I saw only three fantails and a couple of blackbirds. 7354

CHAPTER 14

JIM

I discover the name of the Maori gentleman in "Poisoning Paradise". It is Jim Doherty. He is of Tuhoe descent and a kaumatua (*Maori elder*). He has been at the interface between Maori and European cultures for many years, particularly with respect to environmental issues. Currently he is Chairman of the Tuhoe Tuawhenua Trust, which administers 9,000 hectares of Maori freehold indigenous forest lands in the Te Urewera National Park. He is a member of a number of Maori committees that advise local and central government and has an extensive knowledge of indigenous fauna and flora and "tikanga Maori" (*Maori customs*). Jim was involved in the puha and watercress study, [118] and was an expert advisor to the ERMA decision-making committee that reassessed the use of 1080 in 2007. He has serious concerns about 1080 and agreed to be interviewed for this book.

I ask him how he feels about 1080.

> J: First off – I don't agree with any chemicals applied to Mother Earth. That's any chemicals. What separates 1080 from the others is the aerial application. It goes everywhere. In terms of culture, I am Tuhoe – that is my whakapapa (*genealogy / origins*). In our culture everything is connected. People are connected to plants – they are connected to animals – to the land – to everything….
>
> But we – and here I mean we as humans – were given extra responsibility by the Creator. We should not be doing the things that we are doing in terms of chemicals.

The other thing for me and for Tuhoe – is that …. things that are there for us, also need to be there for coming generations. Of course that is of great concern to me.

How did you first come to learn about 1080?

J: I was part of a panel about 10 years ago – it was for ERMA. This really drove home to me the impact that 1080 was having on a whole lot of communities. About 12 months after that I met with a couple of young Maori scientists who had just come out of their studies. One was Sean Ogilvie and another was Jamie Ataria (*co-authors on the puha and watercress study* [118]). In Tuhoe we use plants for medicine – this is called Rongoa. I said to these young guys, "Could we do some research on Rongoa plants – find out whether they are affected by 1080?" Way back then the Animal Health Board managed 1080 research funding. We managed to get a grant from them.

What did you find out?

J: The main finding of the research was that, Yes, Rongoa plants take up 1080. It stays within the plant for approximately a month. So then the next question is, "What effect does that have on the quality of Rongoa from those plants?" Plants have an immune system. Their medicinal properties could be affected by even tiny quantities of chemicals. We haven't been able to get any funding to look into this.

Have you had any experience with animals or birds poisoned with 1080?

J: Birds – Yes, of course it affects birds. A big concern is 1080-poisoned animals falling into waterways. In one study, Jamie got an opossum that was killed by 1080 – got some of the flesh – and made it into a sausage – fed it to eels - to see if the 1080 would flow on into the eels.

It did (*research into long-finned eels by Lyver et al.)*. [125] There is such a thing as secondary poisoning. Using that same scenario, take birds that are scavengers – they feed on dead animals. There are birds that live on insects – they will be affected by 1080 in insects. There are also birds that will have a go at eating the bait ……A lot of that stuff has not been properly looked into.

Is your ancestral land affected by 1080?

J: I chair a trust that looks after around 9,000 -10,000 hectares of land. I would say three quarters of that land is covered in forest. We do not allow 1080 to be used anywhere in that forest. This is the Te Urewera National Park. As you know, Te Urewera is part of Tuhoe's treaty claim (*referring to the Treaty of Waitangi*). Te Urewera was removed from national park status and a new Act has now been put in place. Until four years ago, DOC administered some of the land and they were using 1080 in some remote areas. Not now. There has been none in the last 4 years. At this point, the board is still in the process of producing a management plan.

Do you have any closing remarks?

J: I think it is natural that Maori would be opposed to any chemicals. We look at it in this light: When I refer to "Mother Earth", I actually mean this in the same way as a human mother. Would we subject our own children to those chemicals?

Other Maori iwi have also expressed unease. In December 2016 the *Taranaki Daily News* reported that the Ngatiawa ki Taranaki Trust (representing local Maori from the New Plymouth region) had extended a "rahui" (ritual prohibition blocking access to an area and its resources for spiritual reasons) that extended along the coastline from New Plymouth's Back Beach to the Mokau River, for a further six months. It was initially imposed because of

the disappearance and presumed drowning of a local fisherman, but the extension was because 1080 dropped onto nearby Mt Taranaki "raised fresh concerns for the land and waterways". [126]

However, not all Maori oppose the use of 1080. In 2015, 21,000ha of forest in the Auckland's Hunua Ranges were sprayed in an aerial 1080 drop. Local iwi (Ngati Whanaunga) were consulted and gave permission. A representative is on record as saying that "if it does get into the waterways, it's been explained to us how they are going to manage keeping that 1080 out of the supply of the dam" [127] (the Hunua ranges is the catchment area for 60 percent of Auckland's drinking water). 1080 was not detected in water samples taken subsequently. However, anti-1080 activist Clyde Graf has stated that "flight charts …. showed that 1080 poison bait was dropped directly into all streams within the operational boundaries. Hundreds of flowing watercourses were included." [128]

DOC has recently indicated a desire to get Maori groups around the country on-side. Jim belongs to the Maori advisory and advocacy group, Nga Matapopore which has liaised with Landcare scientists and DOC about this issue. A paper entitled "Bridging disciplines, knowledge systems and cultures in pest management" [129] states; "feedback from the Maori advisory and advocacy group, Nga Matapopore, highlighted a preference for avoiding the use of aerially-applied toxicants for animal pest control." Clearly, the authors viewed collaboration between Maori and European "stakeholders" as desirable. They concluded, "we can contribute, ….. to the on-going efforts of practitioners and researchers to bring disciplines and knowledge cultures more in tune with each other when addressing conservation and environmental challenges." If you can penetrate the management-speak, these sound like fine sentiments. But is it just window dressing? The aerial 1080 campaign shows no sign of abating.

CHAPTER 15

HUMANS

As mammals we are, by and large, very susceptible to 1080 poisoning. As a species, our LD_{50} for 1080 is 2 mg/kg so we rank halfway between wombats (1.5 mg/kg) and finches (2.7 mg/kg). [12] The amount of this poison required to kill the average 70 kg human is around 140 mg and this is rather less than the amount of potassium cyanide that would do the same job (approx. 360 mg). We are 33 times less susceptible than dogs – for which we should be grateful – but six times more so than mice. The LD_{50} defines the lethal dose for 50% of a group, but what is the "make-very-sick" dose and how long might such a sickness last? What is it like? Have there been any reports of sublethal 1080 poisoning in New Zealand? As it happens, Yes. Two sisters from Reefton (a town that sits inland from the West Coast of the South Island) were picnicking one afternoon, when 1080 pellets rained down on their heads. The sisters were reported as "feeling ill" within 40 minutes of the aerial drop (consistent with the known time delay for the metabolic conversion of fluoroacetate to fluorocitrate) but did not immediately associate it with 1080 poisoning. [130] Medical tests undertaken by a locum GP showed an abnormality of liver function in one of them.

I discover that I have a link to one of these ladies, via a mutual friend. The degrees of separation in this country are very few …. I try to get in touch. I am hopeful. Nobody calls. I know the case is under review by the Accident Compensation Commission (ACC); New Zealand's "no fault" insurance system. This often involves a "gagging" clause. I can feel a great silencing machine at work. The image of the three wise monkeys has been applied to DOC rangers, who are in the front line of the "Battle of the

Birds", but would be just as appropriate for scientists, politicians and bureaucrats.

In 2015, the *Greymouth Star* reported the case of another possible victim of sub-lethal 1080 poisoning. [131] A 72 year-old retired fisherman came forward after learning of the Reefton couple. He was observing a helicopter dropping 1080 pellets in the Pelorus Sound region of the South Island from a vantage point on his boat, when the wind changed and he "breathed something". He subsequently complained of a chronic cough and extreme weakness so that he could not walk properly. He also lost a great deal of weight and developed a severe headache. He was diagnosed with temporal arteritis (a condition that results in inflammation of the arteries that supply blood to regions of the head and neck). Interestingly, his wife, who had also been on board the boat, developed similar symptoms and was later diagnosed with the related condition, polymyalgia rheumatica (PMR). As a rheumatologist, I know both these conditions well. They can be hard to diagnose. If sub-lethal 1080 poisoning were to masquerade as PMR, then there could be hundreds of unrecognised cases.

There is no proof that 1080 poisoning caused this couple's symptoms but the story makes me concerned. Muscle tissue is known to be affected. Mallard ducks that had been deliberately poisoned with 1080 showed signs of severe muscle damage when examined after death as shown in Figure 3. [23] Heart muscle is also a target as shown in South African experiments involving deliberate sub-lethal poisoning of sheep. [132] All 17 wethers given low doses of 1080 for up to 5 months, were found to have widespread microscopic changes in the heart muscle when they were autopsied. If this can happen to sheep, what are the chances that something similar might occur in a human? They might silently develop what is termed "cardiomyopathy", which can be translated as cardio (heart) – myo (muscle) – pathy (sickness), a condition with many different causes ranging from alcoholism

to atherosclerosis. Chronic 1080 poisoning could be hiding in this group as well.

Most of the human literature regarding 1080 poisoning deals with suicide attempts. A Chinese group described 38 patients affected by poisoning with 1080 (described here as SMFA standing for sodium monoflouroacetate) [133] who presented themselves to the National Cheng Kung University Hospital between 1988 and 1993. All had attempted suicide. There were initially more than 38 as, "Victims dead on arrival and those with co-ingestions (who had taken more than one substance) were excluded." The clinical features of 1080 poisoning were extraordinarily variable but nausea and vomiting were common as were diarrhea, agitation and breathing distress. High citrate levels were found in the blood (this is a product of 1080 breakdown) and also low calcium levels. Because of effects on the brain, extreme anxiety was a feature in some, as well as "verbosity, irritability, and hyperactivity". Seven patients died despite attempts at resuscitation. Effects on the heart were most often the cause of death with abnormalities in rhythm and sudden cardiac arrest.

There was reference to the use of alcohol as an antidote which interested me in view of the mouse experiments I was involved in in Dunedin all those years ago. To quote: "….. one young woman ingested 240 mg SMFA, a usually lethal dose, mixed with 30% ethanol, (*as*) Sn-Rung wine. Vomiting, hyperactivity, and (abnormalities of cardiac rhythm) were noted but she soon recovered and was discharged in stable condition." Poor young woman. No doubt the wine was meant to hasten her demise but instead it seems to have prevented it. All the same it must be remembered that this is a poison without an effective antidote. We are told: "Although the immediate administration of ethanol after exposure may be helpful, larger delayed doses may not be beneficial. Five of the seven fatal cases received ethanol therapy more than one hour after (1080) ingestion, it

obviously did not improve survival." This is interesting stuff and makes one very sure that 1080 is a nasty poison. But I am more interested in accidental chronic poisoning. What about those who have worked closely with 1080 over the years in New Zealand? Amazingly, there is almost nothing. The only reference I can find was published in the NZ Medical Journal in 1977. It is a case report entitled: "Chronic sodium monofluoroacetate (Compound 1080) intoxication in a rabbiter". [134] Its not available on-line so I send out an interloan request to the library and wait. At last it appears.

A 59-year-old rabbiter was admitted to Christchurch hospital with a six month history of increasing ill-health. He was probably typical of those employed by the rabbit boards of the time. His symptoms included tiredness, vomiting and itching of the skin. Over the previous month he had become short of breath and had developed a bleeding nose. He had been employed for 10 years by the pest destruction board and used 1080 twice a year, for 4 weeks at a time. He was involved in preparation of the poison, its impregnation into carrots and then the distribution of poisoned bait. It is reported that he wore rubber gloves and overalls when handling 1080 and had never knowingly ingested it. He had last performed these duties 3 months previously.

On admission to hospital he appeared very ill with wasted muscles, scratch marks over his skin and signs of heart failure. There was evidence of damage to the nerves and possibly to the part of the brain that controls motor function, as he had a tremor and unusual rigidity of the muscles (like Parkinson's disease). There were signs of malfunction of the thyroid gland and features suggesting impaired sex hormone production with reduced pubic hair. Biochemical testing revealed that the kidneys were failing and subsequently a biopsy was obtained. This showed small cyst-like structures in the tubules of the kidney. The liver was also biopsied and a similar feature was found in those cells. Two weeks after admission the urine was analysed and found to be

positive for organofluorines (1080). Tests were repeated 5 weeks and 6 months later but were negative. It was concluded that this patient had developed severe chronic 1080 poisoning resulting in kidney, nerve, brain, heart and possibly glandular damage.

The kidney changes closely resembled those described in rats given 1080 experimentally, especially the cysts in the tubules. [135] The authors expressed surprise that 1080 should have still been present in the urine, well after exposure to the poison. They concluded, "this case strongly suggests that repetitive exposure to SMFA (1080) may be cumulative and result in nephrotoxicity (kidney damage) particularly if pre-existing renal impairment exists". In other words, people chronically exposed to 1080, even in short bursts many months apart, run the risk of accumulating the poison and developing damage to many organs including and especially the kidney.

Eisler reports that "In the 25 years of use in the United States, there have been four suicides and at least 12 accidental deaths". [136] He states that 1080 is easily absorbed through the lungs and poisoning by inhalation is quite a risk. He continues, "When handling 1080, human operators should wear protective clothing including gloves and a respirator." A quick review of the Graf Boys' "Poisoning Paradise" film shows footage of men handling a monsoon bucket full of 1080 pellets with green dust clearly seen rising off the load and blowing around. The obviously annoyed foreman is interviewed and denies that his workers face any risk at all. Nobody seems to be wearing a respirator. A more recent Graf Boys' film of the 2017 Makarora drop shows a similar picture (Figure 7) of a digger operator surrounded by a cloud of green dust. Was this the pre-feed or was it 1080? [137] I wonder how many have become unknowing (and probably undiagnosed) victims of chronic 1080 poisoning?

There is an old paper from 1948 that gives a first hand account of poisoning from inhalation of 1080 powder. [138] It is

important because the victim was medically qualified and took pains to document precisely what was happening in real time. He was exposed to "a puff" of "technical grade active" 1080 while it was being weighed for preparation of rodent baits. He noted, "… a tart sourish taste … followed almost immediately by a tingling sensation around the corners of the mouth and in the nasal passages.....soon the entire face had become numb, and the tingling sensation was rapidly entering the arms and legs. This was followed by spasmodic contractions of the voluntary muscles, gradual loss of speech, and within two and a half hours after inhaling the powder…., unconsciousness. No actual pain was noted during the entire onset".

It is hard to believe that more events like this have not occurred in the last 50 years in New Zealand, where 1080 has been used so extensively. I would not like to be under a 1080 drop myself, no matter how much I am assured that there will be no dust, but this is what happened to some younger members of the New Zealand armed forces in September 2015. The *New Zealand Herald* reported that "115 Limited Service Volunteer trainees aged 17 to 25 were exercising in the Coromandel Forest Park, ….with 25 instructors …while helicopters were dropping bait laced with 1080 poison". [139] Off-duty logging contractor Mark Nyhoff saw helicopters "flying back and forth over the trainees". He "photographed two 1080 pellets in the Kauaeranga River near where the trainees were camped, and a dead possum upstream from them."

The "1080Science" website [140] has appendices from the 2007 ERMA review available for perusal by the general public. Appendix M relates to human health. [79] On Page 680 there are interesting facts recorded about levels of 1080 in workers exposed to the chemical during its manufacture in Wanganui and Timaru. Nine workers provided 54 urine samples. In 10 of 54 samples (from 4 of the 9 workers) the levels of 1080 exceeded the BEI (Biological Exposure Index), which has been set at 15

ppb (0.015 mg/L). One of these samples contained 3.4 mg/L of 1080 – a level that exceeded the BEI threshold by 227 times. The ERMA review notes, "to reach such a high urinary concentration, the worker would need to receive a dose of 1080 close to the minimum lethal dose in humans." Would you be happy if that worker was a member of your family? How long would those levels have been present? Surely there are serious grounds for concern. DOC has become absurdly cavalier about the dangers of 1080 to the human occupants of our fair isles.

CHAPTER 16

MARY

Mary Molloy is spokeswoman for Farmers Against Ten Eighty (FATE). She and her husband live just outside Hari Hari, in South Westland, and have done for 40 years. Mary spoke to me from Stewart Island. She likes to go down there, to their small cottage at Ringaringa Bay as, in her words, "they haven't ruined it yet". Mary is now 66. She has three children, seven grandchildren and two great-grandchildren. She and her husband own two small farms and they live on one of them. The other has a farm manager. I asked Mary when she first became aware of 1080 as an important issue.

> M: It started in the deer capture days. [*live recovery of wild deer by helicopter during the 1980s.*] The Ministry vet in charge of our area thought it was a good idea to TB-test the deer. There were a lot of deer farms. We became involved as we were farming deer as well as milking cows. He used the PPD test [*purified protein derivative of Mycobacterium Bovis – a test that indicates past or present infection*]. The neighbour's deer had a reaction to the vet's test. So we went down to help slaughter the deer on the neighbour's farm. I was upset as they were perfectly healthy, vibrant animals. That started my questions about this TB test. I have found out that it can be extremely unreliable. There are lots of false positives and false negatives.

Tell me about the TB issue on the Coast.

> M: There are known "TB areas" and the animals affected are mostly cattle. Farming methods can be improved

to ensure that TB is not an issue, as underfeeding, not on good pasture …. allows susceptibility to TB. Good producing animals don't usually have a problem. Deer farms also had animals that tested positive but most of it was in cattle. The Animal Health Board (*now OSPRI*) blamed the possums (*for the spread of TB*) but that is not proven to be correct.

What about now – are there still TB infected animals?

M: There are still one or two pockets in the same places that there always were…. Animals have the tail test (*Mantoux*) and the blood test (*QuantiFERON-TB Gold*), not as often as yearly. Now there are very few true positives. Each year, around 187 animals go to the works from all around New Zealand, because they have reacted to the test – (*meat is analysed and cultured to see whether TB bacteria can be grown in the laboratory*) - but three quarters of these are found to be completely healthy. We had never had a positive animal on our farms until two years ago. An animal from Karamea came down in a mob of stock. A cow. She had been tested 9 times in her lifetime – never failed a TB test – went to the works and came up with TB positive. We went straight into a programme – we don't believe you should keep offspring from that group of cows. OSPRI do more frequent testing but otherwise there is not much advice. We followed good farming practices, not keeping related potentially susceptible stock. We followed advice collected from overseas websites as OSPRI does not help here. You can supply milk (*from a farm where TB has been identified*) but meat from livestock on infected farms cannot be exported to the European market - but it can go anywhere else including the domestic market. The farm that animal came from had always had TB except for a 9 month period when it was sold. Strange things happen around the time

of sales – you would hear a story like this – "As soon as so and so bought this farm at auction, I had to take him the notice to say that he had TB again …" It helps the old farmer get the best price, but it doesn't help the new farmer….. If a farmer does get TB in their stock – you have to do a lot of testing – its inconvenient. But on any farm, everything carries on exactly the same. Pasteurised milk means TB in milk is not an issue to human health .

What is the extent of TB in farm animals in New Zealand at present?

M: We have been well under the world standard as a TB-free country for a very long length of time – with low levels of infection. We have been well below 0.2% animals found to have TB – just surveillance is needed from time to time. Other countries do not do what we are doing with the 1080 – when they have similar very low levels of TB ….we are at 0.04% for cattle and deer right now. Other countries do not use 1080 to try to cure TB (*or completely eliminate it*). The only livestock that are tested are cattle and deer. They don't test sheep or any other farmed livestock.

What about possums as a major reservoir for TB?

