



**Environmental  
Protection Authority**  
Te Mana Rauhi Taiao

# **1080 use in Aotearoa New Zealand 2018**

**An annual report on  
the aerial operations,  
research, and incidents  
relating to 1080 use.**

# 1080



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# Contents

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<b>Executive summary</b>	<b>5</b>
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<b>Background</b>	<b>7</b>
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<b>Aerial pest control operations in 2018</b>	<b>8</b>
How aerial 1080 is used for pest control	8
Commissioning organisations in 2018	9
Operators that applied 1080 aerially in 2018	10
Mandatory reports after each aerial 1080 operation	10
Rules for 1080 formulations and application rates	11
Location of operations	11
Size of operations	14

---

<b>Protecting public health</b>	<b>15</b>
Agencies with delegated power for 1080 permissions	15
Management of water intakes ensures public health is protected	15
Monitoring provides assurance that water supplies remain safe	16
Conclusion	16

---

<b>Communication</b>	<b>17</b>
Consultation with Māori	17
Consultation with hunting groups	17
Changes to operations as a result of consultation	17
Assessing applications against the guideline	18

---

<b>Outcomes of 1080 aerial operations</b>	<b>19</b>
Benefits for TB eradication	19
Benefits for native species	19
A long-term approach	19
Pest numbers before and after operations	20
Overall assessment of the outcome of the operations	20

---

<b>Research into 1080</b>	<b>21</b>
More research needed on 1080 and alternatives	21

---

<b>Research in 2018</b>	<b>22</b>
Manufacturers' research projects in 2018	31

---

<b>Research projects since 2007</b>	<b>32</b>
Alternatives to the use of 1080	32
Optimising the use of 1080	38
Other related research	45

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<b>Incidents and matters of public concern</b>	<b>49</b>
Incident summaries	50

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<b>References</b>	<b>57</b>
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# Executive summary

This 12th annual report is to inform people on the aerial use of sodium fluoracetate (1080) formulated baits in Aotearoa New Zealand.

Aerially applied 1080 formulated baits are used to protect forests and farmland ecosystems across Aotearoa New Zealand. From the eradication of introduced predators that prey upon taonga species nesting in our most rugged terrain to protecting livestock from bovine tuberculosis (TB) carried by possums, 1080 is a necessary, albeit controversial, tool in New Zealand's current pest control toolbox.

The Hazardous Substances and New Organisms (HSNO) Act 1996 outlines the rules around the use of 1080 in New Zealand.

All decisions by the Environmental Protection Authority (EPA), including the decision to allow the use of 1080, are expected to be transparent and open to public scrutiny and discussion.

We have expanded this year's report to include a summary of past research into 1080 use and alternatives. The report also includes information on aerial operations in 2018, incidents relating to these operations and research conducted in 2018, but does not include information on ground-based application of 1080 or related incidents.

In 2018 a single incident of non-compliance with 1080 HSNO controls was reported to the EPA. This is the lowest number of non-compliance incidents since the last formal reassessment of 1080 in 2007.

That reassessment, by the Environmental Risk Management Authority (EPA's predecessor), determined through an extensive public process that while the benefits of using 1080 outweighed the adverse effects, the controls on its use should be tightened.

Operators who want to use 1080 must follow the controls set out under the HSNO Act and the relevant Health and Safety at Work (Hazardous Substances) Regulations 2017. These include a requirement for all operators carrying out aerial 1080 pest control operations to provide post-operational reports for all activity, with details of every operation. We have reported on those operations since 2008.

The EPA is active in meeting its obligations under the HSNO Act to protect the environment and the health and safety of the New Zealand public.

## The application of 1080

Throughout 2018, aerial 1080 operations focused on effective interventions against pest species that threaten native wildlife and act as vectors of disease. The primary targets were possums, rats, and wallabies, with secondary poisoning anticipated for stoats.

About 55 percent of the area treated was with operations undertaken to control possums with the goal of eradication of bovine TB. This work is to protect farm animals including domestic deer and cattle from the disease that is sustained in possum populations.

About 42 percent of the area treated was with operations undertaken to protect a range of native species including the North Island kōkako, whio (blue duck), kererū, kea, Hochstetter's frog, ngirungiru (South Island tomtit), kārearea (New Zealand falcon) and kiwi (several species, including North Island brown kiwi and great spotted kiwi), at-risk populations of long-tailed bats, and vulnerable plant species such as Hall's totara.

The part of the bait pellet which does the actual poisoning is called the active ingredient. In typically used 1080 bait pellets for aerial use, the active ingredient (pure 1080) comprises only 0.15 to 0.2 percent of the total weight of the bait.

The approved maximum amount of the active ingredient per hectare is 30 grams. This equates to roughly two tablespoons of pure 1080 in bait across a stretch of land roughly the size of a rugby field.

Data from operations demonstrate that operators use much less than this amount.