M: I think this is a myth and a legend. Lets say there is TB in one area. Its on one particular farm. Well, none of the neighbours get it – not for 30 years. As long as there is no contact with the neighbour's stock, there's not a problem. If it was the possums, then it would spread - they are not confined to that one farm. So what is the vector for TB? It's the cattle or deer really. The early work on possum-to-cattle transmission of infection was done in the Wairarapa. Cattle will come up and lick a possum that is acting strangely in a field. This is how TB is supposed to be transmitted. There's a picture that keeps

being trotted out (*by DOC*) - as evidence that possums transmit TB to cows because cows lick them. Well, I can tell you, they had to wire that possum to the ground to make it stand still! In the nineties, thousands of possums were caught around one infected farm - up to 6,000. They were autopsied for the Animal Health Board. Not one was positive. Some have lesions on them – visible lesions, for example in the armpit, that are thought to be suggestive of TB infection. Mostly these are fight lesions. Very, very few possums handed in for necropsy have ever had TB, but some do. Repeated aerial 1080 drops does not cure (*completely eradicate*) TB – even the ground control is not done consistently. We used to get 1080 drops on a 4-yearly basis up to 2010 – all the way through the nineties. We kept our doubts to ourselves but we thought, "What the hell are they doing it for?" Not for truth. Not science. Possums have been demonised for no good reason.

Do you think native birds have been affected by aerial 1080?

M: We have had a major loss of birds. We don't get a bounce back now (*in bird numbers*). In the early days we did, but not any more. We used to have lots of falcons, tuis, bellbirds, brown creepers. Their numbers are all down now. Very low. Now if I see a tui, I ring my husband up (he might be down at the pub) and it's a major event! I used to be able, in the 1970s, to show any species of bird to my children. Now I am scratching to show any to my grandchildren. Wood pigeons used to be there every spring on the willow trees, just hundreds around the creek. Not now. Last year there were a good number - about 40 – but this was unusual. Many have just gone. Is this a coincidence? Nothing to do with all the 1080 dropped? Frogs used to carpet the roads on a wet day – Australian whistling frogs. Literally! If you drove along

the road you would drive over them. We don't have them any more ….

Same with insects - they are all in very low numbers. We in Hari Hari, haven't had any more drops since 2010. I am told that OSPRI are not coming back. But that doesn't mean that DOC won't come back. They are doing the "Battle for the Birds". I think they should call it, "Battering the Birds". We are fortunate that ours is a mixed podocarp area – DOC are focusing on beech forests – the beech masts. Masts benefit our native creatures! You would almost think that the TB link with possums and 1080 is a fraud! To justify the drops. Kea have almost disappeared. Kaka have almost disappeared. One guy I know has a farm near P…… There used to be 40 to 50 kaka on the back of his farm - after a drop they all disappeared. DOC always focuses on breeding success but when you knock the population back so much, breeding success is not enough ; 60% breeding success for a handful of birds is not enough to get the population to come back. Kiwi are killed but are never taken to necropsy – I know the odd occasions when they have been handed in – then they just evaporate! There are no tests done on them. This allows DOC to say "There have been no 1080 kiwi deaths!" Stoats are not killed by 1080, and rat populations can boom after drops. Rats came into homes along the bush edges, beside the state highway between Hokitika and Whataroa, after the 1080 drop in 2010.

What are the alternatives to 1080 for possum control?

M: I don't object to the use of cyanide by skilled operators, and trapping. There is a very good market for fur. There could be a market for meat too, e.g. pet food but that went out the window with 1080. On our own

farm, we haven't seen a possum for 20 years. There used to be hundreds. We have never used 1080 on the farm – we have only trapped. You can't be an organic farmer on the Coast – too much 1080. There is a margin for organic milk. It would be good if we could get into that but we can't - we are too close to 1080 drops. Can't be an organic bee-keeper either – for the same reason.

Mary finished with a personal warning for me.

M: You may not keep your job if you write this book. There are lots of people who are anti-1080 but they are keeping quiet because they want to keep their jobs. We are older now, so we don't really care, we just let it wash over us, but if you are employed there is a risk …….

[*Caro also warned me of this – Dan had warned her "They will get you in every area – they will take you down – you will lose everything – are you prepared to lose everything?"]*

CHAPTER 17

TUBERCULOSIS

Tuberculosis has fascinated doctors throughout the ages. The form of the infection that affects humans, and is caused by *Mycobacterium tuberculosis*, used to be famous amongst doctors as "the great mimic" because it could appear in many guises and was difficult to diagnose. It is now rare in people of European origin, but still occurs in New Zealand. I recall a recent case in a Polynesian patient who remained undiagnosed until after his death in Auckland Hospital's intensive care unit. The healthy human body is adept at walling off TB bacteria (bacilli) and preventing them from running wild and causing the full-blown disease we call tuberculosis. Tests have been developed to detect activation of the immune system and these, as mentioned by Mary, are used in our cattle.

A "reactor" may be either actively infected (a problem) or harbouring a few dormant bacilli (not a problem). This means that making a diagnosis of TB in animals, where it is usually caused by *Mycobacterium bovis (M bovis*), is plagued, as it is in humans, by uncertainty. False positive tests are common. The subject has filled whole medical and veterinary textbooks. *M bovis* can affect humans too but is less of an issue now than it used to be. Pasteurisation of milk kills the bacteria by the application of heat. According to the U.S. Department of Agriculture Bovine Tuberculosis fact sheet, *M bovis* accounts for "less than 230 TB cases per year in the United States".

All the same, transmission of TB from cattle to people was once common, especially in Great Britain. I well remember a strange indented scar in my own mother's neck that used to fascinate me as a child. She was born in England in 1913 and

no doubt contracted the infection from unpasteurised milk that she would have drunk as a child. According to family lore, the infected lymph gland was removed under ether anesthetic by the local GP on the kitchen table. Tuberculosis was once the "Great White Plague", and responsible for the deaths of Keats, Emily Bronte and Chopin amongst many others. It seems hardly credible in this modern digital age, but only a few generations ago, *M bovis* was a real threat.

After speaking to Mary I wanted to chase a few things up. It was news to me that New Zealand already has very low levels of TB in its cattle. Other countries with similar levels don't drop 1080 – there is no need. Is this true? If so why are we? Livingstone et al. [141] states authoritatively, "New Zealand's bovine tuberculosis (TB) control programme has greatly reduced the burden of tuberculosis on the farming industry, from 11% of mature cattle found with TB at slaughter in 1905 to <0.003% in 2012/13." Alexis Pietak informs me that "……the rates of TB infection in cattle were 0.5% by 2006 ……..However, to be considered a TB-free country, New Zealand's herds must test at 0.2% (*or below*) for 3 years". [57] In 2015, Stuff.co.nz announced: "The number of cattle and deer herds infected with TB has hit an all-time low of 34." So are we below the 0.2% number now? Yes we are. In fact New Zealand has been below the 0.1% TB threshold for 10 years, so by world standards we are now TB-free. [142]

How does this compare with other countries? In Mozambique, TB infection in cattle is a mind-boggling 40%. [143] In the U.K., 4.2% of cattle herds tested positive in 2014 leading to their TB-free status being revoked. In the U.S., the prevalence of bovine TB in individual cattle has been estimated at 0.00001%. So, it depends on where you are. I find it interesting that the U.K. is doing so badly. They are blaming this on badgers (as wild vectors, like possums). A young Englishman alerted me to the parallels between New Zealand and British pest control philosophies a

few months ago. He had recently arrived in the country and was just starting a job as a DOC ranger. Apparently the Brits have been killing their badgers. According to *The Guardian*, [144] "In 1982, gassing badger setts – at that time with cyanide – was outlawed as inhumane, but some farming groups have suggested suffocating badgers with 'anoxic' gases such as carbon monoxide would be more humane." This sounds disturbingly familiar. More recent information suggests that the badger killing has misfired as: "Rather than the number of cases of bovine TB falling among herds in and on the edge of the badger killing area in Dorset, they have been increasing". [145]

In New Zealand, despite the massive aerial 1080 campaign of the last two decades, there is no evidence that possum numbers have been appreciably reduced (we still drive over an average of two dead possums every 5-10 km, here in the Queenstown area, just as we used to do 50 years ago). Yet bovine TB amongst cattle has fallen dramatically, thus suggesting that the possum is not the villain of the piece. There is an ominous document on the Web entitled "TB prevalence in Great Britain and New Zealand cattle". [146]. Its main message seems to be that aerial 1080 has controlled New Zealand's TB problem and that the U.K. should emulate us and eradicate its badgers that way too. It states, "TB wild animals [sic] are the source of infection for >80% of our infected herds." Really? I would like to make a plea to any English people who might be reading this. Don't copy us!! You love your dogs! You love your robin redbreasts! No doubt many of you love your badgers! Just look over the Atlantic and do what the Americans do.

Despite their passion for chemicals, the land of Erin Brockovich has achieved a remarkably low level of bovine TB without resorting to aerial 1080 (which as you will recall was banned in the mid-1980s). The U.S. Department of Agriculture FAQ sheet [147] lists the following recommendations:

1) livestock should be tested for TB regularly,

2) they should be kept as a closed herd and replacement stock should be raised on-farm.

3) Contact between your herd and other herds should be restricted or eliminated.

4) You should test any new outside animals before purchase and quarantine them for 60 days ……

All this seems to me to be what Mary was talking about. Good animal husbandry and avoiding infectious contacts. Canada has also wrestled with the problem of a wildlife TB vector in the form of the elk. To quote the Canadian Veterinary Journal, "In public meetings held around RMNP (*Riding Mountain National Park*), a few participants suggested that removal of the elk would solve the problem of bovine TB. However, this view was not widely held….". [148] The authors go on to warn, "Attempts at wholesale depopulation of wildlife in a free-ranging population are likely to be unsuccessful and may actually scatter animals, spreading rather than containing the infection."

So, are wild possums really the enemy, the reservoir of infection? What I have read so far (and my discussions with Mary) make me doubt this. Bill Benfield notes in his book "At War with Nature" [78] that the Animal Health Board was set up in 1993 to address the 'possum crisis'. It then morphed into TB-Free NZ in 2013 and more recently into OSPRI. On the OSPRI website, under "Why is 1080 poison critical to TB control in New Zealand", we are told, "Scientific analysis links almost 70 per cent of new bovine TB outbreaks in at-risk areas to wildlife, mostly possums". Control of possums is "critical to protecting the 50% of New Zealand's export earnings produced by the Primary sector." The source study quoted was published in 1976. I look it up. Twenty-nine calves that were tuberculin test negative were grazed in a paddock where 12% of possums had been

"found with TB lesions" six months before. After 6 months, 26 out of 29 of the calves were retested, and found to be positive, with 16 having "gross lesions of TB" at slaughter. This sounds quite flimsy. How many possums were there and why were they on this paddock? Was TB confirmed by culture in all possums and calves? Could the calves have simply infected each other? Were the possum "TB lesions" confirmed or were they actually just fight scars? Unfortunately I cannot source the paper (it is not on any databases that I have access to). I decide to search for some more background information.

Possums did not always have TB. It was probably transmitted from infected cattle some time after 1967. [149] A study conducted near the Hauhungaroa Ranges in the North Island (coincidentally, very near the Pureora Forest Park of "tomtits and robins" fame) was reported in 1995. [150] A post-mortem was performed on 6,083 possums that had been trapped and killed. Of these, 2.1% showed gross lesions suggestive of tuberculosis infection, and 1.25% were subsequently confirmed as having TB on microscopic examination.

This supports what Mary mentioned about skin lesions looking like TB but in fact being something else (often the result of fighting). So 1.25% is the estimate here, from quite a large number of possums. A different message comes from Coleman et al. who studied the prevalence of TB-infected possums in Westland's Ahaura Valley. Many fewer possums were examined, totaling only 440 over the entire period. The prevalence of TB infection varied wildly from 1.9% to 53% depending on the year of sampling. In an article entitled "Mycobacterium bovis infection in wildlife in New Zealand", [151] these authors state, "Levels of infection average 5%, but may reach as high as 60%". This is extremely misleading, but we do as it happens have a much more accurate estimate. The Hon. Richard Prosser, NZ First MP, asked a question about this in the New Zealand Parliament in 2015.

Richard Prosser:

> "How many, if any, possums were dissected to look for TB for each of the past ten years, and of these, how many were found to have TB? [152]

The Hon. Nathan Guy
(Minister of Primary Industries):

> "..in the 2014/2015 year 9,838 possums were surveyed with no infected possums found."

Abridging the rest of the answer, of a total of 124,213 possums tested by the government since 2007, only 54 have been proved positive for TB. This gives a prevalence of TB-infected possums of 0.043%.

So, only a small number of tuberculous possums remain in the wild. They are alleged to be a threat to our beef and dairy industry if they manage to transmit their TB to cattle. What is the evidence for this? Coleman et al. make the following comment: "The mode of transmission between possums and livestock is poorly understood and difficult to study. However, dominant cattle and deer have been observed to approach semi-sedated ('sick') possums, and sniff and mouth them." This must be the photo that Mary mentioned where the poor possum was fixed to the ground!! The source paper is available [153] and it is astonishing that any weight at all could be given to the findings reported. For one thing, the possums in question were sedated with ketamine (horse tranquiliser) and placed within a fenced observation area. Their behaviour was felt to mimic that of possums terminally ill with TB (a highly questionable assumption). For "34% of observation time" the cattle investigated the possums, "commonly close enough to be within aerosol transmission distance, and some sniffed the possum, touched it with their noses, and in many cases licked it extensively." That's it!

In another study, [154] cattle and deer were "exposed to" sedated possums. The main finding, for the cattle, was that the most

dominant animals tended to be TB test positive (meaning they had been exposed to TB previously) and these were the most curious around the possums. In fact there was no evidence for transmission of TB from possums to cattle at all. Just a sort of tenuous link. A bit like - drunk people tend to fall over - hip fractures often happen when people fall over - therefore people who fracture their hips are likely to be drunk! There was a stronger result for deer, where the four most dominant animals investigated the sedated possum most actively, and subsequently became infected with tuberculosis. But the authors ignored the difference concluding, "This study strongly suggests a central role for terminally ill tuberculous possums in the transmission of tuberculosis to cattle and farmed deer". Over-inflated to say the least. Is this the "evidence" upon which the entire TBfree part of the aerial 1080 campaign is based?

Commonsense would suggest that the only "risky" TB-infected possum is one living right next to a farm that is stocked with cattle. To be able to "sneeze" on a cow and infect it, the possum would need to get through the fence and make a close approach. If this possum can be trapped near the fence, then the potential TB carrier could be eliminated. Possums tend to develop a fulminant form of bovine TB that makes them very sick and they often die within 6 months [155] so we need to know whether, during that period, they are likely to wander around in the bush infecting scores of others in a "Typhoid Mary" scenario. [156]

As it happens this has been studied quite recently. Deliberately-TB-infected possums were released into the Rimutaka Forest Park in an experiment to measure possum-to-possum transmission of TB. [157] A total of 16 possums were infected with the experimental strain and released. 100 cage traps were set up in a grid, 40 meters apart, on their home range land. Six months after their release, all possums trapped on

each grid were euthanised and examined for visible signs of TB. Their lymph nodes were cultured in the laboratory to distinguish experimental from background strains of TB. What was found? Between one and four cases of secondary TB were found to occur for every 300 home range overlaps (possum home ranges averaging 5 hectares). That is, 300 TB infected possums would need to roam into the territory of 300 uninfected possums for more than 6 months, before 1-4 new cases of TB occurred, so the likelihood of possum-to-possum infection seems very low.

If it is that uncommon for TB to pass from possum to possum, surely possum to cattle transmission is going to be very unlikely indeed? Lets assume though that it may sometimes occur. Targeting a few sick possums around a small number of farms does not require $60 – 80 million per annum of aerial 1080 to be dropped over the entire native forest estate, the vast majority of which is not adjacent to farmland at all. A recent PLOS one publication [158] aimed to investigate the cost-effectiveness of the New Zealand aerial 1080 program versus simple trapping. They concluded that traps or poison-bait stations "……set for > 3 consecutive nights at 150m interval spacings, would likely place >95% of the possums ……. at risk of encountering these devices, year-round." In other words, trapping possums is a perfectly good way to get rid of them and, if you only need to trap a defined area (bordering farms), then it seems extremely likely that you can prevent TB from transferring to cattle. Eliminating possums altogether is not going to happen, whether you are trapping or using aerial 1080. But their elimination is not actually required, just prevention of TB transmission.

My conclusions are as follows: New Zealand currently has very low levels of TB in its cattle. We have TB-free status as a nation. There is no risk at all to export markets at present. Some possums are infected with TB, probably less than 0.05% overall, although in small pockets the percentage may be higher.

Those that are infected could possibly transmit TB to cattle at farmland margins [27] although the evidence for this actually occurring is very weak. Therefore, the best strategy to minimise any transmission that might occur, is to control possums in those border areas by trapping or using ground-based pesticides. This is what Mary and her husband have done for thirty years. The one infected cow on their farm during that period came from a distant farm where TB had been isolated previously. There is actually no TB-rationale for aerial 1080 at all. We should copy the Americans.

As an addendum to this chapter, author and anti-1080 campaigner, Bill Benfield has just had a small win in an attempt to restore some honesty to the 1080 debate. The *New Zealand Herald* reported in 2016, "A ruling issued yesterday by the Advertising Standards Authority Appeal Board upheld a claim by Wairarapa environmentalist Bill Benfield that an email sent to farmers throughout the country by the TB agency OSPRI claiming that possums were responsible for around half of all new infections in cattle and deer herds 'was not supported by the evidence'". [159]

The advertisement was thus deemed to be in breach of a code of ethics rule concerning "truthful presentation". Benfield described ministerial responses to questions in Parliament as showing that "TB in Southland, Waikato and the West Coast was so low they could be declared free of the disease." The article reminded *Herald* readers that the Minister of Primary Industries had recently announced government investment of "$69.8m over the next four years for TB eradication, on top of $30.2m already contributed". These funds go to OSPRI, which is a private company set up as a charity. It is funded via a slaughter levy on farmers, plus "a significant injection" of funds from the taxpayer (now to the tune of $100million). Its stated goal is "ridding New Zealand livestock of TB in 10 years, and possums - a carrier of the disease - by 2040". If you read right down to the bottom you

learn, “Much of OSPRI’s work targeting possums involves the use of the pesticide 1080, which Benfield strongly opposes.”

Something is rotten in our small island nation. There are plenty of citizens who could use some of that $100 million being sprayed around in the form of unnecessary 1080. Salvation Army food-banks report that demand for their services is at an all time high. Meanwhile, New Zealanders are constantly reminded that we have a wonderful lack of corruption in this country. But our grades have been slipping. Watchdog Transparency International recently accused the Government of “astonishing” complacency.[160] The chair, Suzanne Snively, warned that, if action was not taken to keep pace in areas such as environmental protection, further downgrades in the survey were likely. Seems we are already well down the slippery slope. As Snively reminded the Government, “increased perceptions of corruption could hurt New Zealand’s reputation as a trading nation”. No! It couldn’t interfere with trade or (Heavens Above!!) tourism could it? Would that make somebody actually sit up and take notice?

CHAPTER 18

PAMELA

Pamela and her husband, Brian, currently live in the township of Haast. They bought a section for a holiday home in 2002 and then established a business in Haast Township in 2006. Moving to the Coast was new for Pamela but Brian has known the region for many years, having worked as a possum trapper and in deer recovery. Retiring after thirty years in the aviation industry, Pamela now owns and operates two shops in Haast that cater to the tourist trade. One specializes in possum /merino clothing and the other in honey and related products.

What impact do you think 1080 has had in the Haast region?

> P: There definitely seem to be less native birds around Haast than when I first arrived. I realized that every time they did a (1080) drop the bird life seemed to be decreasing. You don't see tuis, woodpigeons and fantails like you used to. When driving along State Highway 6 you rarely see any native birds at all now. At Haast beach, in an area known as Cowan's bush, 15 years ago there might have been 100 wood pigeons on the power line – now there are none. There has been a huge decline over the last 20 years. We had a small population of seven keas in Haast township about ten years ago and when they did a 1080 drop on the North Haast they disappeared the next day. In 2015 there were four kea in Haast township and then after the North Haast 1080 drop on the 30th November we only saw two. Fortunately the remaining pair did breed over the following summer but are now threatened by the proposed Spring 2016 "Battle for our Birds" 1080 drop (*update June, 2017:*

"The day after the True Haast Left drop of late 2016, the 5 town kea disappeared never to be seen again"). The hardest thing with 1080 is that you have men in their 80s, who have lived here all their lives. They go to (anti-1080) meetings and say that native bird numbers have significantly decreased in the area in the last twenty-five years and a DOC worker, who is only 25 years old, says this is wrong! They won't listen to what people actually remember. The DOC operations manager says the bird numbers are increasing in the Landsborough (*near the headwaters of the Haast valley*). They make a statement: "We have had a 100% increase in birds" but if you look at it, the numbers are so small – there are only between 1 and 3 birds. So in 1998 there was an average of 0.5 birds – and the next year we've got one bird. So that's a 100% increase! OK lets say there are 3 birds – but I want to know - why aren't there 50 birds?