In 2018, the application rates of 1080 formulated baits were predominantly in the range of 3.6 to 4.8 g of 1080 per hectare which is roughly one teaspoonful of 1080 across a rugby field.

There were 29 aerial 1080 operations conducted in 2018 across New Zealand.

As a result of ongoing consultations with Māori and hunting groups, changes were made to 11 out of the 29 operations. These modifications included boundary changes, timing of the operation, adding deer repellent, and changes from aerial to ground application at some sites.

This report contains a summary of the post-operational water testing and results.

Around 230 water samples were tested following aerial 1080 operations in 2018. All but six samples had no detectable level of 1080. None of those six samples detected 1080 level that exceeded the Ministry of Health's provisional maximum acceptable value for 1080 in drinking water. See [Drinking-Water Standards for New Zealand 2005 \(Revised 2008\)](https://www.health.govt.nz/publication/drinking-water-standards-new-zealand-2005-revised-2008)<sup>1</sup>.

Post-operational reporting also documents the species testing conducted throughout 2018 in the operational areas.

The aerial operations and land area covered in 2018 are detailed in this report. In 2018 the total area treated was smaller than in 2016 and 2017, mostly due to the absence of a mast event in 2018. Mast events are natural phenomena that occur intermittently in forests when bumper crops of beech seed, tussock seed or podocarp fruit lead to higher-than-normal rodent levels in affected forests. Fewer areas were affected

by mast events in 2018 than the two previous seasons. This meant that fewer predator control measures, including 1080, were required in 2018 compared to previous years.

## Research continues

The 2007 reassessment of 1080 advocated for continued research on 1080 including formulations, timing and delivery, as well as alternative methods of pest control.

This year we have included a section that summarises research into 1080 efficacy as well as alternative methods for predator control. This section details research projects starting from the 2007 reassessment through to 2018 and is organised by research category.

We have summarised more than 30 projects that were either ongoing, started, or completed in 2018. In addition, we have detailed more than 60 projects that have been completed since the last reassessment, spanning 11 years.

There is consensus that research programmes should continue to explore alternative ways to achieve sustainable pest eradication, including sophisticated trapping technology such as developed by Zero Invasive Predators, and the consideration of the application of genetic technologies.

The EPA continues to support all research efforts to find additional methods of pest control. A “toolkit” of approaches is likely to be needed for effective pest management across a wide variety of landscapes in New Zealand, especially if the government target of pest-free Aotearoa by 2050 is to be realised.

<sup>1</sup> <https://www.health.govt.nz/publication/drinking-water-standards-new-zealand-2005-revised-2008>

# Background

## 1080 continues to play an important role in protecting New Zealand's native species

1080 is the common name given to the manufactured form of sodium fluoroacetate. The main use of 1080 is in baits that are designed to be eaten by possums and rats and other invasive (such as non-native) species. Most baits used in aerial application on public conservation forests are cereal baits dyed green or blue to make them unattractive to birds.

In 2007 the Environmental Risk Management Authority (the EPA's predecessor) carried out an extensive public process to reassess the use of 1080 across New Zealand. This process found the benefits of using 1080 outweighed the adverse effects but that the controls on its use should be tightened.

The decision-making committee for the 2007 reassessment of 1080 required operators to report on all aerial 1080 operations to the EPA. We are required to collate the information provided in these operation reports and produce an annual report on aerial 1080 operations completed during the calendar year.

The EPA has reported on the outcome of aerial 1080 operations since 2008. Operators have up to six months to submit their operational reports. All operation reports for aerial 1080 operations completed in 2018 and submitted to the EPA are published.

[1080 aerial operators' reports<sup>2</sup>](#)

<sup>2</sup> <https://www.epa.govt.nz/resources-and-publications/1080-aerial-operators-reports/>

# Aerial pest control operations in 2018

In New Zealand operators control pests such as possums, wallabies, rabbits, rats, and stoats using ground-based and aerial application of poisons. Ground-based operations may include trapping, shooting, or placing various toxins in bait stations. These toxins, or vertebrate toxic agents (VTAs), may include 1080.

In remote or rugged land, aerial application is more efficient and cost-effective than ground-based operations.

## How aerial 1080 is used for pest control

Organisations that manage large areas of land across New Zealand often employ 1080 as part of their ongoing pest management programmes to protect native species and/or to combat disease spread. This means the individual aerial 1080 operations reported in annual reports are usually part of an ongoing, multi-year pest management programme. These are carefully designed to deliver a positive conservation outcome for a particular area or to provide assurance to farmers and markets as to the health and status of farmed animals.

The timings of individual 1080 operations within a programme are dictated and adjusted according to information about the population ecology, and dynamics of the target pests. In some situations, environmental conditions (for example, the effect of a mast year) will significantly influence successive timings.

In some cases, managers may divide large geographical areas into smaller operational units and manage pests over time by rotating aerial 1080 operations around those smaller units as required.