What other things have you noticed?

P: The death of the insects in the bush. The bush is incredibly quiet. We used to find fantails would follow you for midges. It doesn't happen now. There are no spiders' webs. Brian has noticed the lack of insects. He looks into logs and sees if there are grubs. They just aren't there.

What made you start becoming active in the anti-1080 movement?

P: I am now more open to voicing my opinions. I am a member of the Ban-1080 party. There was a 1080 drop in the kiwi sanctuary here – that killed kiwis. There were seven monitored kiwis that died. It was all totally covered up. None of those staff work for DOC any more. The pilot involved in that drop moved away. I have also heard from an elderly local … that a similar thing happened in 1990 after a 1080 drop in the Arawhata River area -

Tuning Forks area - a significant number of dead kiwi were found. You know, if you showed a kiwi dying on TV or social media, it (*1080*) would be banned straight away. So they covered it up. My biggest upset is the inhumane way it kills animals. We keep getting this thing that they just "roll over quietly and go to sleep". They don't. It takes hours and is horrible. People see their dogs dying but DOC just says, "Dog owners should be more vigilant!" A lady in Auckland lost her dog, (*after the 2015 drop in the Hunua ranges*). It ate a possum that had been poisoned with 1080. That possum just washed out of the drop zone, down a stream and onto her property. Which is where the dog found it.

One of biggest populations of mohua was in the Landsborough. There were two DOC staff that used to go and monitor the mohua. They would catch them in mist nets and tag them. But the DOC office in Haast has been rapidly downsized. Before the Landsborough drop in 2014 they counted 247 birds. What number what have we got now? They won't tell me. Here in Haast, a lot of the birds aren't monitored any more. Neither the Kea Conservation Trust nor DOC know how many kea there are in South Westland.

How many 1080 drops have you had in the Haast region?

P: One drop every year since 1998. We have 7 blocks within a 50 - 75km radius. Abbey Rocks, North Haast, True North Haast (South Haast), Landsborough, Upper North Haast, Okuru and Turnbull, and the Waiototo/ Arawhata. The North Haast drop was supposed to be in 2014 - to coincide with a mast. But we did not have a beech mast here – so why do a drop in an area that didn't need it? Then they suddenly did it on the 30th November, 2015. We had torrential rain on the Friday. The 1080 drop

zone was in flood, they did the drop on the Sunday and on Tuesday we had another 200ml of rain, all in total disregard of the manufacturer's instructions not to use 1080 on wet ground or in wet weather. They went ahead with the drop. Stupidity. They had to do that drop – so that it was then clear for four months. After that, these blocks were open for the Roar (*deer-hunting*). If they hadn't done it that day they wouldn't have been able to do it. So they went ahead even though it would all have been washed away.

Do you have anything else to add?

P: I think that the new Health and Safety at Work Act 2015 must have an impact on the ability to aerially apply 1080. Its too much of a risk (*for those who participate in the drop and for those on the ground beneath*). Also - my background is aviation. I think that under the "Civil Aviation Act", they would be pushing the legality of spreading 1080 from the air. I state my opinion on Facebook and at public meetings with DOC and OSPRI. They try to discredit you. But I will carry on being vocal in my opposition to 1080.

After I finish my interview with Pamela I feel very demoralised. Something horrible has crawled out of the phone and slithered down my spine. I have always believed in the basic goodness of human nature. Over the 36 years that I have practised medicine, I have on many occasions been humbled by the courage and honesty of my patients. But this is a different story. The wanton destruction of native birds and insects as described by Pamela and Brian, really beggars belief. Yet, people, many people, including DOC workers and helicopter pilots, bureaucrats, politicians and scientists have actively espoused this aerial 1080 campaign. Even the "protectors" have climbed on board, with conservationists including the Forest and Bird Society who

are now enthusiastic advocates. What is going on here? Does everyone just fail to notice the lack of birds or are the drops hidden in bush areas, away from prying eyes? Has it happened too slowly for the change to be appreciable? What about the kiwis? I am not by nature a conspiracy theorist but could there really have been a gigantic cover-up?

A month later I am given the phone number of the helicopter pilot mentioned by Pamela. I give him a ring, leave a message but hear nothing. A few weeks later, to my surprise, he contacts me. I ask him to describe what happened:

> D: This was about 2006 / 2007 in the Haast region. I was involved in monitoring the kiwi sanctuary (*which lies on the seaward end of the Haast Range in South Westland*). The birds had monitors on them – there were 7 or 8 birds. The usual routine was that every 6 months or so we would go up in the helicopter, a Hughes 500D, me and two guys from DOC, and detect the kiwi signals so we could check they were still there. An antenna on the helicopter picked up these signals. The monitor on the kiwi only gave off the signal if the bird was moving – if they died they stayed still and there would be no signal.

Can you tell me what happened on the final trip?

> D: This was about a week after a 1080 drop in the area. I went up with a couple of DOC guys I hadn't seen before. We picked up one signal.

So you didn't actually see this bird?

> D: No. It was probably just in its burrow but we could tell it was alive.

What about the other birds?

> D: Well there were no other signals. It was unprecedented. I couldn't believe it really. The DOC guys took off their

headphones so I couldn't hear what they were saying to each other…..Then they wanted to be dropped off in the middle of nowhere – not sure how they got back out from there but I just left them to it.

Did you actually see any dead kiwi?

D: No. Later I received a threat by phone… (*he prefers details to remain confidential*) – basically just to shut me up. I don't like the stuff (*1080*) – I saw what it did to a herd of deer up in the Landsborough. People don't know what happens because they don't see it.

I am disturbed but not too surprised by this story. Kiwi feed on ground-dwelling insects and were identified by Alexis Pietak as a species likely to be at risk from 1080 poisoning. [57] Obviously any kiwi toxicity has to be kept right out of the public eye. Was there a cover-up? One can only speculate. The DOC boys in green may have a "Black Ops" department. The pro-1080 faction (which includes about 90% of the population) seems more and more like a cult, brainwashed by propaganda or "Fake News" and unable to see anything wrong with their actions. Is this how Waco happened? Auschwitz? And as I look up at the little fantail innocently fluttering about the eaves of our house, picking up insects, this carpet-bombing of the bush with 1080 seems almost worse than a crime against humanity.

CHAPTER 19

ANIMAL CRUELTY

In 2011 the "*Peninsula Press*", a community newspaper based in the town of Thames, Coromandel, reported that Robyn Kippenberger, National Chief Executive, Royal New Zealand Society for the Prevention of Cruelty to Animals (RSPCA) said: "The SPCA is totally opposed to the use of 1080 in the control of wild deer as death in this species has been shown to be agonising and protracted with significant suffering…..". [161] She added, "As 1080 is not species specific, the SPCA is extremely concerned by the 'by-kill' resulting from (its) application …... It is effectively 'drift netting' of the forest causing uncounted deaths of both indigenous and introduced species."

The subject of animal cruelty was addressed by the Parliamentary Commissioner, Dr Jan Wright, in her 2010 review paper. [24] She cited a report which rated the "welfare impact" of 1080 as "moderate" and graded it as 6 out of 8. [162] Wright interpreted this as meaning that the poison could be regarded as "moderately humane"[163]. How this grade was arrived at was explained by the following piece of pseudo-science, "…the neural effects of 1080 result in a progressive decline in the level of consciousness, and therefore reduced durations of negative experiences". In other words, the animals are so knocked out by 1080 that they do not feel pain.

Another report commissioned for the Ministry of Agriculture and Fisheries (MAF) [162] states, "For deer and wallabies, the impacts of 1080 were considered to be less severe than for other species. However, this may reflect the stoic nature of some herbivores such as deer, and the paucity of information on which

to base evaluation." In other words, deer and wallabies seem to put up with pain, but we are really guessing here.

How these completely subjective opinions, based on nothing more than surmise, could be passed off as a form of "science" is nothing short of astounding. Death by 1080 is not humane by any measure. Miranda Sherley, of Australia's SPCA, explored this in a paper entitled "Is sodium fluoroacetate (1080) a humane poison?" [7] She concluded that: "the most desirable poisons have a minimum number of symptoms before rapid loss of consciousness and death, with no lasting effects on survivors [*cyanide rates as 'desirable' by these criteria as death is almost instantaneous*]. Sodium fluoroacetate does not clearly meet these criteria and it is inappropriate to claim that 1080 is a humane poison based on prior reviews that fail to consider wider welfare impacts and do not use a consistent framework for assessing humaneness".

Death can be slow, taking up to three days. I have been told (off the record) about a 1080 drop that was carried out near a central North Island town a number of years ago. Pellets were mistakenly scattered over the local pony club. The next morning all the ponies were found dead, having vomited up their own stomachs. It is a disturbing image. This part of the 1080 story makes my heart quail. The contrast between how we treat wild and farmed deer is incredibly stark. Farmed deer are managed according to the Animal Welfare Act of 1999, specifically the Code of Welfare for deer (2007), [164] a document from the Ministry of Primary Industries, the same MPI as presides over most of the 1080 aerial drops in partnership with DOC. Discussing the responsibilities of the owner, this states; "where practicable, ensure that a deer that is ill or injured receives treatment that will alleviate any unreasonable or unnecessary pain or distress being suffered by the deer or that it is killed humanely." What code of ethics could possibly justify treating wild and farmed animals so differently?

Dogs are the best-known victims of accidental 1080 poisoning. With an LD_{50} of 0.06 mg/kg, they are 33 times more sensitive to its effects than man. Thus, they could be considered the canary in the goldmine with respect to the effects of 1080 on the ecosystem. Tony Orman, writing in the September 2015 edition of NZ Dog's World, [165] described the experience of a West Otago family and their dogs. The family had been on a pig-hunting trip into the back-blocks. This was several months after a 1080 drop into the region and well into the "all clear" period as specified by DOC. On the way home in the car, their hunting dogs "became crazed with pain' and "started chewing through the wire mesh separating them from the family". It was quickly understood that 1080 was to blame and they were shot. Later that night the family's beloved 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." She needed to be shot forthwith, to the family's enduring grief.

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. [166] This would only represent a small fraction of animals affected, as their owners, to prevent unnecessary suffering, shoot many immediately. Dogs can die from primary or secondary poisoning. The electronic press site "Stuff, Auckland Now" reported in October 2015 that another black Labrador ("Lulu") died after biting a possum that had been poisoned with 1080 after the 2016 drop into the Hunua Ranges, south of Auckland. [167] A toxicology test arranged by the attending vet supported a diagnosis of 1080 poisoning. Lulu's last hours are described as follows: "She was running around banging into things, shaking and frothing. She ran off into the darkness and we heard a splash. Then nothing. Lulu had died in her favourite swimming hole."

The dog-owner is pursuing legal action against the Auckland City Council, which authorised the drop.

The last word on this topic should belong to 64-year-old Lewis (Lew) Hore of Oamaru, a town on the east coast of New Zealand's South Island. In an article that appeared in the *Tasmanian Times* in 2015, [165] he described what he had observed at the Wainanakarua Reserve, near his home. This 4,100-hectare scenic reserve was created in 1980. Lew chanced upon it 20 years ago. "It was a magical spot," he recalls, "the dawn choruses by the bird life were beautiful…. Now at dawn, it is silent due to successive aerial drops of 1080 first in 2000 then 2002 and 2008. …. The 1080 contractors (*named*) admitted that over 80 percent of deer were poisoned." Lew saw 18 dead deer after the 2000 drop (*he views deer repellant as 'useless', more on this later*) as well as many dead birds including 16 tomtits, 4 brown creepers, swallows, grey warblers, thrushes, blackbirds and chaffinches. Lew has since informed me that all the dead birds were grid-referenced to a map of the Reserve and that later the map was shown to a senior Landcare scientist who estimated the number of bird deaths (when extrapolated to include the entire area) would have been about 10,000.

I know of Lew as he came to an anti-1080 meeting held in Glenorchy in November 2015. He brought with him large boards of photographs, graphically depicting animals frothing at the mouth and in the final agonising stages of poisoning. He now travels around the country showing these images, at considerable personal expense, in an effort to educate the public. It is something of a crusade. I am ashamed to say that my own reaction was to look away. I saw others doing the same. I wanted to dismiss them as "hype" but caught myself and wondered why. Perhaps it is a desire to dismiss the truly horrible as fantasy. I have heard that images of emaciated Jews and other Holocaust prisoners surfaced in Europe in the latter years of World War Two, well before the liberation of the camps. They were initially

dismissed as fabrications. It was only after eyewitness accounts confirmed their veracity that the general public was prepared to accept the events as real. Lew and other dedicated anti-1080 activists demand that we not turn away but look closely at the animal suffering caused by this poison and truly understand the consequences of our actions.

CHAPTER 20

DEER

Interviews with Kaylyn and Dick

White-tailed deer (*Odocoileus virginianus*), otherwise known as whitetail, are the smallest members of the North American deer family, (males stand 1 metre at the shoulder). New Zealand has the only two herds in the southern hemisphere. One of these lives in the Glenorchy area, at the head of Lake Wakatipu and one is in Stewart Island. Hunting these deer is permitted and there are "Tips for hunting" on the DOC website. [168] Sadly, the whitetail is extremely sensitive to the effects of 1080. Dr Kaylyn McBrearty of the Department of Ecology, Lincoln University, has conducted research into the effects of the 2014 "Battle for our Birds" 1080 drop on the Wakatipu herd. [169]

Local volunteers grid-searched the drop zone for deer carcasses in late 2014. They found five (one of which is pictured in Figure 8). What proportion of the herd did this represent? Kaylyn could not answer this definitively but she stated, "the observed kill has the potential to be demographically significant".

In an unusual move, Kaylyn included correspondence between the Director of the Fish and Game Council and the Director General of the Department of Conservation prior to the drop, at the end of her report. This makes fascinating reading. In answer to a query about whether deer repellant should be used, the latter replies, "the planned 2014 operation using 1kg/ha of toxic bait is, I believe, very unlikely to result in any material by-kill…. Please note that the additional cost of applying deer repellant bait would be approximately $140,000.00 and would require a delay to the operation by some 7 weeks…". Clearly

the powers that be within DOC were seriously mistaken in their assumption that there would be no by-kill. Even the most cursory reading of the 1080 literature would have indicated that whitetail deer are extremely susceptible to this poison as they feed on leaf litter from the forest floor, which is where pellets accumulate after a drop. I have had the opportunity to discuss this with Kaylyn personally. She has now almost finished her PhD and is continuing to study the whitetail herd north of Glenorchy.

Do you think a large proportion of the whitetail herd was killed by 1080 in 2014?

> K: Yes. It is hard to determine actual numbers, even using an aerial survey, but I suspect 50% of the population may have been killed. The density of deer presently is only about one animal per square kilometer.

What are your thoughts on deer repellant?

> K: I support the use of deer repellant on the bait. I have conducted field trials in captive whitetail deer and they did not like the repellant bait. Within 3 hours they had eaten all the non-repellant bait but none with repellant on it. But this does not mean it will work in the wild. The repellant is a coating on the pellet and could wash off in the rain. Further studies are needed.

Red deer are regarded as pests in this country because of the damage they do to the understory of the bush. Why are the whitetails different?

> K: People tend to lump all deer together but they are not the same in terms of impact on the environment. Red deer cause damage because of their high numbers. In our study we found no evidence of a negative impact from whitetails – they are smaller animals and there are fewer of them. The whitetails have a matriarchal society. They stay in

their family unit area and don't range very far. The Stewart Island population (*of whitetail*) seems to be thriving.

Your inclusion of the correspondence between DOC and the Fish and Game Council at the end of your report on-line could be regarded as controversial. Have you had any negative feedback about that?

K: No, not really. I am not interested in propaganda. I am more interested in what is actual. They did not believe it was going to have an impact. It went the other way. The Wakatipu DOC office people have been very helpful.

The same area was subjected to another 1080 drop in August 2016. DOC surveys had found high rat numbers in the area. I look again at the whitetail webpage. [168] Prospective hunters are informed, 'Spring is another favourable time of the year to hunt white-tail deer. During spring deer can be seen coming out of the forest to feed on new grass and shrub growth". It seems unlikely that there would have been too many coming out in the Spring of 2016.

The red deer (*Cervus elaphus*) is a much more important introduced species in New Zealand than the whitetail, both with respect to hunting (a major tourist draw card) and from a conservation point of view. Around 250 animals were released for sport between 1861 and 1919, [170] and numbers have grown exponentially since then. They mostly came from England but some were from the Scottish Highlands. On a recent trip to Scotland, I saw many iconic representations of deer, in art and statuary. They are obviously held in high esteem. This was encapsulated in a scene in the Oscar-nominated film "The Queen" [171] when Helen Mirren, playing Her Majesty Queen Elizabeth II, out walking in the Balmoral countryside and weighed down by recent events including the untimely death of Diana, is suddenly confronted by a majestic stag. The contrast between this semi-

mythical totem animal and the pitiful poisoned carcass lying on the ground in the Fiordland bush, as described by the Hokuri creek hunters (and shown in Figure 8), could not be more stark.

Like all animals introduced into the predator-free New Zealand ecosystem, red deer flourished and by the 1960s were regarded as "out of control" in many areas. The deer-cullers of the 1950s learned to fly helicopters and became involved in the lucrative live deer capture industry of the 60s and 70s. Deer farming was around the corner and eventually developed into an industry that is now worth NZ$255 million in foreign earnings. However, the remaining wild deer have an impact on the environment as they eat forest plants, trees and seedlings and can thus change the composition of the understorey, according to the DOC webpage. [163] Despite references on this page to "eradicating" and "controlling" deer as being "DOC's work" (very Old Testament), 1080 is not actually mentioned at all.

The reality is somewhat different. The Graf Brothers have just released another hard-hitting YouTube film entitled, "Deer Mass-poisoned - Lake Taupo Farmer Speaks Out" describing (and showing) the shocking reality of deer carcasses littering the borders of Lance Aldridge's 2,000 hectare farm near Taupo (central North Island). [172] These deer deaths occurred a few days after the July, 2016, 1080 drop onto the Pureora Forest, which borders his property. Forests surrounding Lake Taupo are poisoned every 3-5 years. The fate of the deer is pitiful to see and other footage showing farm animals such as cows in the final throes of 1080 poisoning is frankly horrifying. I decide to try to get hold of someone who knows about deer.

Dick Deaker is an archetypal "Southern man" who excels in hunting, bush-craft and above all flying helicopters. He is well known in aviation circles. Now aged 71, he is still very fit and continues to work under contract, shooting and harvesting deer on farmland and DOC estate. Graeme Marshall has written a book telling his life story, [173] a life that Dick says has been "fantastic".

In the mid-60s, after leaving school, he spent four years with the NZ Forest Service and the Wildlife Service, Department of Internal Affairs, which were the forerunners of DOC. He worked directly with takahe and kakapo in the Murchison mountains, Fiordland, in an early attempt to bring these birds back from the brink of extinction. Marshall's book features a 1965 photograph taken by Don Merton, of a very young Dick, carefully cradling a takahe in his arms. In his own words, "I have always been passionate about bird life". I ask him about his experiences with 1080:

> D: The first lot of 1080 they put into the Arawata in the 80s – Waipara branch (*South Westland*). That area was always bad for keas. There were lots of them. Aerial hunters couldn't leave carcasses on the hill for more than an hour as clouds of keas would descend ….After that first big 1080 drop – well there were very few keas from then on. It tells you something…I didn't actually see any dead keas but of course you realise that no one is ever going to see dead ones unless they have beacons on them.

Have you discussed this with others working in the bush?