Table 1 shows treatment areas for different organisations from 2008 to 2018. Apart from 2014, 2016, and 2017, when DOC intervened to address high-risk predator populations, it shows that the area of land treated with aerial application of 1080 has been relatively constant since 2008, when mandated reporting began.

**Table 1: Number of 1080 aerial applications per year and area treated by operators<sup>3</sup>**

Year	Total no. of operations	OSPRI/TBfree (000 ha)	DOC (000 ha)	Regional councils (000 ha)	Others (000 ha)	Total area (000 ha)
2008	75	425	107	5	27	564
2009	64	314	167	17	17	515
2010	45	254	171	5	9	439
2011	49	344	127	5	15	491
2012	48	279	136	5	12	432
2013	57	298	126	16	7	447
2014	58	307	645	12	2	966
2015	45	239	104	28	3	374
2016	36	427	619	0	5	1051
2017	50	362	512	2	2	877
2018	29	241	164	22	14	441

## Commissioning organisations in 2018

The 440,909 hectares covered by aerial operations during 2018 were treated by DOC (37 percent), TBfree (55 percent), Auckland Council (5 percent) and other organisations (3 percent).

There were 29 operations:

- nine funded by TBfree
- 11 funded by DOC
- one operation each funded by Auckland Council, Port Blakely and Ngā Whenua Rāhui Komiti
- six operations on private land.

### Department of Conservation

The Department of Conservation (DOC) is a government department that manages approximately 8.6 million hectares of

conservation land. It uses both ground-based and aerial application of 1080 to:

- improve the health of ecosystems by reducing the impact of browsing, competition, and predation by possums, rats, and other introduced pests
- protect threatened species from predators through direct control and secondary poisoning<sup>4</sup>
- control rabbits to meet its regional pest management commitments.

### TBfree NZ Ltd

TBfree NZ Ltd (TBfree) is the statutory management agency for the National Bovine Tuberculosis Pest Management Plan. This plan gives effect to the Biosecurity (National Bovine Tuberculosis Pest Management Plan) Order 1998.

TBfree is managed by OSPRI New Zealand Limited (Operational Solutions for Primary Industries). OSPRI is a not-for-profit company

<sup>3</sup> Figures are rounded to the nearest thousand hectares.

<sup>4</sup> Secondary poisoning results when one organism comes into contact with or ingests another organism that has poison in its system.

and manages two national programmes – National Animal Identification and Traceability and TBfree.

TBfree aims to eradicate bovine tuberculosis (TB) from New Zealand by 2055, with key milestones of TB eradication from cattle and deer by 2026 and from possums by 2040.

The major areas of focus of the TBfree programme service delivery covers:

- disease management
- pest management
- research, development and extension
- corporate and contact centre support.

TBfree uses both ground-based and aerially applied 1080 in its strategy for containing and controlling possums.

### **Auckland Council**

The Auckland Council Regional Pest Management Strategy guides the Council's pest control programmes at a regional level. The strategy aims to identify and control targeted pests so they no longer pose a threat to the economy, natural biodiversity, health, and cultural identity of the city. Park management plans may also identify specific policies and objectives for managing pest species to protect park values.

It selects its pest control methods according to the species and the site to be treated.

### **Ngā Whenua Rāhui Komiti**

Ngā Whenua Rāhui Komiti is a DOC committee that administers a contestable fund established in 1991 to provide funding for the protection of indigenous ecosystems on Māori-owned land.

The Committee receives an annual allocation of funds from DOC and advises the Minister of Conservation on funding applications from iwi, the placing of kawenata (covenants) and negotiates the conditions of funding agreements.

### **Port Blakely Limited**

Port Blakely is the New Zealand-registered division of the international Port Blakely Company. It owns and manages forests in New Zealand. It grows, harvests, and continually replants radiata pine and Douglas fir. Both are sold in New Zealand and to log markets throughout Asia.

Port Blakely funded an aerial 1080 operation at the Waimate Forest to reduce the impact of wallabies to the exotic tree planting programme.

## **Operators that applied 1080 aerially in 2018**

### **Landcare Services Limited**

Landcare Services is a private company which has been operating since 2001. It specialises in pest and weed control for the Canterbury region. Its services include control of aquatic weeds and targeting infestations of vertebrate pests.

Landcare completed one aerial 1080 operation on private land on behalf of the owner.

### **Mainland Vector Contracting Limited**

Mainland Vector Contracting is a privately owned pest control company based in the South Island which has been operating since 2009. It is involved in many areas of pest control including ground- and aerial-based animal control operations.

Mainland completed five aerial 1080 operations in 2018 on private land on behalf of the owners.

## **Mandatory reports after each aerial 1080 operation**

All post-operational reports submitted to the EPA are publicly available.