> D: I have talked to a number of people including DOC people. One guy told me that after they did a poison drop, three or four days later, a DOC team would go in to count the dead rats, mice, stoats and possums. There was nothing on the form to document the bird deaths. I asked if they saw dead birds and he said "Yeah, yeah we find a lot of dead birds...." but there wasn't anywhere to record that. The DOC guys just have to toe the line – otherwise they will lose their jobs.

Have you seen the effects of 1080 on deer?

> D: Yes. I have flown helicopters all around here (*upper Queenstown Lakes District*) and it was not uncommon to see 20 white-tail in the Rockburn, Beansburn area.

That was before they started poisoning around the Dart valley. Not long ago I took that young researcher, Kaylyn (*McBrearty*) for a survey and we only saw two white-tail – before the 1080 drops we would see up to 30.

What about the export markets for wild deer? Are they affected by 1080?

D: Absolutely. You can sell wild New Zealand deer overseas but there are stringent criteria set out by MPI (*Ministry of Primary Industries*) and DOC to prevent poisoned deer getting out to the market. They have a withholding period – for MPI it used to be four months or 100ml of rain, whichever came first … now DOC have made it six months. Anyone shooting a deer has to document the time, date and position using GPS. MPI overlay that with information about the date and position of 1080 drops. If you have taken a deer from a date within that withholding period, then the venison is dumped. This happened to me a few years ago. I shot 11 deer, 1.8 km from the boundary (*of the poisoned area, the exclusion zone being 2 km*) – they all had to be dumped. I belong to the Helicopter Deer Recovery group in Te Anau and about 9 months ago senior DOC personnel told us that they would work in with operators to minimise disruption (*to the industry*) – to date NONE of us has heard a word from them on working in with us!! All we get is emails to say its being done on such and such a date! I just heard from a friend involved in tunnel monitoring (*recording paw prints of rats, mice and stoats to indicate population levels*), in the Waipara and Clark valleys – they found evidence of very few animals on the tunnel pads (*September 2016*). Guess what! They have just poisoned these valleys again!! This is a national tragedy – on an unprecedented scale. Its hard to believe our senior politicians could get sucked in by such BS.

What are your feelings about pest control?

D: I agree 100% that rats and stoats are a serious problem but it's questionable whether 1080 is ever going to work long-term – and I think it's doing major damage in the short term. I have been reading about Captain Cook's first voyage in the late 1700s. They had rats on that boat, the *Endeavour*, and when they got back to England 3 years later, they still had rats, even though there were cats on board to hunt them. That boat was 109 foot long. What does that tell you? Do you think we are going to get rats out of all of New Zealand?

Do you have anything else to add?

D: I started to look at it in my own mind. We could be doing more damage than good. And DOC will not listen – they have got their own agenda. I don't like the dishonesty and the twisting of information. It's an orchestrated litany of lies. They have decided what they are going to do and they just go ahead and do it. All this "public consultation" – it's rubbish. You know the problem of the wilding pines? Well I think it's going to be like that. If I had told you 50 years ago that all the wilding pines you are planting – they were put there by government agencies (catchment boards and the NZ Forest Service) in the first place - are a disaster - you would not have believed it. But that's how they are turning out. I have had a good life but I am watching a disaster taking place. Future generations will look back at us and point and say, "They did that……". We are going to pay for it. My prediction is that the kea and a lot of bird-life in regions which have been 1080'ed – well they are already endangered – we will lose them all.

CHAPTER 21

RATS

If the Hon. Maggie Barrie is to be remembered for anything during her term as New Zealand Minister of Conservation, it will be for her statement in a Radio NZ interview in 2016, that, "We're expecting in excess of 30 million extra rats so it is biblical proportions of plagues of them and then following on from that hundreds of thousands of stoats so we get in early, as soon as we start in July with the 1080 drops we will knock out those rodent populations and not let them get to those predicted levels". [174] Plagues of rats are truly horrible to imagine and strike a chord with the general populace aware of their probable association with the bubonic plagues of the Middle Ages.

Rats make good villains. But there are rats and rats. The Polynesian rat, the kiore (*Rattus exulans*), arrived in the canoes of the first Polynesian settlers, the ancestors of the Maori, during the 13th century. [175] They were a delicacy to Maori and served as a dish at ceremonial occasions. Kiore are of special significance to a northern tribe, Ngati Wai, which sees itself as their kaitiaki (guardian). They now pose little threat to New Zealand's native bird-life and only a few still survive in places like Fiordland and Stewart Island. [175] DOC targeted them in an eradication program on certain off-shore islands, due to their propensity to feed on native birds, lizards and insects. That they are endangered themselves did not seem to be an issue although the DOC website obsequiously notes, "Recognising that Maori sometimes have a cultural interest in kiore, it is the Department's practice to consult prior to eradication programmes". [176]

The Norway rat (*Rattus norvegicus*) and the Ship rat (*Rattus rattus*) are the species of interest as far as the 1080 campaign

is concerned. These animals probably first made their way to New Zealand on European sailing ships in the 1770s and by the second half of the 19th century had become widespread in the North Island, taking another 30 years to colonise the South Island. [177] The ship rat is DOC's Public Enemy Number One. They are omnivorous and enjoy eating insects as well as birds, including adults, chicks and eggs. They also eat fruit and berries from many native forest plants and trees. Their fecundity is extraordinary. If you believe a website called "The Math Forum; Ask Dr Math", [121] (and I see no reason for doubt) under ideal conditions a breeding pair can produce 1,808 offspring in one year. Of course this would not occur in the wild because of the various pressures that limit reproduction such as competition for food and predation by other species. All the same, it clearly illustrates how these animals must have laid waste to populations of vulnerable, often ground-dwelling native birds when they first arrived in New Zealand. They were certainly responsible for the extinction of many species.

Those reproduction numbers need to be borne in mind when working out how easily rats might repopulate zones that have been "cleared" by 1080. If there were no other competitors but still plenty of food, one could predict a huge increase in the rat population a year or so after a poison drop, with new rats coming in from territory around the edges and reproducing like mad. In 2011, the *Nelson Mail* published an alarming story; "Rat plagues linked to 1080 poison drop". [178]

The article went on to say, "Researchers believe the plagues of rats that over-run Nelson's beech forests stem from well-intentioned aerial 1080 operations". It continues, "Scientists attribute the increased populations of scavenging rats after poisoning programmes to the lack of natural predators, like stoats, and the increased availability of food."

The study referred to a paper published in 2011 by Wendy Ruscoe et al. (Landcare Research, Lincoln University). [179] This

is of critical importance to the whole 1080 debate and deserves to be examined in detail. Four areas were studied. One of these was in Te Urewera National Park, Jim's ancestral land (Chapter 14) which served as a control site. There were four situations, 1) Control: no 1080 application or trapping 2) Stoat removal alone (by trapping), 3) Possum removal in a one-off application of 1080 but rats were allowed to repopulate 4) Possum + rat removal with a one-off application of 1080 poison and rats were subsequently kept at low levels by trapping and ground baiting. Eight study sites (900 Ha) were then assigned to one of the four experimental treatments listed above. Population surveys of rats, stoats, possums and mice were undertaken a few months before poisoning / trapping began and then again 3 months, 6 months, 1 year and 2 years later. As an aside, one of the areas receiving "treatment" with 1080 was within the Whirinaki Forest Park, famous for its unique and incredibly ancient podocarp forest, originating from the primeval supercontinent known as Gondwanaland. That anyone should even consider dropping 1080 into that ecosystem is in itself very alarming – but the drop had already been planned prior to this research.

What about the possum removal area? The authors have assumed that only possums were "removed" by 1080 and not other animals. That is almost certainly untrue and the mix of creatures surviving or repopulating the drop zone remains unknown. However, rats were allowed to repopulate and provide some interesting data. Despite an initial drop in numbers immediately post-1080, they had bounced back to control levels by Year One. By Year Two, their numbers were double those at control sites. In other words, the vegetarian possum seems to be controlling rat numbers probably through competition for food.

What about the stoat removal area? Interestingly, there was very little difference in terms of rat numbers, compared with controls. The authors went on to propose the "Competitive release hypothesis". In layman's language this could be stated

as follows: Rat numbers are regulated by other animals such as possums which compete for a common food source, not so much by predators such as stoats. Poisoning possums with 1080 will cause rat numbers to increase. Others have come to similar conclusions. A 2007 study found rat numbers increased nearly five-fold after possum control with 1080 and remained high for up to 6 years. [180]

A different 2002 study [40] examined the eco-consequences of a 1080 drop in the Mokau region, near the west coast of the North Island. Results are shown in Figure 4. The graph clearly demonstrates that rat numbers bottomed out at zero during the 12 months post-drop, then escalated hugely over the next two years compared with the non-treatment area. There was a matching precipitous fall in the numbers of insects in the long term, and the number of insectivorous robins also fell. The authors concluded that "possum-only control may have negative long term consequences for robins and ground invertebrates. Clearly more work in this area is urgently needed." Somehow, this "Call to arms" has been lost in the welter of information about 1080 on the Net – which remains overwhelmingly positive.

So there is a scientific basis for the reported rat plagues that occur after 1080 poisoning – plagues that may not be of biblical proportions (as per Ms Barrie) but are certainly sufficient to decimate native birds. 1080 opponent Paul Murray posted the following blog in September 2014, [181]: "The observations of myself and many other Karamea residents of the 1080 operation that covered 54,000 ha of the Western Kahurangi National Park in 2008, is that rodent populations have exploded. We now have rat and mice problems in our homes and businesses that did not exist before the aerial 1080 operation…."

To bring this up to date, another long term study was published in 2016 by Griffiths et al.. This was performed in the Tararua Forest Park north of Wellington and spanned the years

2009 - 2013. Once more rat populations and their responses to 1080 drops were examined. [182] Once more results showed that rat numbers were only temporarily reduced after a 1080 drop, for about 6 months. Then they were "back up by 18 months" and their numbers then increased above those in control areas. This overshoot reached statistical significance at 2 years post-drop, so that rat numbers were significantly greater than control following 1080 application (Figure 9).

This study also examined the effects of beech masts, termed "seed-fall events', on rat numbers (bearing in mind that this is the standard "Battle of the Birds" rationale for repeated 1080 drops). The effects were apparent in both control and 1080 areas with increased rat numbers due to an increase in the food supply, but a year later all tailed off spontaneously, with the natural post-mast decline in seed quantity. Looked at over a period of years, 1080 application achieved no gains at all in terms of reducing the rat population. Any losses in terms of bird species were simply not measured. Rats appeared to repopulate the 1080 "blast zone" from the edges.

There is a final thorny issue to be examined. Could rats become immune to 1080? There is definite laboratory evidence that this can happen. One group of researchers gave 59 rats a single 6 mg/kg dose of 1080 and 49 of them died. However, when the same number were given a small dose ($1/6^{th}$ the amount) 28 hours before the larger dose, only 26 died. This means that some developed resistance to 1080, probably through induction of enzymes in the liver that normally break down the poison. [122]

In a similar way, a regular drinker will induce liver enzymes to more rapidly break down alcohol. A small-dose-then-a-large dose scenario could easily occur in the wild if a rat drank from a contaminated puddle just after a drop and then subsequently consumed a poisoned mouse. This could lead to a group of rats surviving a dose that would otherwise have killed them.

What about genetic resistance? This process takes generations. [183] In one study, after five generations of selective breeding, the average rat lethal dose changed from around 2 mg/kg to 3.5 mg/kg. In other words the 5th generation rats had become 75% less susceptible to the poison. 1080 resistance has also been described in Western Australian rabbits exposed over 25 years. [184] When you have rapidly reproducing animals exposed to the poison, then you will inevitably breed resistance. Rat behaviour has also been shown to be affected. Those that have survived previous drops may become bait-shy and pass this knowledge on to their young. [185] Are the rats of the West Coast resistant to 1080 through one of these mechanisms? The studies simply have not been done.

Rats or no rats, the 1080 campaign grinds on. The 2017 Makarora valley drop in Mt. Aspiring National Park has become notorious for going ahead despite there being hardly any rats there at all. [137] The DOC "Code of practice for kea" (2016), [96] states that regions should only be poisoned if "the average tracking index for rodents (rats, mice or both combined) must be at least 10%". An Official Information Act (OIA) request (No. 17-E-56) yielded figures for January, 2015 – Dec, 2016 that showed rat tracks in only 1.9% of Makarora tunnels (on average), well below the 10% threshold and also below the more recently quoted 5% threshold. [186]

This is not an isolated incident. Ban 1080 party co-leader Bill Wallace claims, "there are serious rumours DoC has changed their rat counting technique to cover up the lack of the mythical "Rat Plague". [187] According to Wallace, "no rats at all have been recorded in upper beech forest and open tops" within the Kahurangi National Park / Heaphy Track region. This area has been "treated" twice in the last two years, most recently in February, 2017, despite opposition from the Kahurangi 1080 Action Group. [188] So it seems that the people of New Zealand

are forced to use the Official Information Act to find out what their government is up to. DOC appears not to be following their own protocols. What are they trying to accomplish? More rats? This could be a self-fulfilling prophecy; more rats would justify more 1080 leading to more rats which would justify more 1080 ….., and the gullible general public remain none the wiser.

CHAPTER 22

STOATS, MICE AND POSSUMS

Anyone who has read Kenneth Graham's, "*The Wind in the Willows*" will remember the chapter where the weasels and stoats (from the Wild Wood) took over Toad Hall. [189] Badger, Mole, Toad and the redoubtable Ratty, took up stout cudgels and saved the day, bravely evicting the thuggish horde from the dining hall. The stoats were disarmed and sent packing. If we could do the same in the New Zealand bush, then surely the birds would thank us for it. Or would they? As is the case for all aspects of this complex issue, things are not always what they seem. Stoats (*Mustela erminea*) were deliberately introduced into this country in the 1880s to control rabbits and hares. Rabbits were totally out of control. According to one account, in 1892 half a million rabbits were destroyed on the Tarras and Morven Hills runs. [190]

Farmers demanded, not unreasonably, that something be done. Stoats embodied one weapon in the "War Against Rabbits" as it might have been called. Others included the use of poisonous oats and the employment of men called rabbiters who received 2/6 d per skin in the early days. There were apparently warnings from scientists about the dangers that stoats might pose to bird life, but sadly these were ignored and within six years, according to Carolyn King in her book, *Immigrant Killers*, many bird populations had begun to decline quite dramatically. [191] In the 1980s, various methods began to be explored for stoat control including trapping, bait stations using poison and aerial 1080, and brodifacoum. It was postulated that stoats might either directly consume 1080 baits and die of primary poisoning or eat

poisoned prey and die of secondary poisoning. The logic seems irrefutable. But it is more complicated than that.

According to Jo Pollard's "A scientific evaluation of the Parliamentary Commissioner for the Environment's views on 1080", [80] a trial of aerial 1080 for stoat control within the Tongariro Forest in 2002 was "a devastating failure". I find the original reference from Brown. [192] The Tongariro operation is described under the heading "Lessons learnt?" which states, "Stoats reinvaded quickly after the 1080 operation; stoats killed kiwi chicks (including in the centre of the block) within four months of the operation. Five kiwi chick deaths were linked to stoats, but only one set of tracks was recorded in tunnels." So, yes stoats are bad guys alright, but this might suggest that aerial 1080 has only made them worse.

Backing this up is a graph from one of the Powlesland studies that shows a definite increase in stoat numbers (to more than double the number in the non-poisoned area), one year after a 1080 drop. [193] A similar trend was noted after the 1080 drop at Okarito in 2011 where Pollard quotes unpublished data from Kemp et al. as follows, "the 1080 operation was followed by large increases in mice, then rats, then a stoat plague in late 2012". [80]

Do stoats eat rats? Yes. The post-1080 rat "bounce back", which tends to occur around 12 months after the poison drop, creates a huge wave of food for the stoats, causing them to flourish. [80] Stoats have large home ranges that may be up to several hundred hectares and include alpine grasslands. Thus, they could easily reinvade an area that has been "cleared" by 1080. Stoats also feed on mice. Byrom et al. in their paper entitled, "Will reinvasion stymie large-scale eradication of invasive mammals in New Zealand?" caution, "……stoats are specialist predators of mice, ….. (*so that*) with high mouse populations following local eradication of rats and mustelids, conditions are likely

to be ideal for re-establishment of stoat populations through reinvasion". [194]

Do stoats actually eat 1080 baits? Difficult to find this information. Apparently they don't like cereal pellets, so don't tend to die from primary poisoning. Could they die from eating poisoned rats or mice i.e. secondary poisoning? The evidence suggests that mice often don't take 1080 baits (*see next section*) so there may not be many poisoned mice. However, poisoned rats could lead to stoat deaths. On examining the guts of 1080-poisoned stoats, the investigators of one such study concluded, "in most cases secondary poisoning was caused by stoats eating poisoned rats". [195] As an aside, they were quite frank about the effects of 1080 on other fauna noting, "Some passerine birds, particularly tomtits, are also known to suffer high mortality as a result of 1080 operations ….." To get back to the fascinating stoat-gut studies, an important finding was that prey-switching occurs. In other words, stoats that are confronted with an empty forest, post-1080, devoid of their favourite food which is the rat, will change their dietary habits to eat birds instead. Before a 1080 drop, 71% of stoat-guts contained rats and 6% contained birds but this changed to 16% rats and 56% birds post-poisoning. [195]

To summarise a likely sequence of events,

1) 1080 poisoning kills some stoats by secondary poisoning as they eat poisoned rats and (possibly) birds
2) Although 1080 largely clears the forest of rats, mice tend not to be poisoned (see below) and their numbers boom, stimulating a surge in stoats which love eating mice
3) Other stoats from outside the drop-zone wander down from the subalpine grasslands to reinvade the forest. Initially, there are not many rats so these stoats prey-switch and eat a lot of birds instead.
4) After a while rat numbers bounce back, creating a further feast for the stoats which respond by reproducing merrily.

5) All in all, aerial 1080 seems to be quite positive from the stoat perspective.

So how to get rid of them? Trapping seems the obvious answer but even here the ground is slippery. The beautiful Eglinton valley (Fiordland) was the site of a failed DOC experiment designed to save the endangered mohua (yellowhead). [196] Populations of rats and stoats were monitored over a four year period. Stoats were intensively trapped. Stoats recovered from traps were counted and their numbers surged during Dec/Jan, 2000 and Dec/Jan, 2001. This was expected as these periods each followed beech masts the previous summer with high seedfall providing lots of food for rats, which multiplied and provided lots of food for stoats.

Unfortunately, after the second mast, while stoats were still being trapped, rat numbers did not decline over winter as they had done previously but instead boomed throughout the entire year. What happened to the mohua? During the 1999/2000 summer, 27 pairs of mohua and 38 nests were intensively monitored in the central valley. Ten nests failed when the females were killed (6 of them by rats) but 25 nests (66%) fledged their young successfully.

Tragically, when the 2000/2001 summer began, the study area was "searched repeatedly" for mohua but only 9 pairs and 9 lone males were found. Only one pair was intact from the previous summer. The authors admitted, "If sustained stoat control results in a permanently higher rat population …. then this could be disastrous for the Eglinton Valley mohua population in the long term". How sad! Sad for the DOC workers searching the forest for mohua in vain, sad for the scientists who had instigated the study which seems to have been such a fiasco, but most of all sad for the mohua themselves whose little colony in the Eglinton valley appears to have been all but wiped out by good intentions. The moral of the story seems to be that pest control is a lot more

complicated than was originally thought. Mother Nature has her own ways of dealing with invasive species and often those are through interaction with other species. Upset the apple cart by eliminating one and unforseen consequences may follow.

Mice

There are many surprising things about mice (*Mus musculus*) when you take a detailed look at their part in this story. The first is that mice don't actually tend to be killed by 1080. Why? Because, despite the fact that this chemical is supposed to be odourless and tasteless, they don't like the taste. An internal DOC report stated "Wild-caught mice demonstrated very low acceptance of, and subsequent low mortality (25%) from, baits containing 0.08% 1080 in a two-choice laboratory test." [197] They go on, "We suggest that avoidance of 1080 by mice is mediated by conditioned taste aversion." Nor could mice be tricked into eating 1080-filled pellets by pre-feeding with non-poisoned pellets. [197; 198] Clever mice! I wish the birds were as fussy.