Post-operational reporting must include the following information:

- who undertook the operation and the reason(s) for conducting the operation
- the 1080 formulations used and the application rates
- the location and size of the area covered during the operation
- monitoring information, including any water or species monitoring, if carried out in conjunction with the operation
- an assessment of the operation's outcomes an overview of the communication activities (consultation and notification) and outcome
- an overview of any incidents and complaints related to the operation, and any actions resulting from these
- a detailed map of the operational area(s).

## Rules for 1080 formulations and application rates

In New Zealand, a small amount of 1080 poison is mixed into a large volume of cereal or carrot bait to attract the target pest species. There are rules to restrict the concentration of 1080 poison in the bait, as well as the total amount of 1080 poison that can be applied per hectare.

The part of the bait pellet which does the actual poisoning is called the active ingredient. In the typically used 1080 bait pellets, the active ingredient (pure 1080) comprises only 0.15 to 0.2 percent of the total weight of the bait.

The approved maximum amount of the active ingredient per hectare is 30 grams. This equates to roughly two tablespoons of pure 1080 in bait across a stretch of land roughly the size of a rugby field.

Data from operations demonstrate that operators use much less than this amount. In 2018, the application rates of 1080 formulated baits were predominantly in the range of 3.6 to 4.8 g of pure 1080 per hectare, which is roughly one teaspoonful of 1080 across a rugby field.

### Bait application rates

Bait application rates for possum and rodent control operations varied between 0.5 and 4.0 kilograms (kg) of bait (containing 1.5 to 2.0 g of 1080 per kg) per hectare. The average was 1.8 kg of bait per hectare.

Bait application rates for rabbit control operations were between 12 and 31 kg of carrot bait (containing 0.2 g of 1080 per kg) per hectare. The average was 24 kg of bait per hectare.

### Total amount of 1080 per hectare

The 1080 application rates for possum and rodent control operations varied between 0.2 and 6.0 g of 1080 per hectare. The average was 3.6 g 1080 per hectare.

The 1080 application rates for rabbit control operations varied between 2.4 and 6 g of 1080 per hectare. The average was 4.8 g of 1080 per hectare.

### Operators use different baits to target pests

Twenty-six of the operations used cereal bait pellets containing between 1.5 and 2.0 g of 1080 per kg of bait. These operations were designed to control possums, rats, mice, wallabies or stoats. Five of these 26 operations used deer repellent.

The three other operations used carrot baits to target rabbits. The baits contained 0.2 g of 1080 per kg of bait.

### Conclusion

In 2018, the application rates of 1080 formulated baits were predominantly in the range of 3.6 to 4.8 g of 1080 per hectare which is roughly one teaspoonful of 1080. These rates were significantly below the maximum allowable rate of 30 g of 1080 per hectare set by the 2007 reassessment conditions.

All of the bait formulation and application rates for 1080 used in 2018 were compliant with HSNO controls.

## Location of operations

The number of 1080 drops, as well as the dose in each operational area, is influenced by:

- the purpose of the operation and target species
- topography and land cover
- distribution of native species at risk of local or national extinction
- the current distribution of farms infected with bovine TB.

In 2018, 1080 was aurally applied to a total land area of 440,909 hectares. The average size of an individual operation was 15,204 hectares.

The largest application covered just under 58,000 hectares and the smallest was 305 hectares.

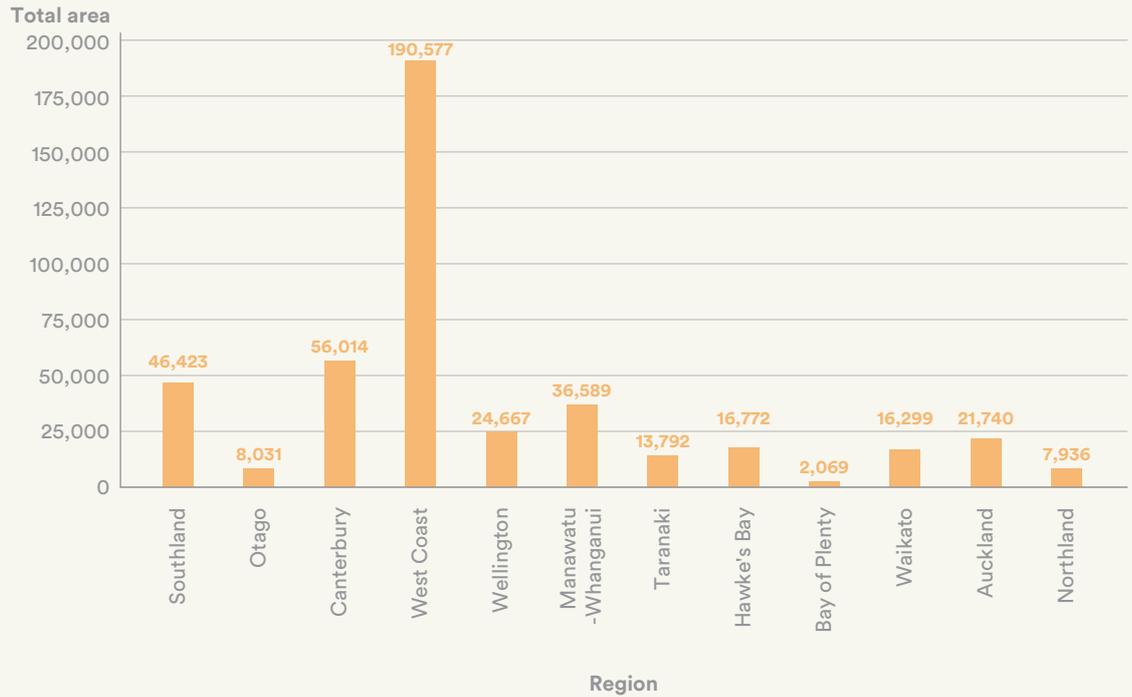
The region with the largest area of treated land was the West Coast (190,577 hectares). The region with the smallest area of treated land (2,069 hectares) was the Bay of Plenty.

There were eight aerial 1080 operations in Canterbury, six operations in the West Coast, three operations in Otago, and two each in Waikato, Manawatu-Whanganui, and the Wellington Region.

The reason for the greater number of operations in some regions is in part due to the differences in the natural environment. For example, the West Coast has 37 percent coverage with indigenous forest. Aerial application of 1080 on the West Coast is considered a key tool for possum and rodent control.

Figure 1 shows the total number of hectares per region treated aerially with 1080 in 2018 and Figure 2 shows the relative size of the treated areas and the operators.

**Figure 1: Total area (in hectares) per region covered by aerial applications of 1080 in 2018**





## Size of operations

The organisations that used aerial 1080 over the widest land area in 2018 were TBfree and DOC.

TBfree uses a combination of both ground-based and aerially applied 1080 in its strategy for containing and controlling possums. In 2018 TBfree treated 241,061 hectares of land using aerial application of 1080 (six operations in the South Island and three operations in the North Island).

DOC treated 164,528 hectares for possums or rodents using aerial application of 1080. This was less than the area covered in 2017 because there were no large scale mast events. The operations were evenly spread across both islands.

Mast events are natural phenomena that occur intermittently in New Zealand forests, and produce bumper crops of beech seed, tussock seed, or podocarp fruit, which leads to higher than normal rodent levels in affected forests.

Widespread mast events occurred in 2016 and 2017, but not in 2018. This meant less predator control was required in 2018 relative to the two preceding years.

The average size of the area of aerial 1080 applications was about 15,000 hectares for DOC and about 27,000 hectares for TBfree.

**Table 2: Area treated by all operators in 2018**

Operator	Area treated (000 ha)	Total area covered in 2018 (%)
TBfree	241,061	55
DOC	164,528	37
Auckland Council	21,740	4.9
Mainland Vector Contracting Limited	5,296	1.2
Landcare Services Limited	1,800	0.5
Ngā Whenua Rāhui Komiti	5,275	1.2
Port Blakely Limited	1,209	0.2

# Protecting public health

## Agencies with delegated power for 1080 permissions

The EPA has the legal authority to grant permissions to use certain animal poisons known as vertebrate toxic agents (VTAs) under s95A of the HSNO Act 1996.

We have delegated the power to grant permissions to use certain VTAs (including 1080) as explained below.

- When certain VTAs are used in a catchment area from which water is drawn for human consumption, or in any other area where a risk to public health may be created if the substance is applied or used, the power to grant permissions is delegated to medical officers of health and health protection officers who have been appointed as enforcement officers under the HSNO Act<sup>5</sup>. These officers are employed in the public health units of district health boards.
- When VTAs are used on land administered or managed by DOC the power to grant permissions is delegated to DOC.
- These organisations carry out audits of some permissions issued by their offices to make sure operators have followed the conditions of their permissions.
- The EPA also carries out audits to monitor how these organisations are using their delegated powers.

## Management of water intakes ensures public health is protected

Water intakes are isolated (along with other measures) if an aerial 1080 operation is within the catchment of a drinking water intake. This ensures there is no risk of drinking water containing 1080 residues that exceed the acceptable limit of 3.5 micrograms (0.0035 milligrams) of 1080 per litre of water. The limit is set at a level that protects human health and is based on the Ministry of Health's provisional maximum acceptable value for 1080 in drinking water.

Water testing may also be required in other water catchments as part of environmental monitoring for compliance with resource consent conditions, or for research purposes. It may also be used to provide evidence where a public health HSNO enforcement officer is investigating non-compliance with a permission condition.

Water testing can detect levels above 0.1 micrograms of 1080 per litre of water (or 0.1 parts per billion), which is 35 times lower than the maximum acceptable value.

<sup>5</sup> These officers are appointed by the Director-General of Health under the Health Act 1956 and then appointed by the Director-General as enforcement officers under the HSNO Act.