This led on to my next unexpected discovery. A major part of the "Battle of the Birds" rhetoric centres on the beech mast (seedfall) events. These, we are told, lead to the intense proliferation of mice as well as rats, which in turn causes an outbreak of stoats. The rats and stoats then kill the birds.

Apparently, as with the stoat story, it is not as simple as that. Certainly, mice do proliferate after beech masts. "Breeding females produce an average of 10 litters (compared to 6 litters in non-mast years)" and "juvenile survival is believed to increase greatly in the presence of the superabundant food source". [199] Using information for mice, rats, stoats, and possums, Tomkins and Veltman constructed "a four-species simulation model for a common pest community in New Zealand beech forests". [199] They state, "When the model was perturbed to simulate common control techniques ……. higher mouse numbers were observed following both toxin (*1080*) application and rat kill-trapping,".

They go on to outline that these large numbers of mice would compete with birds for food (seeds and small insects) and that, because there is no way to control the numbers of mice in forests, an aerial 1080 operation would be "not without ecological risks".

The outcome of such risk-taking behaviour (by DOC) has been demonstrated in real life and was referred to by one group as a "perverse outcome" of aerial 1080 whereby "removal of ship rats results in more mice". [200] Armstrong et al. averred "mice are so far the Achilles heel of many programmes, with mouse numbers irrupting following rat and/or stoat removal". [201] A boom in mice means a secondary boom in predators i.e. rats and stoats which in turn will eat more birds. We seem to have arrived at the same final common pathway as for beech masting alone. What was supposed to have interrupted a natural cycle (aerial 1080) has somehow amplified it - a perverse outcome indeed!

Tompkins and Veltman state in their concluding paragraph, "For example, the recently proposed 'Operation Ark' (*2006*) outlines a plan by the New Zealand Department of Conservation to control rat and stoat numbers on a large scale at several sites in predicted beech mast years…. The goal is to reduce the level of predation on eggs and chicks of endangered native birds such as the…… Yellowhead (*Mohoua ochrocephala*)". [199]

I am reminded of the words of James (Chapter 11) who observed the results of Operation Ark first hand in the Dart Valley and recalled, "There were mouse plagues from time to time (*before 1080*) but no rats. So, we were wondering why we had to have 1080? But they said we did, so the first drop went ahead in 2006. After that it was 2009 ….. Around that 2009 time, suddenly there were all these rats. It was unprecedented." Unprecedented perhaps but not in fact unexpected when you look at the scientific literature. Some species like the unfortunate mohua seem to bear the brunt of "too much attention" from the perversely named Department of "Conservation".

Possums

The Australian brushtail possum (*Trichosurus vulpecula*) is part of the New Zealand wilderness experience. A night-time nuisance, they lope along country roads, turning to stare into the headlights of oncoming traffic with glowing red eyes. Many become road kill. They slide noisily down the roofs of back-country huts and trampers learn to keep their boots and packs inside at night . Otherwise, little possum paws will cunningly reach into every pocket to extract scroggin or anything edible, and then pull everything out so that personal belongings are strewn along the deck in the morning. Fifty years ago, possums tended to be viewed with amused annoyance, rather as boy-racers are today. They obviously had fun with their noisy nocturnal goings-on. Nevertheless, they were a pest. Wooden telegraph poles sported silvery metal collars halfway up, to stop possums climbing to the top and disrupting communication.

Possums were introduced to New Zealand between 1837 and 1924, largely with the intention of establishing a fur industry.[202] Possum fur is certainly remarkable for being very light and extremely warm. This is largely down to its hollow fibers, a feature shared with fur from polar bears and arctic foxes. The possum has done so well in its adopted homeland that it has actually increased in size, weighing up to 6.4 kg, [203] compared with 4.5 kg for its Australian cousin. [204]

Australian possums, affectionately known as “brushies”, are kept in check by natural and introduced predators including dingoes, pythons, foxes and cats. In this country, the only predators are humans and cats (and the latter might find themselves overpowered), so it is not surprising that possums have proliferated to an extraordinary degree. How many are there? According to “1080 The Facts” there are 30 million. This estimate was reached by Landcare Research scientists using a number of assumptions. [205] Without “control” (read aerial 1080), according to their reckoning, there would be 47.6 million.

Rachel Gross writing in "The Atlantic" observes, "Today (*in New Zealand*), many consider possums Public Enemy #1". Nicola Toki, Threatened Species Ambassador for DOC, is quoted as saying, "They chomp on wide swaths of forest, kill millions of birds and chicks a year, and go around spreading bovine tuberculosis to cows…..They've whittled our wildlife away". However, according to Gross, "Pestilence is in the eye of the beholder. Cross the Tasman Sea, and you'll find possums under national protection". [206] So why are possums demonised in this country and where do they fit in with the aerial 1080 story? This can be broken down into four separate questions:

1) What effect do possums have on native New Zealand forest?
2) What effect do they have on native birds?
3) Is 1080 effective in reducing the possum population?
4) What is their role in spreading bovine TB? (refer Chapter 17)

There is no doubt that possums damage the trees and shrubs of the New Zealand forest. They are folivores meaning that foliage comprises the bulk (50-95%) of their diet. They have a special interest in the leaves of certain trees. In mixed conifer-broadleaved forests, they typically focus on 3–5 species which include kamahi, towai, pohutukawa and rata. [207] Shrub hardwood species such as wineberry, tree fuchsia and mahoe are also consumed as well as tawa and kohekohe when locally abundant.

The giant trees of the ancient podocarp forests, such as rimu, kahikatea, miro, matai and totara are not favoured by possums with the exception of the Hall's totara. According to Nugent et al., "Flowers, fruit, and small quantities of invertebrates are eaten in all habitats whenever they are available. …(*plus*) nitrogen rich foods from time to time including birds' eggs and fungi." Of interest, possums also consume some introduced plant species

that we would rather be rid of, including broom, blackberry and willow. One study of the possum diet in an exotic New Zealand forest, found that broom was one of the most favoured plants eaten. Its leaves and flowers constituted 24% of plant fragments in the possum stomachs sampled. [208] However, the possum is unlikely to be rebranded as an eco-warrior any time soon.

The beech forests of South Westland, a heavily 1080'ed region as witnessed by Dan (Chapter 9) and Pamela (Chapter 18), are also possum habitat. Researchers investigating the contents of possum stomachs noted that beech trees themselves constituted <1% of the possum diet. [209] They also failed to find any birds' eggs. Mostly, the possums had been feeding on the flowers and leaves of plants in the understorey, including wineberry, muehlenbeckia and kamahi.

Are possums really all bad as far as birds are concerned? Possibly not. In north Canterbury forests during a beech mast event, possums joined in the feeding frenzy along with rats and mice. Beech seed constituted 27.2% of their stomach contents. [209] Ruscoe et al. [179] modelled what happened when possums (and other species) were removed as part of a broad-scale poisoning programme and found that "rat numbers had increased significantly by Year 2 …., (*becoming*) almost twice as abundant as at the control sites, consistent with competitive release of rats following possum removal."

Thus, the change in inter-species dynamics wrought by human intervention could actually result in more rats which might then eat more birds' eggs with major consequences for adult bird populations down the line. According to these investigators, "rats, the most abundant mesopredator in our four species assemblage (*rats, mice, possums and stoats*), appear to be more strongly regulated by food availability. (*Thus*)…. . the benefits associated with possum control need to be weighed against the consequences of increased rat numbers". [179]

There is another way to view possums, and that is as weedeaters of the forest understorey. This rather heretical notion was first articulated in 1989 by Batchelor who was writing about the role that the moa may have played in the pre-European New Zealand bush. [210] As a large animal, the moa must have exerted considerable grazing pressure on the forest. Its extinction could have disrupted the long-standing plant-herbivore balance leading to a much more cluttered understorey. Perhaps introduced species such as the deer (as a large herbivore) and the possum (as a smaller one) could now occupy the extinct moa's vacated ecological niche and act to open up the forest? Not necessarily a bad thing. However, this proposal has been challenged vociferously by a number of ecologists. There is no doubt that possum browsing significantly alters the balance of plants in the bush, with a reduction in palatable broad-leaved shrubs and an increase in less palatable plants, [211] illustrating that the plant side of the ecosystem has responded to browsing pressure by the new immigrants. In its turn, the adaptable possum feeds on whatever is plentiful in the bush (such as beech seeds during the mast), and does not, by and large, target forest giants. Therefore claims that possums "defoliate the forest" are misleading.

Is 1080 effective in reducing the possum population and does that flow on to an overall benefit to the forest in the longterm? Certainly, 1080 kills possums, but as is the case for rats, a population bounce-back tends to occur. One study showed that a single aerial 1080 hit reduced the "trap catch index" at poisoned sites by 75–100%. Unfortunately, there followed an exponential increase so that by six years post-1080, possum numbers were the same as at unpoisoned sites. [212] There was less browsing of many tree species following the knock-down as expected but again after six years the "foliar cover index" was basically the same for poisoned and nonpoisoned areas i.e. recovery had occurred in the forest canopy and understorey despite a return of the possums. [212] The authors concluded that,

"the forest superstructure seldom appears to be threatened by possum populations that are maintained even modestly below carrying capacity." That may well be achievable with trapping, and suggests that widespread possum poisoning operations may be unjustified from a forest-protection point of view.

CHAPTER 23

BOUNDARIES AND ISLANDS

Boundaries and exclusion zones

The DOC website is reassuring: "The management regime set by the Environmental Protection Authority (EPA) and regional health authorities requires detailed operational conditions and regular reporting …..". [213] The "operational conditions" I am interested in are mentioned in a document from the Ministry of Health describing Vertebrate Toxic Agents (VTAs). [214] The VTA at the top of the list is 1080. I try to imagine how these regulations could work in practice, for example on the Routeburn track, which has been the site of three aerial 1080 drops in the last four years:

> Under "CONDITION 11:
> Exclusion from walking and vehicle tracks", the following appears: "The base exclusion distance for aerial operations should be 80 m." (*so the helicopters have to stay 80 m away from the track).*
>
> Under "CONDITION 13:
> Exclusion from dwellings", we have, "No VTA shall be applied within 150 m of ….. dwellings" (*When the track reaches a hut there has to be a clear zone of 150 m around that hut*).
>
> Under "CONDITION 23:
> Domestic water supply: location", the document states, "The greatest risk to drinking-water supplies may occur during …… aerial 1080 operations, either due

> to major accidental spillage of bait into a water supply or the incomplete or inaccurate identification of water supplies before an operation. These scenarios could see bait entering waterways that should have been covered by exclusion zones……. The distance is set at 3 km for aerial applications of 1080. This set distance, 'should not be reduced'." (*But the water supply for the hut comes from a stream about 50 metres away – so don't the helicopters need to keep 3km away from this?*)

Actually, as locals living near the Routeburn are aware, 1080 is dropped directly onto the track. There is no attempt to avoid watercourses at all. People are employed by DOC to sweep the track so that the tourists don't see the green pellets. Drops are scheduled before the main tourist season starts but the track is open year round.

The *Nelson Mail* did a good job of digesting the main issues relating to boundaries in its article of November, 2013, entitled, "Trampers: 1080 poison landed on us". This describes the experience of a Kaiuma Bay couple who were "angry and upset that a holiday weekend tramp through a Pelorus Sound track ended with them being 'dusted' with 1080 bait." [215] Pellets were dropped near them from a helicopter. How could this have happened? Reportedly, bait had fallen "onto the Nydia Track, and within a 20-metre exclusion area either side of the track set under medical officer of health conditions for the operation." Wait! The couple were advised by a female DOC employee that, "we'd be perfectly safe, because the helicopters would not be dropping within a 100-metre boundary either side of the track". (*So 20 m or 100 m?*).

According to the report, the Medical Officer of Health stated "Skin contact and inhalation are not reported to be significant routes of absorption of 1080 especially in this type of situation," Really? There are many sources that would disagree including

the National Center for Biotechnology Information, U.S. Library of Medicine which cites on its PubChem Compound Database under Sodium Fluoroacetate, "Fatal if swallowed [Danger Acute toxicity, oral - Category 1, 2] ….Fatal in contact with skin [Danger Acute toxicity, dermal - Category 1, 2]…. Fatal if inhaled [Danger Acute toxicity, inhalation - Category 1, 2]". [216] The same source states, "Very toxic to aquatic life [Warning Hazardous to the aquatic environment, acute hazard - Category 1]. [136; 216] What conclusion did the 2007 ERMA review come to? Under Appendix B: Toxicity (P 300), the following statement appears, "The lack of [acute inhalation] toxicity data for 1080 represents a data gap". [217] So it seems that the gap was papered over and everyone carried on as if this wasn't a problem.

Another *Nelson Mail* exclusive has relevance to the boundary zones question. "Two fishing tour guides want answers after they found themselves inside a 1080 drop-zone on the Mokihinui River, despite having an operating permit that requires them to be notified when the poison is dropped". [218] The helicopter dropping 1080 reportedly worked for about an hour, not far from where the men were fishing. A senior policy advisor is reported as saying that bait was allowed to be applied without a buffer zone over the Mokihinui River because otherwise pests would survive along the river banks. The fishermen noticed, "between 100 and 200 pellets per 100 metres along the river bank and in the water" and commented (presciently when one considers the 2016 water-borne *Campylobacter* outbreak in Havelock North),

"We have scant concern for the quality of water in this country." One could conclude that exclusion zones come in all sizes. In the case of the Mokihinui River, zero metres. How about 500 meters? Shark Bay is on the Peron Peninsula in Western Australia. Surrounding areas are being "treated" with aerial 1080 as part of a pest eradication initiative called Project Eden. The aerial baiting programme maintains a bait-free buffer of at

least 500 metres around all officially designated campsites. [219] So the Australians have 500 m. Who made up these regulations? Are they sensible? Like everything in the 1080 story, the truth is very hard to pin down.

During 2016, DOC made a call for public submissions on a proposal entitled "Streamlining the regulatory regime for pest control consultation". I strongly suspect that the vast majority of New Zealanders remain blissfully ignorant of the sweeping changes this brought in. Why should change have been necessary? A DOC report [220] contains interesting information about "incidents and public concerns" of which there were 26 during 2013. Examples include:

> **Type: Incident, alleged stock death**
>
> Date occurred: November, 2013. Stock from adjoining landowner strayed into a 1080 treatment area and were found dead. Although the carcasses were too decayed for testing it was assumed they died from 1080 poisoning. ….
>
> **Type: Objection/threat**
>
> Date occurred: November, 2013. A landowner threatened to burn down a neighbour's property and send packets of 1080 to their children because they had consented to allowing their property to be treated with 1080. Because of the threats, the consenting landowner withdrew consent to 1080 being applied on their property. No further action was taken. (!)

Clearly, if it is possible for DOC and MPI to exclude the rights of regional councils and individuals to complain about 1080-related incidents, then everything would be much easier for the bureaucrats involved. I look for some clarification on the Net and finally find a document called, "Business case: Simplifying the regulation of aerial 1080 under the Resource

Management Act (RMA)". [221] It states at the end, "There is a need to reduce unnecessary RMA compliance costs to Regional Councils, DOC, Tbfree NZ and private contractors/landowners. The compliance costs for resource consents in the last ten years have been estimated at $10.7million. Future costs could be reduced significantly through removing the need for resource consent and managing 1080 operations under the HSNO/ACVM and Health Act requirements". Ahh! Now it is starting to become clear. The Resource Management Act, New Zealand's primary legislation for protection of the environment, will be sidelined from the 1080 debate. Local bodies, landowners and Maori, will no longer have a say into when or where 1080 is to be dropped, and everything will be managed cleanly and cost-effectively by central government (no more nasty neighbours' disputes).

Streamlining legislation was brought in on the 1st of April 2017. Scoop News reported the reaction from NZ First's Richard Prosser, "New Zealand's continued use of this Class-1 deadly eco-toxin is unjustifiable madness, and this new regulatory regime will make it even worse. How is the EPA (*Environmental Protection Authority*) going to enforce the manufacturer's requirement that 1080 must not be used in on or near waterways? How will it enforce the requirement that poisoned carcasses be removed from waterways? Consent conditions, ... are being breached right now. How will that improve when accountability is removed another step?" [222]

Islands

The September 2016 issue of the popular magazine *North and South* features an article entitled, "Weasel words". [223] This discusses the "predator-free by 2050" policy announced by the New Zealand government on 26th July, 2016. [224] The author begins by describing a trip to the Tawharanui Regional Park (about an hour's drive north of Auckland) where he spent "several minutes up close to a creature eerily comparable to a

dodo". I can absolutely relate to his amazement as I have had a similar experience on Tiritiri Matangi Island, a bird sanctuary where I first encountered the takahe. This bird is the size of a large hen, standing around 50 cm high, and weighing up to 4 kg. It has glorious blue and green plumage with a thick red beak and lumbers about on the ground because it is, like the kiwi, incapable of flight. Takahe (*Porphyrio [Notornis] hochstetteri*) were assumed to be extinct but were rediscovered by Geoffrey Orbell in the Murchison Mountains of the South Island in 1948. Dick Deaker (Chapter 20) was involved in takahe recovery and preservation in the mid-sixties. The current Takahe Recovery Programme orchestrated by DOC is attempting to establish 125 breeding pairs at safe sites which include "pest-free islands as well as mainland sites with well established predator control including predator proof fencing". [225]

Tawharanui Regional Park is one of these safe sites, thanks to a 2.5 km predator-proof fence erected in 2004, which stretches across the peninsula and turns it into a sort of island. Tiritiri Matangi Island is a real island not too far away, situated 30 km north east of Auckland in the Hauraki Gulf. Both have become deservedly popular with tourists as they allow people to see and hear rare native birds living in a semi-natural setting (following an extensive re-vegetation program using native plant species).

Pest eradication, aimed primarily at rats and stoats, has been undertaken using the poisons 1080 and brodifacoum distributed aerially and in bait stations, followed by intensive ground control in the form of trapping and hunting with dogs. It is interesting to recall that this came at a price, as admitted on the Tiritiri Matangi Restoration project webpage of 1999 which states (of the then-recent brodifacoum drop): "Three native species seem to have suffered high impacts. About 90% of pukeko were killed, and morepork and harriers were obviously reduced". [226] However, 17 years on, both Tawharanui Regional Park and Tiritiri Matangi island have forgotten those "bumps in the road" and showcase the

success of the "pest-free" philosophy by indicating how native bird species can thrive when rats and stoats are not eating their chicks or eggs. Which is why journalists are routinely invited to these places, and politicians visit to have their pictures taken cradling that unique dinosaur-relative, the tuatara. Lots of money is needed to maintain these sanctuaries but it is a tiny fraction of the extraordinary sum that would be needed to turn all of New Zealand into one giant paradise of birdsong. The only question the mainstream media seems to be asking is, "Why not more? A few million dollars is not enough! Lets make it billions!!" Unfortunately, amidst all this clamour, basic commonsense seems to have been left behind.

Let's break "pest control" down into what it logically requires. The first step has to be the elimination of existing predators. The tool being used in the "Battle of the Birds" is aerial 1080. On mainland New Zealand, there is a big problem. People live here. We are also susceptible to pesticides. We are mammals. Our LD_{50} is 2 mg/kg. Therefore, it is not sensible or practical or even legal to consider dropping 1080 all over our towns or cities. Even if 1080 is absolutely plastered over large tracts of both the North Island and the South Island, there will still be exclusion zones around the areas where humans live. What's more, these zones will need to extend over the fields where sheep and cattle and other farm animals live. They are also mammals and are known to die horrible deaths when exposed to 1080. So adding all of these zones together, a very large part of New Zealand can never be subjected to "pest control" at all.

And we know that rats love the marginal areas, the barns, farm buildings and compost heaps, rivers and swamps not to mention rubbish tips. Lets turn our attention then to the native forest estate. No matter how much 1080 is dropped there, even with kill rates of > 90%, there will still be rats. They will gaily repopulate the drop zone from the edges after 12-18 months and the repopulation crew will be young and eager to breed. [182] This gets to the core of the problem. There will always be edges. A

small island that is entirely surrounded by water can often be kept predator-free, although this begs the question of how rats and/or stoats got there in the first place (on boats or by swimming from the mainland). A peninsula such as Tawharanui Regional Park is entirely dependent on the integrity of its predator-proof fence to maintain its pest-free status. These wonderful things are eye-wateringly expensive at $250- 350 per metre depending on whether you want complete pest exclusion or a "leaky" fence that can be supplemented by trapping. [227] How can a predator proof fence be constructed to shield a place the size of New Zealand? The short answer is – it can't.

So the DOC public relations exercise that is the Tawharanui Peninsula (or Tiritiri Matangi island) is a way of pulling wool over people's eyes. Not quite Theresienstadt, but close. These "islands" have been subjected to "purges" but not for many years now, and the loss of native birds by poisoning or hunting has been forgotten. They have been repopulated with healthy specimens that do of course thrive without predators.

In the wild, repetitive aerial drops of 1080 have a very different effect. You cannot take precious species out while the poison does its work on predators alone, so all are potential victims of by-kill, direct or indirect. A crash in insect populations likely ensues (if you believe the work of Meads and the evidence that 1080 is a powerful systemic and contact insecticide), [41] which means famine for insectivores and disruption of the complex web of the ecosystem. Reproductive toxicity, proven to occur in rats, skinks and earthworms after sub-lethal poisoning, is unlikely to spare birds, lizards and other native fauna. This could bring an end to the natural regeneration of many species. If all of this were allowed to play out on the protected "islands", a very different and more realistic picture of the "Battle for the Birds" would emerge. Think the trenches of the Somme. That would not be so effective in garnering the dollars needed from the public purse to keep the whole show going.

Before leaving the subject of island conservation, it is important to look at one of the so-called success stories. Secretary Island is part of Fiordland National Park, situated in the southwest corner of the South Island and given UNESCO World Heritage status for its extraordinary beauty and conservation value. This region has been entitled Te Wahipounamu, "The Place of Greenstone". Secretary Island is steep and rugged, rising to 1,196 m above sea level and separated from the mainland by Thompson Sound to the east and Doubtful Sound to the south.

According to the 2016 DOC webpage, "The only animal pest species present on Secretary Island are deer and stoats."[228] Look further and one can find another earlier 2004 page.[229] This asks, "How will we remove stoats from the island and prevent them from returning?" It continues, "The department is proposing to remove stoats from Secretary Island using an intensive network of around 1,800 traps. Additional traps will be placed along the adjacent mainland and several small islands around Secretary Island to minimize the risk of reinvasion."

So what happened? This is summarised in a book published in 2011 entitled, "Island invasives: eradication and management".[230] DNA techniques were used to identify any new invaders following the eradication programme. Were there new invaders? Yes, "Four individuals from the post-eradication Secretary Island population (*were identified*) as first-generation immigrants from the mainland". There will be more than four. The authors admit, "We also assumed that the level of reinvasion would be lower than preliminary genetic results have indicated". So stoat trapping and hunting with trained predator dogs continues on Secretary Island, and no doubt the birds are singing joyously, but the original aim of becoming "stoat-free" (which is still referred to on the 2016 page) has been proven to be impossible. Does this have any implications for the goal of the whole of New Zealand becoming "predator-free by 2050" one might ask?

Deer are also in DOC's sights. A document entitled, "Secretary Island Operational Plan: Deer Eradication", dates from 2007. [231] This contains something very interesting in the section that discusses the best ways to render the island "deer-free". Under "Rejected Techniques" one finds, "Aerial Baiting (1080 carrot bait) has been excluded as a method due to the uncertain efficacy and high costs." Right. Not a good option for the 8,140 ha Secretary Island but perfectly OK for hundreds of thousands of hectares on the mainland where the cost has been estimated as > NZ$100 million.

CHAPTER 24

PSYCHOLOGY AND ENVIRONMENTAL FASCISM

But man is a part of nature, and his war against nature is inevitably a war against himself.

Silent Spring, Rachael Carson

Psychology

I find the last question on my list, "How could everyone be so wrong?" particularly interesting. If the application of aerial 1080 by the NZ Department of Conservation is actually wiping out native fauna in a truly Orwellian act, how could a wrong of such monumental proportions have come to be accepted as a right by perhaps 95% of the New Zealand population, including scientists, animal lovers, doctors, vets, trampers, politicians, journalists, my friends and family and until one year ago myself? If you examine this path and carefully trace it back through the woods, you can find the witch's cottage without too much difficulty. Firstly, there is ignorance.

According to Statistics NZ (2006), 86% of New Zealanders live in urban areas. These people may only meet native birds (and insects) around the city edge or in regions of parkland. Most of the bush close to cities has never been subjected to 1080, although that is changing with the recent drops in Auckland's Hunua ranges. Thus, there is general ignorance. People have not seen the carcasses on the ground as described by the Hokuri

creek hunters. 1080 has been a NIMBY (Not In My Backyard) issue. There is a general preference to "leave it to the experts", "DOC know what they are doing." Everybody is too busy in this age of information-overload to take on something else. Scientific literature is deadly dull anyway, and cannot be digested in a 10-second sound-bite. "I don't need anything else to worry about....."

Secondly, the victims are silent. Either because they are dead or because they are living in remote areas. Nobody is likely to notice a lack of birds deep in the bush except those who regularly go there such as hunters, and their motives are regularly questioned by the pro-1080 lobby. DOC workers might notice, but their ongoing employment requires them not to rock the boat. If trampers notice and ask questions, they are fed the following: "The lack of birdlife is due to constant predation by rats and stoats. DOC is working hard to fight this with an extensive aerial 1080 programme in a world-beating effort at pest-control….".

In medicine, major mistakes are generally detected by the end-users of medical research, in other words, patients. Doctors are very used to hearing about drugs that are "major breakthroughs" when they first get through the stringent test of clinical trials, only to fail, often due to toxicity, after release into the public arena. There is an extensive list of these failures, including thalidomide for morning sickness in the 1960s (fetal deformities), practolol for hypertension in the 70s (the frightening "mucocutaneous syndrome"), and rofecoxib for arthritis in the 2000s (increased risk of stroke and heart attack).

All of these drugs had been enthusiastically touted by eminent professors and experts in the field, with papers presented at conferences and learned articles written in top-ranking journals in their support. Many were in use for decades before the penny actually dropped. What if a drug were developed for a group

of people who were totally unable to speak for themselves and nobody ever looked into its effectiveness or whether it had side effects, except the company that made it?

The next factor to be taken into account is something more powerful than all academic and scientific concerns combined; fashion. People prefer to run with the pack. Much of the New Zealand public is currently pro-1080 due to information from DOC websites and relentless promotion by the tame and intellectually lazy mainstream media. Anti-1080 campaigners are mostly perceived as moronic, archetypal "rent a crowd" activists - unshaven, swannie-wearing hunters from the West Coast – shades of the inbred hillbillies of *Deliverance*. They are deeply uncool. Their motives are called into question. "Why are they worried about the deer? They just want to be able to shoot them!". This pulls in the vegans and vegetarians.

For those who are part of the scientific community, a pro-1080 stance is absolutely necessary. Being "anti" is tantamount to endorsing the slaughter of precious native birds by rats and stoats and assisting many species down the road towards extinction. Those wayward souls who continue to question the status quo are nudged gently back to the fold by the funding stream. Grants for salaries do not come their way. Members of the establishment who sit on granting committees almost invariably endorse the party line. No obvious preferment takes place in public view, but those with the wrong opinions simply "fail to thrive". Peer review in the small science and ecology community of New Zealand is hardly unbiased. Publish or perish. If you make a fuss – well you sink, and if you are loud or annoying enough, you may be publicly shamed, put in the stocks! Take the case of the late Dr Mike Meads. No prospect could be more horrifying for an up-and-coming academic in any field.

Environmental Fascism

There is a rising tide of dissent amongst ecologists, biologists and conservationists regarding the ethical implications of killing one species for the preservation of another. Arian Wallach is a leading Australian biologist with a particular interest in conserving dingoes. She has stated, *"…faith in, and tolerance for, killing for conservation is waning. Despite this, killing still monopolises conservation. Visions of restoring ecological communities to ancestral configurations are fantasies that continue to harm millions of animals globally each year".* [130] Wallach leads the "Dingoes for Biodiversity project" which exists under the auspices of the Centre for Compassionate Conservation (CfCC), University of Technology, Sydney. This cause has attracted some big names. The CfCC website features a photograph of Jane Goodall (British primatologist, ethologist, anthropologist, and UN Messenger of Peace) hugging a dingo. The "About us" section on the CfCC home page states, "We offer a new vision of conservation in which promoting dingoes replaces lethal control of introduced species for the enhancement of biodiversity."

This is a very far cry from what can be found on the Queensland Government website, Business and Industry portal[232] headed " Declared pest animals (including insects). Dingo". It announces, "The dingo is a primitive canid related to wolves. It was not part of the ancestral fauna of Australia. …… It has been regarded as a serious predator of domestic stock since early European settlement in Australia…….The dingo is a restricted invasive animal under the Biosecurity Act 2014". This encapsulates much of what is appearing in the 1080 debate in New Zealand. On the one side, we have business interests with a right wing political approach endorsing the multi-million dollar pest eradication industry. On the other side, a motley collection of rogue ecologists, the odd ethicist, a smattering of doctors and lawyers and a group of people from all walks of life, including

hunters, who simply don't like seeing animals die in pain. Sadly the "Greenies", especially those belonging to the middle classes, tend to sit on the fence.

Vucetich and Nelson deal with the ethics of the poison-the-pests approach in detail in their paper entitled, "What are 60 warblers worth? Killing in the name of conservation". [233] They refer to various mistakes made by the scientific and conservation fraternity in their zeal to save species from extinction. They state, "Killing for conservation often proves to be unjustified because, although the costs to those individuals killed are certain, the benefits to populations and ecosystems are not". Furthermore, "Neglecting the cost to individuals, or thinking that concern for individuals is misplaced, runs the serious risk of transforming conservation research (and management) into what others in environmental philosophy have termed "Environmental Fascism". [234] What does this mean? Fascism is a political concept associated with Mussolini and Hitler and conjures up visions of goose-stepping Nazi soldiers in the second World War. These images that do not immediately gel with bellbirds warbling in the forest canopy or rock wrens hopping nimbly from boulder to boulder. Umberto Eco, author of *The Name of the Rose,* wrote an essay in 1995 entitled "Eternal Fascism" [235] which is helpful. He defined 14 general properties of fascist ideology and 7 of these are immediately recognisable as underpinning the pro-1080 movement in New Zealand in 2017, as follows:

- The Cult of Tradition
  [1080 has been "scientifically proven" to be effective]
- The Cult of Action for Action's Sake,
  [*We need more 1080 now; there is no time for further studies!]*
- Disagreement Is Treason,
  [*Those who oppose 1080 will be personally responsible for the extinction of species*]

- Obsession with a Plot
  (or the hyping-up of an enemy threat)
  [*Without 1080 there will be a plague of rats of "biblical proportions"]*
- Fear of Difference,
  (in terms of ethnicity, sexuality, culture, politics etc.)
  [*Rats, stoats, deer and possums are "foreign" and deserve to die*]
- Pacifism is Trafficking with the Enemy
  [*If we don't fight the rats with 1080 we will be overrun!]*
- Its the Will of the People
  (helps undermine democratic institutions)
  [*Eliminate boundary zones, they cause unnecessary paperwork*]

You do not have to look far to find evidence of this mindset. Ann Potts noted "The conservation domain consistently employs a metaphor of invasion" when describing the impact of possums on native wildlife and plants. [236] This militarist terminology causes the possum to be "positioned as an aggressive trespasser contaminating the very backbone of the New Zealand economy".

The same terminology has been used of rats, stoats and mice. Hermann Goering, famous Nazi war criminal, is quoted as having said, "The people can always be brought to the bidding of the leaders. This is easy. All you have to do is tell them that they are being attacked… It works the same way in any country."

These ideas were given a fresh new look recently in a TED Talk by Julia Galef entitled, "Why 'scout mindset' is crucial to good judgment", subtitled "Why you think you're right — even if you're wrong". [237] She contends that people have two ways of looking at the world; the most common is the 'soldier mindset' where actions stem from deeply ingrained reflexes, rooted in a need to protect yourself and your side and to defeat the enemy.

The less common 'scout mindset' involves calm and unbiased enquiry into the actual truth of the matter. The scout, according to Galef, wants to know, above all, what's really there, as accurately as possible. She uses the Dreyfuss affair as an illustrative case study. [238]

To briefly summarise, in 1894 the French general staff discovered that one of their own was selling military secrets to Germany. Suspicion fell upon Captain Alfred Dreyfus who was resented by the aristocratic officers in the army's High Command for many reasons, but mostly because he was a Jew. What followed was an appalling miscarriage of justice, resulting in the completely innocent Dreyfus being sent to Devil's Island for many years before he was eventually exonerated.

As Galef notes, "Some information, some ideas, feel like our allies. We want them to win. We want to defend them. And other information or ideas are the enemy, and we want to shoot them down." She calls this 'motivated reasoning' typical of the soldier mindset. As an example, if you support capital punishment but are reading a study that shows it's not effective, then you are highly motivated to find all the reasons why that study was poorly designed. But if it shows that capital punishment works, then you are likely to think that it's a good study. The New Zealand 1080 story seems to fit right in to Julia's framework. Too much soldier and not enough scout. This may help explain why, despite research that has often been very badly done, clear evidence of bird deaths, and many witnessed accounts of terrible animal suffering, the vast majority of New Zealanders continue to actively support the aerial 1080 campaign.

Our little country has been given a number of names over the years. Land of the Long White Cloud (*translation of the Maori word Aotearoa*), Land of the Wrong White Crowd (*referring to Maori land claims*), Land of the Strong White Cloud (*referring to the use of potent "skunk" marijuana*), Godzone, Godless-zone

…..As a nation we have had the “Clean and Green NZ” mantra shoved down our collective throat *ad nauseam*. Cartoonists play a role very similar to the court jester of medieval times. They remind us of our stupidity.

CHAPTER 25

WHO BENEFITS AND WHO PAYS?

Who benefits?

In his classic book, *They all ran wild: the story of pests on the land in Australia*, farmer-philosopher the late Eric Rolls made the following comment about aerial 1080 baiting in Australia, undertaken during the 1960s using poisoned meat, "I do not like indefinite poisoning and this is the most indefinite ever undertaken. No one has a clue about what percentage of the baits are eaten or what is eating them, yet secretaries and presidents and treasurers are delighted to be photographed in the act of loading the meat into aeroplanes." [239] Too true. The people at the top of the tree are invariably happy with pest destruction, as it has tremendous voter-appeal. The politician involved sends the following messages:

1) I protect native birds and animals (*I am a wise guardian of all that is good*),
2) I am aware of the importance of the environment (*broad appeal with cash implications for voters involved in the tourist industry*),
3) I am prepared to take the hard decisions (*some animals may die as a result but with my great wisdom I can play the long game*),
4) I will protect export markets (*from the threat of TB – with implications for farming voters*). All the major political parties (with the exception of NZ First) now follow this reasoning and support the "predator-free NZ" catch-

> cry ("1080" is conveniently omitted) with an unseemly scramble for photo-opportunities. [224]

The benefits of the aerial 1080 campaign then flow to the supplier. This may be the Tull chemical company in the United States, or possibly one or more Chinese suppliers but details remain sketchy. Since the threatened-poisoned-milk-powder affair, anything related to the importation of industrial-grade 1080 into this country has basically been erased from the Net. A 2004 report from the *Aniston Star* (Alabama) that covered the attempt by Oregon congressman Peter DeFazio to have the Tull factory closed because it constituted a terrorist threat [240] (*Chapter 3*), also stated that a Mr Charles Wigley owned the company. Mr Wigley was quoted as saying that he received the majority of orders from New Zealand's Department of Conservation and Department of Agriculture (prior to the transfer to the Finance and Primary Industries portfolios).

So, whoever owns the 1080-supply company now presumably continues to receive orders (and payment) from the New Zealand government. No doubt the orders have gone up substantially. The 2015 drop involved more than 1,700 tonnes of cereal pellet baits. [146] As baits contain 1.5 g/kg of pure 1080 and there are 1,000 kg in a tonne, this means that the total amount of industrial strength 1080 being dropped onto New Zealand's landmass in 2015 was 1.5 x 1,000 x 1,700 g = 2,550 kg. Presumably this would cost quite a lot of money. It can also be thought of in a different way. If we take the average size of all men, women and children in New Zealand to be 50 kg and the average dose required to kill that person as 100 mg (using the 2 mg/kg estimate for the LD_{50}), then we are dropping enough 1080 each year to kill 50% of a group of 25 million people. The same thing can be worked out for the number of birds, deer or whatever else is eating the baits.

Once imported, 1080 then moves to a company called Animal Control Products (ACP) now trading as Orillion, which is based

in Whanganui and makes it into pellets. This is a state-owned enterprise, owned by the Minister of Finance and the Minister for Primary Industries. In the words of Bill Benfield in his book, *The Third Wave*, which is about as close to underground eco-literature as we have in New Zealand, its 2011-2012 Corporate Statement of Intent noted, "65% of revenue is from 1080 and 1080-related products". ACP has apparently "implemented risk management strategies in all areas of its business". So what are these risks? According to Benfield, ACP perceives an increasingly vocal anti-1080 lobby as one of the most important.[241] I look for the reference but cannot find it within a labyrinth of government websites.

However ACP has its own newsletter [146] that does not mince words about the 2014/15 "Battle of the Birds". It states, "cereal pellet baits manufactured by ACP were distributed over 700 thousand hectares in a huge counterstrike against predatory pests, on an unprecedented scale." More information follows, "This was a massive ramping up of effort by DOC with the total area treated being more than 5 times the area treated by aerial baiting over each of the previous 3 years." There is a rather pathetic box outlined in red on the 3rd page titled, "Protest Action". This describes a small peaceful protest conducted by about 20 people outside the Whanganui 1080 factory in November 2014. One was reported as carrying a placard saying "1080 is illegal everywhere else," which the newsletter scathingly noted was "incorrectly stated". Nothing seems to have come of the protest. The risk management crew at ACP obviously managed to keep it well under control.

Benefits flow to those who are there to take advantage of them. Some of ACP's 1080 has now been transferred to a separate storage facility at Rolleston near Christchurch. A company called "Pest Control Research NZ Ltd" has been formed to manage this. The West Coast Regional Council were reported in 2014 to have invested $500,000 of ratepayers' money in that company in

which they hold a 49% share. [242] However, a more recent report, featured on the *New Zealand Herald* website, states, "A 1080 poison bait factory at Rolleston - bankrolled by $1.9 million from the West Coast Regional Council as part-owner - has been granted resource consent by the Selwyn District Council." [243] So in fact even more ratepayer's money has gone in. The report says that Rolleston resident, Jonathan Scott, was opposed to the consent for the following reasons, "risk to employees and their families, the risk of contaminating the water race that runs right past the school and through to the dog park, and the risk to schools and homes because the factory will be in the path of nor-west winds, with the risk of blowing 1080 dust around". The residents of Oxford, Alabama, might sympathise. However the Rolleston report goes on to say, "$11 million potential 1080 sales has whitewashed the issues." Sounds like a tidy little earner for someone.

Who benefits as the 1080 leaves the factory on its way to being dropped onto the land? DOC is in the driver's seat for "Predator-free NZ" and OSPRI is funded to run the TB-free campaign. MPI is increasingly taking over from DOC, driven by a business model that bypasses any namby-pamby animal cruelty concerns. People working within these organisations must feel uncomfortable at times.

Most DOC rangers are in the job because they love the outdoors and the natural environment. It must be distressing to come across dead animals and birds on the ground after 1080 drops and to be discouraged from even recording them. However, they fall back on the mantra, "the science supports it" and if they value their jobs, they will not question decisions from further up the tree. Rather they will get on and make sure that 1080 is spread over the designated sites as comprehensively as possible.