## Monitoring provides assurance that water supplies remain safe

Post-operational water monitoring was carried out for 16 aerial 1080 operations in 2018, with 229 samples taken for analysis.

There were 131 water samples collected after the Hunua Ranges aerial 1080 operation from four reservoirs, streams flowing from the operational area, and from streams of cultural significance. The sampling followed the Auckland Council water monitoring programme which focused on managing actual and perceived risk.

1080 was not detectable in any of the water samples tested after the Hunua Ranges operation.

For the remaining 98 samples taken following other operations, 92 had no detectable 1080. Six contained 1080 above the level of detection, however, none of these exceeded the tolerable exposure limit of 0.0035 mg per litre.

## Conclusion

None of the water samples tested after the aerial 1080 operations in 2018 had 1080 levels above the acceptable limit for drinking water or posed risk to water supplies. This finding is consistent with previous research on the inability of 1080 (when applied properly) to contaminate receiving water supplies (Srinivasan et al., 2018).

Since the reassessment in 2007, more than 1,496 water samples from drinking water catchments and other water bodies have been analysed for 1080 (this includes the 2018 water samples). We expect operators and regulatory bodies to continue to test water across operational areas to reassure communities that 1080 remains within acceptable limits.

# Communication

Communication on the timing and location of 1080 operations is vital to the safety of local communities and their domestic animals. The operation reports submitted to the EPA must include information on the pre-operation notification and consultation process.

All 1080 aerial operations must be publicly notified in a newspaper available in the area in which 1080 is going to be applied.

The EPA expects operators to notify and consult with affected Māori groups, neighbours, recreational and commercial hunting groups, and local communities. Operators must detail in their reports how they will carry out their consultation and notification when they apply to DOC and/or to the public health units within district health boards for permission to carry out their aerial 1080 operation(s).

The process for communications activities required to implement an aerial 1080 operation is described in the *Communications Guideline for Aerial 1080 Operations* (2009) published by the Environmental Risk Management Authority (EPA's predecessor). The EPA is reviewing this guideline to ensure it is relevant to current communication practices and activities.

[Communications Guideline for Aerial 1080 Operations \(2009\)](https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Guidance/4569c19e32/1080-Communications-Guidelines.pdf)<sup>6</sup>

## Consultation with Māori

It is important that operators engage with Māori as early as possible when considering an aerial 1080 operation on public land or in an area where the public may be affected.

Ongoing discussion with Māori is essential to establishing good relationships with relevant hapū and iwi. Operators have confirmed they are benefiting from the knowledge and expertise Māori have to offer.

In 2018 Māori were consulted and notified for the 27 aerial operations undertaken on public land.

## Consultation with hunting groups

Hunting groups are generally consulted and notified when an aerial 1080 operation is to be carried out on public land where recreational hunting is likely. In 2018, hunting groups were consulted and notified via letters, emails, meetings, and public notices of all operations on public land.

## Changes to operations as a result of consultation

Following consultation, alterations were made to 11 of the 27 operations completed in 2018 that required consultation.

- For seven operations, the proposed boundaries for the application area were modified in response to feedback received during consultation. In four of these cases, the boundary changes were made to exclude sensitive sites, which can include areas such as water supply, huts, and stock that may be at risk from unintentional access to baits.
- The timing was changed for five operations due to stock movement and planned hunting activities.

6 <https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Guidance/4569c19e32/1080-Communications-Guidelines.pdf>

- Three operations changed from aerial to ground application of 1080 for parts of the treatment area.
- Two operations added deer repellent.

In 16 cases there were no changes required following consultation. This shows that early engagement with Māori and other affected groups during the planning stage benefits the operators.

## Assessing applications against the guideline

When treating land managed by DOC with 1080, the operator must obtain DOC's permission. If the land being treated is a catchment area for water supplies for human consumption, or in any area where it may cause a risk to public health, permission is also required from the public health unit within the district health board.

### Ministry of Health

Before granting permission for an aerial 1080 operation, HSNO enforcement officers employed by public health units within district health boards (public health HSNO enforcement officers) assess the communications plan for the operations against the *Communications Guideline for Aerial 1080 Operations*. The Ministry of Health reports the results of these assessments to the EPA.

The Ministry reported that public health HSNO enforcement officers received 58 applications in 2018 and all of these applications met the requirements of the guideline. They issued 54 permissions in 2018. Seven of these permissions were revoked due to changes in operational details, budget restrictions, or permit conditions, and replacement permissions issued.

The Ministry notes permissions for some applications lodged in 2018 may not have been issued until 2019.

Not all of the 54 permissions for 1080 operations resulted in completed operations, due to unfavourable weather and/or other site-specific factors – some operations were cancelled, and others deferred or merged.

### Department of Conservation

In 2018, DOC issued 21 permissions for aerial 1080 operations on DOC land. Four of those permissions were not acted on because pest densities did not meet anticipated operational trigger levels, operational objectives changed, or weather conditions prevented the operation. Out of the 21 permissions granted by DOC in 2018 for aerial 1080 operations, 15 operations were undertaken in 2018.