The 1080 industry supports salaries for DOC bureaucrats and fieldworkers and their equivalents in OSPRI, and these people

support their families. A sizeable cohort of artists, web designers, photographers and public relations consultants are attached. Further down the executive arm are the hands that actually deal with 1080 itself. These tend to belong to relatively poorly paid and often unskilled men who make the 1080 into poison baits, oversee its storage and arrange its transport. Helicopter pilots are at the end of the delivery chain. But there are some, like Dick Deaker, who refuse to be involved. They are often hunters who have witnessed, first-hand, the appalling cruelty of death by 1080.

How could conservation groups possibly benefit? "Forest & Bird" in the words of their webpage, "is New Zealand's largest independent conservation organisation, with 50 branches nationwide. It protects our native plants, animals and wild places, on land and in our oceans". [244] Although much of the initial opposition to 1080 came from this quarter a decade ago, Forest and Bird is now ardently pro-1080. After the May, 2016, declaration of more government funding for 1080, a press release from this group expressed bitter disappointment that this was not enough and in fact was, "close to worst case scenario for New Zealand's native animals." [245]

If you really want to get rid of every last rat, a 2015 study by the University of Auckland estimated that the cost would be more than $6.2 billion over 50 years. [246] So they are correct in so far as that is concerned, bearing in mind that the majority of international commentators have described the task as impossible. Forest and Bird state on their website, "We're not a government organisation and do not receive government funding – we rely on the generosity of our members' subscriptions, donations and bequests to carry out our conservation work." Therefore the reason for their pro-1080 stance must be that they support the common opinion of the New Zealand public which has been moulded, using relentless pro-1080 propaganda, by pro-environment groups such as themselves. Would bird lovers

be so keen to donate if they knew about the 2016 DOC code of practice describing green pellets in the stomachs of dead kea? [96]

So where does that leave the scientists? Many definitely benefit from the 1080 programme as it funds their research (via the DOC offshoot research company, Landcare Research) and helps build reputations and careers. The only problem is that some research has not delivered what was expected by the party line. The study of Griffiths et al.[182] that showed no benefit from 1080 over placebo in controlling rat populations over several years, springs to mind, or that of Ruscoe et al.[179] who found that maintaining the four-mesopredator balance was crucial to bird survival in the modified ecosystem. Where are the professors and the academics who must be able to see what is simply commonsense (that rats cannot be eliminated from the mainland)? They appear to be cowering below the castle ramparts. Perhaps the vast majority of people would do the same. Do you follow what is convenient and supported by all your friends or do you flout convention and stick your neck out? A small number of scientists in the world of New Zealand Ecology have spoken out and continue to work tirelessly to try and inform the public about the realities of the 1080 campaign. But they are in the minority.

Who pays?

The answer to this one is easy, the New Zealand tax-payer. Of the country's 4.5 million people, an estimated 3.2 million pay tax. DOC has an annual budget of $335 million. Some of this (and one would suspect quite a lot) goes to the 1080 industry. As of May 2016, NZ$20.7 million in new operating funding was also allocated to "The Battle of the Birds". Add to this the $80 million per annum destined for OSPRI for control of possums in the vain hope of completely eliminating TB, despite clear evidence that residual disease is minimal in this animal reservoir. [152] Because total eradication, i.e. a zero incidence, is impossible, the World Organisation for Animal Health sets the definition of

"TB-free" at 0.2% for TB infected herds and 0.1% for infected cattle. New Zealand has been at < 0.04% herd frequency for more than a decade.

This OSPRI money might as well be sprinkled like confetti out of the helicopters for all the good it can possibly do. Yet farmer levies, taxpayer and ratepayer contributions continue to pour in. And the farmers pay quite a lot. According to Mary, TB slaughter levy rates from 1 August 2016 have been $13 per head for dairy animals, $6.30 per head for beef animals and $11.50 per head for live cattle and deer exports. All exclusive of GST. Ratepayers also help fund this losing battle. So farmers who are ratepayers and taxpayers actually pay three times over for something that my research suggests has absolutely no chance of working.

Leaving aside all the appalling consequences of 1080 for our native fauna, the money argument alone should be enough to immediately disband OSPRI and divert those funds towards something that society actually needs. The gap between New Zealand's rich and poor has widened more than in any other developed country during the past 20 years, according to an OECD report.[247] Charities such as the Variety Club work tirelessly to improve the lot of poverty-stricken children. $80M a year could turn a lot of lives around.

CHAPTER 26

WHAT ELSE CAN BE DONE?

Masterly Inactivity

How can we get rid of the rats and stoats if we don't use aerial 1080? What else can be done? Well, one answer is that we could leave things well alone. This has its equivalent in medicine, a strategy known as "masterly inactivity". This basically means "waiting for things to get better by themselves" but implies that the system in question has the ability to right itself, as does the normal human body (sadly it would not work for a machine such as a car that won't go!). Thus, the doctor becomes a collaborator with the body's natural defences. According to psychiatrist Francois Mae in his paper "Masterly inactivity: a forgotten precept", [248] the term "masterly" implies tact, information and expertise, while "inactivity" does not necessarily mean doing nothing.

Take the example of the current overuse of antibiotics. As well as killing the "bad" bacteria, these drugs also kill the natural bowel flora and can so change the composition of that community (or microbiota) that noxious organisms can gain a foothold, and may seriously threaten the health of the human host. In some situations, withdrawal of antibiotics and the passage of time, allowing the natural flora to repopulate the gut (masterly inactivity), can be beneficial. Eventually the bad guys are crowded out by the good. [249]

"Masterly inactivity" is a philosophical concept that can crop up in other situations. According to Bruce Fein of *The National Interest* magazine, it could be applied to foreign

policy.[250] An example is the deliberate avoidance of unnecessary wars and conflicts, a policy reportedly adopted by President George Washington. As such it is an ideal counterweight to the militaristic jingoism of the Battle of the Birds. All sorts of war-like images have been employed in this campaign over the last few years, including helicopters thundering over the forest with bucket loads of deadly 1080 in an "Apocalypse Now" type scenario. The language used by the Minister for Conservation in a May, 2016, Radio NZ interview [174] expresses this clearly in the following excerpts:

- We must respond if we're to protect our native birds and animals from the threat ….
- …. fight back against an expected pest population boom……
- …the plague of millions of starving rats and tens of thousands of hungry stoats will turn on native wildlife, bringing disaster if we do nothing …
- …..whole populations wiped out if nothing is done ….

Sounds more like a Hollywood disaster movie rather than anything to do with the New Zealand bush. As local columnist and author, Joe Bennett, noted in his recent article on the Predator-free policy, [251] "we're writing the script for this little morality play and rats, mice, stoats and possums have been cast as villains." He continues, "Of course the predator-free New Zealand will still be swarming with the principal predator of all, the one who brought the others in, the one who ate all the moas, the one who destroyed all the bush, the one who – but enough of that already."

In a healthy ecosystem, many plant and animal species are able to flourish together in a balanced and harmonious way. This has its medical equivalent in the state of "homeostasis",

meaning "the tendency of a system (*the human body*) to maintain internal stability, owing to the coordinated response of its parts to any stimulus that would tend to disturb its normal condition or function." Could interference with the ecosystem cause deterioration and collapse akin to a life threatening illness in a human being? Undoubtedly.

According to Wikipedia, "Ecological collapse refers to a situation where an ecosystem suffers a drastic, possibly permanent, reduction in carrying capacity for all organisms, often resulting in mass extinction".[252] An example from prehistory is the Carboniferous Rainforest Collapse, which is thought to have been due to climate change, while more recently we have witnessed the collapse of the Atlantic northwest cod fishery due to overfishing. A change in the balance of species can also seriously upset the interwoven ecosystem net. Courchamp et al. [253] wrote a paper entitled "Cats protecting birds: modeling the mesopredator release effect". They described a system where the following species were connected; bird (prey) – rat (mesopredator) – feral cat (super-predator). Using sophisticated modeling, they found not only that uncontrolled predators could cause the extinction of prey species but also that eradication of super-predators such as feral cats might have unwanted effects, such as an explosion in the rat population which would also cause prey extinctions. This is exactly what happened to the Eglinton mohua population when rats were unleashed by intensive stoat trapping in 2000/2001. [196] Ruscoe's Competitor Release Hypothesis expresses the same concept.[179]

A recent review entitled, "Stop Jumping the Gun: A Call for Evidence-Based Invasive Predator Management" goes over similar ground. [254] To quote; "Killing predators can also have strong impacts on large herbivores, small prey species, and vegetation structure and composition ……. Such cascading impacts have often not been predicted and have resulted in

overall negative outcomes for biodiversity, despite the original intentions …".

Are there any examples where reintroduction of a species has led to overall improvement? Yes, ecosystem homeostasis has been restored within the last decade in Yellowstone National Park. Scientists have studied interactions between the gray wolf, an apex predator, the Rocky Mountain elk, its herbivorous prey, and the trees on which the elk likes to feed, which include the aspen and the thin-leaf alder. [255] This wolf - elk - alder food chain has been termed a "trophic cascade". Demonised for centuries as fearsome predators with no redeeming characteristics whatsoever, wolves were hunted almost to extinction in many areas of the U.S. including Yellowstone. The removal of wolves destabilized the ecosystem by lifting the biological control on elk numbers. Wolves were reintroduced to Yellowstone in 1995-1996. Their return had many unexpected effects. Alder trees, long suppressed by elk browsing, began to grow taller and to live longer. In turn riverbanks were stabilized and this actually made rivers and streams change course. Beaver colonies became established along the river banks and with them came beaver dams, quiet pools and more diverse aquatic life, which in turn led to the appearance of more birdlife such as owls. A web of life linking the plant and animal kingdoms with the physical landscape itself was restored.

A disturbing example of man-made eco-catastrophe is reported to have occurred on Australia's Macquarie Island according to a 2012 story in *Quadrant* magazine entitled, "Wrecking Macquarie Island to save it". [256] Retired physicist John Reid, describes this sub-Antarctic Island territory of Australia as having been teeming with many forms of wildlife in the 1970s including penguins, seals and albatrosses. It was decided that the island needed to be returned to its pre-European state. Therefore feral cats should be eliminated. This was done using aerial brodifacoum, a broad-spectrum poison capable of

killing many of the same target animals as 1080. The unwanted consequence was an explosion in rabbits (cats having kept them in check). Next came devastation of the land itself from rabbit plagues, with tussock-covered slopes becoming totally denuded. Nesting birds lost their habitat. Latterly, there has been extensive dieback of cushion plants in the plateau region of the island. The futile and tragic attempt to "manage" the ecosystem has, according to Reid, been "an unmitigated disaster".

The Antarctic Division of the Tasmanian Parks and Wildlife Service, who were responsible for the pest management programme, has not shouldered any of the blame. Instead this has been laid at the door of sealers from two centuries ago, myxomatosis, which failed to control the rabbits, and global warming. Reid speculates about why it is assumed that Science always "Gets it right!" and how "an unholy alliance can form between environmental scientists on the government payroll and environmental activists and lobby groups acting politically". The rabbits and cats were blamed for seabird extinctions despite the fact that these species had been co-habiting for nearly two centuries and the island had arrived at a new stable ecology - one that involved introduced species. The parallels with the New Zealand situation are only too obvious (DOC being our equivalent of the Tasmanian Parks and Wildlife Service). Will a magazine in 20 years feature an article entitled: "Ecosystem collapse wrecks New Zealand"?

A recent article in Conservation Biology[130] provides an example of what does seem to have been a successful example of biological control of an introduced species. A breeding colony of Little Penguins (*Eudyptula minor*) in Middle Island, Australia, decreased from 600 to 10 birds over five years due to fox predation. Sheepdogs were brought in to guard the colony in 2006 and that strategy seems to have been uniquely successful, with fox predation eliminated and penguin numbers increasing. However, the failed attempts at biological control, such as

the introduction of stoats to this country, make any successes pale into insignificance. Furthermore, with rats as a target, it is difficult to think of an introduced predator that could fit the bill, unless you count the Australian python, an animal that very effectively controls rats in that country, but is unlikely to be acceptable in its own right over the Tasman.

As stated in a recent *Economist* article entitled, "In defence of predators", [257] there can be "No return to Eden", meaning that once invasive species have arrived and bedded in to a new habitat, they become "fiendishly hard to eradicate". But it's not necessarily all bad. In his influential book *The New Wild: Why invasive species will be nature's salvation*, [258] author Fred Pearce argues that trying to exterminate such invaders is a flawed strategy. Ecosystems are dynamic and, if the incoming species do not die out within a few years of arriving, they will be assimilated and incorporated into a modified ecosystem, sometimes with unexpected benefits. He gives the example of the tamarisk shrub, which has colonised the American west. Demonised by mining companies for its water consumption, it is in fact preventing desertification in areas where other plants can't survive, as well as acting as a habitat for local birds.

In New Zealand it has been suggested that the possum could have similarly beneficial effects on forest ecology by spreading seeds and putting a brake on rats by competing with them for food. Environmental scientist, Jamie Steer commented, "We now have literally thousands of exotic species in this country and tens of new species are added to the ledger each year……. we can't disinvite them. Nor can we wind back the clock to a romantic pristine past. We'll have to start managing for the environments of the future and stop pretending like Gondwanaland is either sensible or achievable." [259] Another recent article from the same author in on-line magazine *Spinoff* was entitled*, "*What if the Predator Free 2050 plan is actually a terrible idea?" [260] Dr Steer

presented these ideas at a scientific conference on biodiversity, held at Te Papa, Wellington in May 2017.

Trapping and re-establishing the fur trade

Trapping rats has been proposed as an option. New self-loading traps have been developed and there are ongoing improvements in technology to make them more efficient. Eliminating rats has been shown to make a difference to bird nesting success and community group volunteers can function as effective predator controllers. [261]

In 2013, researchers from the University of Waikato published a study investigating the effectiveness of local rat control. This community led programme studied a 50 hectare area on the south-western edge of Lake Taupo, in the central North Island. It involved trapping rats and poisoning them at bait-stations. The authors concluded that the "Pukawa Wildlife Management Trust's management strategy, employing traps year-round plus poison (*in bait-stations*) from September onwards, had indeed reduced the potential number of rats present surviving in or reinvading the Pukawa bush in spring to very low levels." How many community groups could do this and how much native forest could thus be protected? These questions remain unanswered but at least this strategy largely avoids the risk of by-kill.

Possum trapping could also be beneficial – both to preserve possum-favourite understory trees such as fuschia and mahoe in the bush and to boost the possum fur trade. This subject is addressed in the short film by South Coast productions entitled, *Victim or Villain? - the NZ Brushtail Possum*. [262] Luxury merino-possum garments featured on the catwalk at the Milan Fashion week of 2016. The product is expensive but much sought after, because of its incredible lightness and warmth.

The industry that has grown up around it is now estimated as being worth NZ$50–70 million per annum. One would think that

New Zealand must have an almost unlimited supply of possum fur so this cannot help but be a surefire money-spinner.

From the possum trapper's perspective, plucked fur pays well, fetching $150 a kilo in 2012, and there are probably many young men who might be attracted to the out-in-the-wilds possum-trapper lifestyle. Some of these people might currently be on benefits so attracting them into paid work could be a win-win situation for the taxpayer and society as a whole, especially in areas of high unemployment such as the West Coast where a number of industries such as coal mining are currently under threat. This is not a new idea. The government used to provide bounties on stoat tails, rabbit tails and even kea beaks (when these birds were considered pests). However, there are well recognised problems with bounties. The Australian experience as described in *They all Ran Wild* [239] revealed that if the bounty payment is not set high enough, then potential hunters will not take up the offer as it will not be worth their while. Conversely, if the payment is set too high, the scheme encourages fraud and secret "farming" of the animal in question to receive maximum income. Nevertheless, the same body of literature [263] strongly asserts that a goal of total pest eradication (as per Predator-free New Zealand) is an impossibility.

One might presume that possum hunters and DOC would be united in their desire to rid the country of this pest animal. However they are sometimes on different sides of the fence as illustrated by the case of Napier possum trapper, Clayton Freeman, 48, who was recently prosecuted for trapping possums in a conservation area without a permit. [264] Mr Freeman is reported as saying, "I'd have thought they'd be happy. They want the possums gone and I was happy to kill them at no cost to them". This has been the subject of a Landcare Research report. [265] Its stated aims are, "To determine whether fur harvesting can provide a sustainable livelihood for trappers 'competing' for possums with the possum control industry".

This seems very odd. How could "competing" be an appropriate term? On the one hand we have taxpayer-funded DOC, which is ostensibly fighting the good fight to rid New Zealand of a malevolent pest, and on the other we have an industry that seeks to harvest possums for their fur. These are both pulling in the same direction. Surely there could be no competition. DOC could spend less taxpayer money (or divert it into school lunches for poverty-stricken children) and the fur industry could pick up the slack. Everybody wins! Unless …clunk. Another piece falls into the puzzle. The key word is "industry". The Oxford Dictionary definition is "Economic activity concerned with the processing of raw materials and manufacture of goods in factories".

What we have now is nothing to do with the environment. It is a >$160 million pest eradication industry that competes in the open market with other industries. It has a basic resource (1080) that is made in factories (into pellets) and supports economic activity (salaries for DOC workers, bureaucracy, PR people, helicopter pilots, truck drivers, security guards, research grants, etc, etc). This is a great industry to belong to if you believe the "Save-the-birds" rhetoric because it is paid for by the taxpayer and is government-guaranteed. To maintain the industry you need a good number of pests to eradicate, so you don't want pesky hunters reducing their numbers. You also want to increase your output if at all possible and "grow your business". Hence, more frequent and larger 1080 drops. Appropriately, the whole thing is now being taken over by the Ministry of Primary Industries. We have a business model. Now we feel safe. The concepts of by-kill and damage to the ecosystem are being relegated to the distant past. The reassuring message is, "The science supports it". And crucially, nobody questions that assumption.

Gene drives

Could Science actually step in and save the situation? Not the old science of poisonous chemicals but the new science of

genetic modification. Some believe it could, if pests could be rendered infertile. [266] In the early part of my medical degree, I was fortunate to spend a few weeks of elective study with University of Otago biochemist, Professor George Petersen, one of the pioneers of what was then called genetic engineering (GE). Now, at age 82 and an Emeritus Professor, he has been termed New Zealand's "Father of DNA". According to an *Otago Daily Times* report, [267] Petersen felt that, "New Zealand had benefited from taking a transparent but cautious approach to laboratory experiments involving genetically modified organisms (GMOs), including voluntary limitations initially imposed by DNA researchers themselves."

It was these voluntary limitations that I recall being discussed 40 years ago. At that stage, a world-wide moratorium on certain GE experiments was in place. We discussed why caution was necessary. Nightmare scenarios included one where the germ-line genetic sequence of the rice plant might be changed so that crops became less fertile or even completely infertile. Uncontrolled propagation of such a gene could compromise rice production for a major region such as the Indian subcontinent, causing widespread famine. It was exciting to be 18 and sitting around discussing such things with a world authority.

Forty years on, GM technology has become well established but remains controversial. The nightmares mostly did not come to pass as organisms with new genes tend to be less "evolutionarily fit" and even if accidentally released into the wild are usually eliminated within a few generations by natural selection. However, that handbrake may now be off with new technology relevant to gene editing. This, is the process whereby new genes are inserted into a host organism's DNA sequence. Science journalist, Jennifer Kahn, [34] describes the gene drive technology, known by the acronym "CRISPR", as "a word processor for genes that has been converted into a perpetual motion machine".

If a genetic change is introduced into the germ-line, CRISPR can cause this gene to spread relentlessly until it is in every single individual in a population. It could be used to eliminate a rapidly reproducing pest species such as the rat, by ensuring that only male offspring are produced. So, this is brilliant, right? No chemicals. No by-kill. Could there be a downside?

Some of the possible long-term effects sound worrying. Your engineered rat might interbreed with another related species (think the kiore), eliminating them as well. He might leave our shores and spread the elimination trait throughout the world. So rats everywhere might disappear. Would that be a bad thing? According to one recent high-profile publication, rats fulfill an important ecosystem service role as scavengers, ensuring that for example carcasses are removed from the environment. [268] There are associated hygiene benefits, believe it or not. Could a "no rats" world come to resemble one where the garbage collectors are permanently on strike? To me this sounds dangerous.