In addition to that, two permissions issued in 2018 were not acted on until 2019, and will therefore be included in next year's annual 1080 aerial operations report. Two operations that were undertaken in 2018 had their permissions granted in 2017.

Our 2017 report noted that two permissions issued by DOC in 2017 were acted on in 2018. One of these was for the Karamea Bluffs and Stormy Ridge operation on the West Coast, the other was for the Kirkliston Range operation in Canterbury.

The process and requirements for obtaining DOC permission is available on its website.

[Animal pest control operations](https://www.doc.govt.nz/get-involved/apply-for-permits/business-or-activity/animal-pest-control-operations/)<sup>7</sup>

<sup>7</sup> <https://www.doc.govt.nz/get-involved/apply-for-permits/business-or-activity/animal-pest-control-operations/>

# Outcomes of 1080 aerial operations

## Benefits for TB eradication

TBfree says that 423,000 hectares of land was declared free of bovine TB in the 2017/18 financial year. At the end of 2017/18 there were 32 infected herds, a decrease from 54 at the end of the previous financial year.

## Benefits for native species

Species monitoring is a way to ascertain the success or failure of aerial 1080 operations and how they benefit New Zealand's ecosystem.

Species monitoring is not a mandatory requirement for 1080 operations, but where monitoring is carried out, operators must report the results to the EPA. Often operators monitor plant and animal species in order to determine the need for pest control operations and the success of the operations.

DOC's long-running study to monitor native species in the Landsborough valley in South Westland shows the benefits of timely and effective large scale interventions against pest populations.

### [Doubling native bird numbers in the Landsborough Valley](https://www.doc.govt.nz/our-work/tiakina-nga-manu/landsborough-valley-bird-numbers-double/)<sup>8</sup>

Typically, immediate positive responses in nesting success and chick survival for vulnerable bird species are recorded. Long-term studies are showing significant population increases for species such as mōhua, robins, bats, and whio, and reversal of population decline for species such as kiwi, fuschia and kākā. The past decade

has seen a significant improvement in DOC's understanding of and ability to intervene to protect vulnerable species across their range.

The 2018 post-operation reports noted benefits for many native species. These included North Island kōkako, pīwakawaka, long-tail cuckoo, short-tail bat, whio, kererū, poaka, kākā, kea, korimako, Hochstetter's frog, South-Island tomtit, tūi, yellow-crowned kākāriki, pīwauwau (rock wren), riroriro (grey warbler), kārearea (falcon) and kiwi (several species including North Island brown kiwi and great spotted kiwi), at-risk populations of long-tailed bats, and vulnerable plant species such as Hall's tōtara, and domestic cattle and deer stock.

More information about the benefits for native species is on DOC's website.

[Proof 1080 is saving our species](#)<sup>9</sup>

## A long-term approach

We are aware that it can take a long time to detect changes in species' composition, benefits to ecosystems, or the presence or absence of TB.

While some operators carry out long-term monitoring, they are required to submit their aerial 1080 reports to us within six months of the operation. This means the results of longer-term monitoring will not be captured in the reports they submit.

8 <https://www.doc.govt.nz/our-work/tiakina-nga-manu/landsborough-valley-bird-numbers-double/>

9 <https://www.doc.govt.nz/nature/pests-and-threats/methods-of-control/1080/proof-that-1080-is-saving-our-species/>

## **Pest numbers before and after operations**

Operators must provide a measure of possum or other relevant pest numbers before and after the operation (if available).

Pre-operational monitoring of pest species (measure of possums and other targeted pests) was carried out for 18 of the 29 aerial 1080 operations undertaken in 2018.

Of these 18 operations, 15 operations also undertook post-operation monitoring of targeted pest species.

## **Overall assessment of the outcome of the operations**

Of the 15 operations that undertook post-operation monitoring, monitoring is ongoing for four operations. Eleven of these operations reported that they met their objectives.

# Research into 1080

## More research needed on 1080 and alternatives

In 2007 the 1080 reassessment decision-making committee recommended to agencies involved in pest control that further research should be undertaken:

- alternatives to the use of 1080 for pest control
- improvements to the use of 1080, for example, with respect to methods of application and application rates
- specific technical areas, such as the stability of 1080 in storage, surface water and soil research pertaining to OECD Guidelines 309 and 307 respectively, and the effect of 1080 on rongoā Māori (traditional Māori healing).

Research on 1080 and alternatives undertaken in the past year can be broadly categorised into:

- work undertaken by research institutes (Manaaki Whenua – Landcare Research, universities), operators (DOC, Zero Invasive Predators (ZIP), OSPRI and TBfree), and product manufacturers (Orillion and Pest Control Research)
- work seeking to optimise the use of 1080, searching for alternatives to the use of 1080 and other related research.