There are other implications. Get rid of rats, and you are left with the other predators … so get rid of stoats too and then cats ….. Hold on, I am not happy with that. And this technology may not be easy to reverse! However, more likely, the ever-adaptable invasive species in question will simply circumvent the genetic block. A Nature paper from 2017 entitled "Gene drives thwarted by emergence of resistant organisms" describes exactly that scenario. [269] Nevertheless, influential people are speaking about gene drive technology in reverential tones so watch this space and brace yourself for the propaganda.

CHAPTER 27

CONCLUSIONS

It is now two years since I heard the Hokuri Creek hunter's story. I have read a great many scientific articles about pesticides, ecology and conservation and have gone through many newspaper reports and magazine articles but there is still much I do not know. Nevertheless, I have learned enough to make me quite certain that I stand with the small but determined group of New Zealanders who are anti-1080. Here are the questions from Chapter 2 with my best answers:

A List of Questions

1. What is 1080, how does it work and what is its history?

   Answer: It is a metabolic poison. This means that all air-breathing creatures are affected. The bumper sticker, "1080 kills everything" is not much of an exaggeration.

2. Does it kill native birds, insects or fish? If so which ones?

   Answer: Yes, robins and tomtits, brown creepers, fernbirds, kea, rockwren, moreporks to name just a few. Insects: probably spiders, aphids and sandflies plus others – although evidence is conflicting. Fish seem relatively resistant. They can contain quite high levels and still be swimming around. Spawning fish could be adversely affected.

3. What happens to bird populations long-term after repetitive 1080 drops?

   Answer: There are very few long-term population studies and those that exist have major design flaws. Nonetheless, there is no evidence that aerial 1080 is beneficial for

native bird populations (although short-term studies do show improved fledging success due to knock-down of rats). A few studies suggest that bird populations may plummet after 1-2 years. Reproductive toxicity has been proven in mammals but has not been studied in birds.

4. How does it affect pest (rat, stoat, possum and mouse) populations?

   Answer: 1080 kills rats directly and indirectly but due to reinvasion from the edges of drop zones and their extraordinary fecundity, their numbers bounce back and often overshoot baseline levels, 1 - 2 years later, with devastating effect on native birds. Stoats are not usually directly poisoned but may eat poisoned rats. A lack of rats can cause stoats to prey-switch to birds. The competitive release hypothesis suggests that knocking down one species allows others to flourish. 1080 poisoning may paradoxically cause increases in numbers of rats and stoats long-term.

5. Is it dangerous to humans?

   Answer: Yes very dangerous. It can be absorbed by inhalation which means operators must wear adequate respirator gear. Small children would be at considerable risk if they ate a pellet. Prolonged low-level exposure could lead to deleterious effects on the kidney, heart, nerves and testes.

6. Does it get into water and could it pose a risk to people drinking this water?

   Answer: Yes, helicopters drop it directly into streams. It is soluble and usually disappears rapidly due to the action of biodeflouridating bacteria but these may act slowly in cold conditions. Carcasses of large poisoned animals such as deer can contain active 1080 for months

and pollute watercourses. Trampers are at risk if they drink from mountain streams in drop-zones.

7. Is 1080 necessary to deal with bovine TB?

   Answer: No. New Zealand has been TB-free for years on international criteria. There is minimal evidence that the possum is a significant vector. Australia, with many possums, has virtually eradicated bovine TB without using aerial 1080 to target them. Trapping possums around the edges of farms and good farming practice is all that is needed to keep bovine TB at current levels.

8. Who benefits from the aerial 1080 programme and who pays?

   Answer: The makers of 1080 benefit financially. The New Zealand government benefits as they own the companies that manufacture and distribute pellets. There is an extensive network of government-funded pest-control companies and operators who benefit financially. The taxpayer pays. Farmers may have to pay three times.

9. If we can't use aerial 1080 for pest control what other options are there?

   Answer:

   - Predator-proof fences can be used in specific regions, designated as wildlife preserves, to prevent repopulation by pests.
   - Trapping possums will have beneficial effects for some understorey native trees and, if stimulated by government grants, could boost the possum fur industry and provide employment. It will also minimize transmission of TB to cattle when undertaken in border zones surrounding farms.
   - Trapping rats, especially in community led

initiatives, could improve nesting success for native birds in designated areas

- Within remote areas of the New Zealand bush, where trapping is not an option, the modified ecosystem should be allowed to re-establish its own natural balance. This "hands off" policy equates to "masterly inactivity" and is the only biologically plausible approach.

10. How could everyone be so wrong?

    A: Easily!! - Everybody has been too busy to look into it, has swallowed the propaganda and blindly believed that "the science proves it".

I tell people I am writing this book and I detect a tiny change in their tone of voice, a slight shift of the eyes. You can see them thinking, "Ohhhh…. , she's a Greenie" (if they are the sort of people who don't like Greenies) or , "Ohhhh, she's a bit mad.. ", if they are Greenies themselves. This is the same for people I know and people I don't know, friends and family, people I respect and people I love. It is rather like a bad dream. You are at a party. Everything is going full swing, lots of music and drinking and dancing and everyone is having a raging good time. Then you discover that someone has died in the kitchen. There is a body on the floor, hidden under a table. A man has died. You know that something has to be done but nobody believes you and nobody wants to know. You try to catch people's attention but they are talking to each other. They can't hear you. The music is too loud. After a while you realize, they are deliberately ignoring you. You are an embarrassment. Nobody believes you. Nobody wants to spoil the party. It seems so impossible – a body in the kitchen…..But you know its there. You know there has been a death. Family should be informed, an undertaker needs to be found, a cause of death determined…This is probably someone's

father or husband or son. Someone will be worried when they don't come home – soon they will come to investigate. Then they will find out that you knew he was there but did nothing ….. You go and look at the body again, just to be sure. Yes – Its horrible. You don't want to look at it. Nobody is coming into the kitchen. It seems like people are avoiding coming into the kitchen. You try and find a phone to call the emergency services but there is no mobile reception. There is no landline. People tell you to come back out and enjoy the party, but you can't. There's been a death …..

I do not feel like diving once more into the New Zealand ecology literature that says the same thing again and again in almost the same words, or reading any more unctuous press releases about the plagues of rats and stoats that are "killing our birds" and how our big-hearted politicians will step in and "save them". I no longer want to notice the earnest DOC workers and the gung-ho helicopter pilots who "get on and do the job" (its not very nice but someone has to do it and we know that the-Science-supports-it). Or even think about the people who checked the rat track cards around the Kepler or in the Makarora valley and found almost no evidence of rats at all … and then just shut up while the wheels turned and more poison was scattered all over forests and mountain tarns, into the homes of kea and kiwi, robins and tomtits …. In particular I don't want to think about the scientists who have trained their eyes to see only the comfortable facts and their brains to reach the comfortable conclusions, while they push the awkward ones under the carpet (shades of Al Gore's *Inconvenient Truth*).

Then there are more shadowy figures, the money-men who "protect the industry" or even "grow the industry", the pest eradication we-must-get-every-last-rat people and the slippery PR ones, who make sure they get the spin just right. Lets not forget the media people who speak loudly and ignorantly about birds like the rock wren who cannot speak for themselves. If

they could, what would they say about how it feels to cuddle down with bright green pellets under a blanket of snow for three days of slow agonising death?

I have heard about doctors on the West Coast who are worried about the hazards to human health posed by aerial 1080, but who feel they cannot speak out for fear losing their jobs. I know (from Dan) that there are lawyers who are prepared to argue that 1080 in the flesh of woodpigeons may not have been the cause of death, and judges who have ruled in their favour.

A whole tissue of lies has been woven together and then gently (but skillfully) pulled over the eyes of the general public. It is a beast with tentacles that have reached so far into the interstices of New Zealand society that trying to pull the bloody thing out seems well nigh impossible.

Since the Graf Brothers u-tube video entitled, "Deer mass poisoned - Lake Taupo farmer speaks out" [172] was posted in August, 2016, there have been 27,084 views with many comments including:

> Marilyn – That is so irresponsible! What are they thinking???? There are other ways of controlling animals. How would they like to die like that? That is horrible. They will be accountable for this some day...mark my word.
>
> Peter: Why is this not making national news and where are SPCA and SAFE in relation to animal cruelty?
>
> David: ….This is a crime against humanity as well. Thoughts and prayers from the U.S brothers.

Makes me ashamed to be a New Zealander. And it also makes me wonder - is there something peculiar about New Zealand that has allowed this to happen here? Is it because we are a small and young society, without enough in the way of checks and

balances? This possibility has occurred to others. A *NZ Herald* Dialogue article about immigration scams was entitled, "Gullible Kiwis only too easily taken for a ride". [270] The journalist writes, "In the eyes of Asian immigrants, New Zealanders are generally kind and caring, but also stupid and gullible." Kiwi gullibility has also been exposed in the world of cyber-security where more than one in 12 workers were reported as having been fooled into giving away their computer passwords by the simplest of tricks. [271] Perhaps the time has come for us to grow up and become a little more critical and discerning about the information we are fed from the Net and elsewhere.

I went for a walk up the Routeburn valley in late 2016 with some friends. A beautiful two hour stroll from the carpark to the Routeburn Flats hut and adjacent grassy picnic area. We ate our sandwiches by the clear mountain stream and gazed in awe at the amazing scenery. A year ago, there were no sandflies here, which I remember struck me as very odd. Later, I learned that 1080 had been dropped all along the Routeburn in August, 2014. Then, I read about its insecticidal properties and the pieces started to fit together. Now the sandflies are back, although not in great numbers. We noticed some scattered birdsong along the track and saw a rifleman, a tiny little bird balancing on a branch. Then, as I briefly paused and bent down to examine a plant, there was a small movement in my peripheral vision and I found myself being examined. A small bright eye just a few feet from my face. A New Zealand robin. Reminds me of Malcolm. The same clear, uncomplicated gaze. Lacking all guile. Friendly. He hops around, almost jumping onto my boot. I try to find him some insects to eat but then a horrible thought creeps into my mind. Don't take food from strangers, little bird. 1080 is due to be dropped here next week. I shouldn't encourage him. For the same reason it is suggested that you don't feed keas ….The pre-feed from next week's "campaign" has been dropped already – little cereal pellets that don't contain poison to entice and delight

the creatures of the forest floor. Then when the nasty ones rain down they will be snapped up quickly by all who like cereal, which has the same constituents as bird-feed.

Rachel Carson published her groundbreaking book, *Silent Spring,* in 1962. [272] This "documented the detrimental effects on the environment—particularly on birds—of the indiscriminate use of pesticides." The impetus for the book was a letter written by a friend of Carson, to the *Boston Herald* in 1958, describing the deaths of birds around her property that occurred after aerial spraying of DDT. Carson, who was a marine biologist, took on a new role as an advocate for the environment, commenting that pesticides should be "more properly termed 'biocides' because their effects are rarely limited to the target pests". She accused the chemical industry of spreading disinformation and public officials of accepting industry claims unquestioningly. Sound familiar?

The book caused a furore and was fiercely opposed by the chemical companies. Nevertheless, its effects were far-reaching, ultimately leading to a ban on DDT in the United States, and inspiring the genesis of an environmental movement that led to the creation of the U.S. Environmental Protection Agency, significantly the very organisation that banned the use of compound 1080 as a pesticide in 1985. [273] Tragically, by the time the book was published, Carson had already developed the breast cancer that was to take her life and was undergoing radiotherapy. She and her publicist were concerned that she would be too weak to withstand the criticism that would be aimed at her personally and indeed there was plenty of this. Former U.S. Secretary of Agriculture, Ezra Taft Benson, commented in a letter to former President Dwight D. Eisenhower that the fact that she was unmarried despite being physically attractive indicated that she was "probably a Communist". [273]

In his recent opinion piece entitled, "Towards a 'silent spring'", [274] Richard Prosser noted that, "Like DDT, 1080 is a broad-spectrum poison. Like DDT, 1080 was first licensed as an insecticide, and it is known to be deadly to all air-breathing organisms." I briefly look into how 1080 actually does differ from DDT and confirm that they are completely different in terms of chemical structure. Moreover, DDT is subject to the problem of bioaccumulation, meaning that it accumulates in the tissues (usually fat) of living organisms. DDT can stay there for many years and if those animals eat more DDT-containing insects, they will accumulate more, with toxic and carcinogenic consequences.

Although banned in the United States, DDT is still widely used as an insecticide to kill malaria-transmitting mosquitos, especially in Africa and Asia. In 2001, Brazilian scientists reported DDT accumulation in chicken eggs from a region near Rio de Janeiro. [275] A house and outbuildings had been sprayed with DDT ten years before, to control sandflies. A decade later, chicken eggs sampled from the same place contained a concentration of DDT that was more than 1,000 times greater than eggs purchased in a Rio de Janiero market. 1080 does not appear to bioaccumulate in the same way as DDT but it is certainly deposited in the muscle of poisoned animals.

The Cawthron Institute trout experiments indicate that it can remain in the tissues of living animals for an undefined period. While interviewing people for this book I was told a story about a West Coast possum trapper who caught, killed and ate a possum many months after a 1080 drop. The possum had appeared well and was carrying a joey. The hunter ate his dinner and then threw the remains of the stew to his dog who subsequently developed typical signs of 1080 poisoning. Are there any data on levels of 1080 in wild deer or trout caught from regions subject to 1080 drops over the last decade? No. There have been no studies of this kind done at all. Why not?

Doctors have been accused of "playing God" when they use tools such as germ line manipulation to intervene in human reproduction. [276] The New Zealand 1080 experiment has seen a group of scientists, DOC workers and politicians "playing God" with our unique and irreplaceable ecosystem. They have not been doing a very good job but nobody seems to have noticed. New Zealand is a land of sheep and not just the four-legged kind. Killing native birds actually constitutes a crime under the NZ Wildlife Act of 1953 but for some reason deaths induced by the Department of Conservation seem to be exempt. Continuing with this Battle-of-the-birds, where birds and insects are the victims, and paradoxically rats and stoats are the winners, can only be described as an appalling eco-crime. And continue it does, seemingly unstoppably. William James O'Leary, tramp, bushman and legendary gold prospector, loved the wilds of the South Island. Dennis Glover's poem, "Arawata Bill" immortalized his travels and deep feeling for the land. Dropping loads of poisonous chemical all over this pristine and beautiful place is appalling on all levels and has to stop.

Mountains muzzle mountains
White-bearded rock-fronted
In perpetual drizzle.
Rivers swell and twist
Like a torturer's fist
Where the maidenhair
Falls of the waterfall
Sail through the air.

From Arawata Bill. Dennis Glover.

EPILOGUE

Are the forests really silent? Or are they echoing with birdsong – a post-1080 paradise? The chance comes for me to find out. A drop went ahead in the Routeburn/Dart area in October 2016, the fourth in the past decade. It was followed within a fortnight by at least two very heavy downpours of rain. Now a local hunters' organisation is doing a post-drop grid search of a section of the forest, looking for carcasses of whitetail deer that might have become by-kill. One animal has already been found dead, 1080 muscle testing is awaited. This is Part Two of Kaylyn McBrerarty's study of the Routeburn/Dart whitetail herd. Possibly half the herd was wiped out by the 2014 drop but this time 1080 pellets were coated with deer repellant. Has it worked?

We gather at the Routeburn carpark. Eleven of us. Ages range from teens to mid-seventies. Everyone is male and a hunter except me. A few quizzical glances are cast in my direction. We attract some attention from the numerous tourists milling around the area. One Asian lady asks us what we are doing:

> "Looking for deer after the 1080 drop – ones that might have been poisoned".
> "What, they are dropping poison here?"
> "Yes"
> "Who is doing this?"
> "The New Zealand Government, Department of Conservation."

One of the bystanders asks us if we are "pro" or "anti". The response is ragged. Quite a few muttered "anti's" but nobody seems very forthcoming. These are hunters, not armchair conservationists. We head off up the Routeburn, veer off onto a smaller track and eventually congregate at a corner; our start point. We have to leave the track and follow map lines that

traverse the heavily forested hillside, looking for deer carcasses as well as rats, mice and birds. We are also looking for 1080 pellets (are they are still visible?) and for large paper rubbish bags (Kleensaks) that have been planted randomly, the night before, as "controls". There are some problems with the GPS units, but finally we set off into the grid-search area in units of three; one person in the middle and one 20 meters on each side. It is very tough going. Tons of windfall.

We have to clamber awkwardly over and around giant tree-trunks lying on the ground, their roots sticking up at 90 degrees, ripped out of the ground by the weight of the falling tree. There are caves of crumbly earth behind the root balls. This carnage is the result of a freak snowfall about a week before the 1080 drop. It came down in a huge heavy dump in the middle of the night, transforming the area into Switzerland and causing massive damage to trees. Roads were blocked, power was off and tracks closed. So there is a lot of scrambling, heaving, grunting, panting and sweating. Much of the country we cover is very steep.

What do we find? About eight rubbish bags. I see no dead birds and nobody else reports finding any. Someone sees two live kaka (native parrots typically found below the bushline). I see a bush robin. There is scattered birdsong in places but overall the forest is very quiet. Much quieter than my own garden about 10 km away. We do see some green 1080 pellets, many broken down into messes of granules but some seemingly quite intact, despite the rain. A few of these are bagged and sent away for analysis. I hope we will find out whether they still contain potent poison.

How many pellets are there on the forest floor? Fewer than I imagined there would be. Sometimes I walk for 20 minutes without seeing any. Someone else walking along a ridge finds about eight in the space of 200m. What about rats and mice? Our little party sees one dead rat sprawled at the entrance of a

burrow at the base of a tree. Its location is radioed to base. But we also see a live rat that flicks away around a tree trunk. When we subside onto the ground for a bite of lunch we find ourselves being observed by a mouse, which is certainly not in its death throes. Others see some dead mice and the odd rat. There are no whitetail carcasses but one of the guys on a track uphill from us sees a live whitetail. A hind. She is apparently coming towards us but we don't see her. The undergrowth was very thick at that point.

What are my conclusions? 1080 has not eliminated all life in this forest, perhaps because the rain rapidly washed away much of the poison. There are still some birds, rats and mice here, although many have probably died. The ecosystem lives on but very much at "half-mast", if you use birdsong as an index of vitality. Nature's power to destroy is very much more apparent than man's. Inquisitive birds such as kea could well have succumbed, but without tracking collars you would not know. Kaylyn has collars on 10 whitetail, and one has stopped moving. Reducing the density of 1080 pellets to 2 kg/ha has, I am sure, resulted in less by-kill but also, clearly, less overall effectiveness. If we saw one live rat, how many more are there in the entire forest, to live and breed another day? Our grid search has only covered a tiny fraction of the area that has been poisoned. I would like to see what the rat-track index is like now. Sub-acute poisoning remains an unanswered question. And I remember later that I did not see any insects at all, despite getting very close and personal with a number of rotten tree trunks.

What was the point then? What have all those green pellets achieved? Nothing. Waste of time. Lots of creatures will have died painful lingering deaths to no avail. The birds are not "thriving" here. More like hanging on. Birdsong was much louder in a nearby never-1080'ed-valley I visited recently. And the rats will be back in big numbers sooner rather than later. The live

one we saw might not have found active pellets before the rain came, or it could have become bait-shy, or be a case of sub-acute poisoning. It could also be an example of a 1080-resistant rat. Is anyone testing for this? I don't think so, but the machinations of DOC are kept well away from the public eye so nobody knows. Sadly the knee-jerk response to all of this is predictable. More 1080! Kill the rats! More firepower! The analogy of a battle is in fact very apt. It reminds me of descriptions I have read of The Battle of the Somme. Both sides advancing in the mud by a few desperate metres only to be beaten back, sustaining massive casualties. In the end, the world just got sick of fighting and losing men and the war was over. I hope that sense will prevail here too and this futile battle will eventually be abandoned.

Author's note: A further 1080 drop into the Routeburn/ Dart area took place in September, 2017.

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