In addition to reports of new and ongoing research for 2018, we have included for the first time an extensive summary of the research reported over the past 11 years, and its outcomes (where possible).

# Research in 2018

Information about the following research projects that began in 2018 is current as of August 2019.

- Predator Free 2050 Limited (PF2050) funded projects on genomic resources for rats and stoats, gene drive strategies for rodent control, low-cost eradication of possums from native forest, and complete removal of possums on a large scale. These research projects were conducted by research organisations and universities.
- ZIP has initiated new projects on tahr carcasses as a preferred food source for kea, and a kea repellent for cereal bait.
- DOC has begun to prepare a risk profile of 1080 with respect to freshwater wild food species in cooperation with the Ministry for Primary Industries – Manatū Ahu Matua (MPI) and has launched a new project on improving small mammal monitoring.
- OSPRI and the research company Connovation Limited have conducted cage trials for solid cholecalciferol (vitamin D<sub>3</sub>) baits and encapsulated 1080 baits for aerial delivery.
- OSPRI and Manaaki Whenua – Landcare Research are working on deer repellents for 1080 baits, low-cost eradication of possums from native forest, and investigating effective methods to deter kea from eating 1080 baits.

**Table 3: Summary of new, ongoing and completed research in 2018**

Status	Organisation(s)	Project
<b>Alternatives to the use of 1080</b>		
Ongoing	DOC Lincoln University Connovation	<b>Aerial para-aminopropiophenone (PAPP) for mustelid control</b> This project is developing a ready-made bait containing encapsulated PAPP which could be used in either bait stations or deployed aerially to control stoats and ferrets. Initial trials in pens identified two bait types as suitable. These are being field trialled in bait stations in 2019/20 to test their effectiveness on stoats.
New	Predator Free 2050 (PF2050) Cornell University Manaaki Whenua – Landcare Research	<b>Realistic population modelling of gene-drive strategies for rodent control in New Zealand</b> This project will assess the feasibility of CRISPR-based gene drive approaches for rodent control in New Zealand through the development of an ecologically realistic modelling framework incorporating spatial dynamics.  Planned outcome: Understanding the theoretical potential of new genetic control approaches.
New	PF2050, Ministry for Business, Innovation and Employment University of Otago CSIRO	<b>Underpinning genomic resources for invasive New Zealand rats</b> In collaboration with the New Zealand's Biological Heritage National Science Challenge <sup>10</sup> , this project will involve the full genome assembly of rat populations and the transfer of CSIRO sequencing technologies and bioinformatics software to Genomics Aotearoa.  Planned outcome: Underpinning genomic resources for ship rats, and improved New Zealand capability.
Ongoing	DOC Lincoln University Connovation	<b>A new toxin delivery device for stoats—results from a pilot field trial</b> A re-setting toxin delivery device was developed and tested in a pilot field trial. The device fires a paste containing PAPP on to the belly of stoats as they pass through a tunnel, which they later ingest when they groom the paste from their fur. The results indicated that further development is required to make the devices more durable for field conditions as some of the devices had malfunctioned within six weeks of deployment. However, monitoring of trail cameras in the trial area did record a 90 percent reduction in stoat detection after 28 days (Murphy et al., 2018).
New	PF2050, Ministry for Business, Innovation and Employment Manaaki Whenua – Landcare Research	<b>Stoat genome assembly and landscape genetics</b> This is a collaboration under the Biological Heritage National Science Challenge. It will combine genome sequencing and a landscape genetic connectivity study of stoats to better understand stoat dispersal distances.  Planned outcome: Underpinning genomic resources for stoats, and stoat eradication guidance.
New and complete	OSPRI Connovation	<b>Cage trials for a solid cholecalciferol bait for aerial delivery</b> Cage trials using extruded 12 g cholecalciferol baits were completed on possums and rats in 2019. The trials were successful for both species. OSPRI and Connovation will discuss the next stage of research.

10 The National Science Challenges are funded by the Ministry of Business, Innovation and Employment. The New Zealand's Biological Heritage National Science challenge was created to protect and manage native biodiversity, improve biosecurity and enhance resilience to harmful organisms.

Status	Organisation(s)	Project
New and complete	OSPRI Connovation	<p><b>Cage trials for a solid encapsulated 1080 pellet bait for aerial delivery</b></p> <p>Cage trials using extruded 12 g 1080 baits were completed on possums and rats in 2019 to investigate whether encapsulated 1080 would be more effective against rats than current baits. The trials were successful for both species, though a repeat of these trials is anticipated. Meetings are planned between OSPRI and Connovation to discuss the next stage of research.</p>
Complete	Connovation	<p><b>Use of first-generation anticoagulant and cholecalciferol to combine benefits</b></p> <p>This research aims to create a product with the efficacy of a second-generation anticoagulant without the detrimental environmental characteristics of a first-generation anticoagulant. To do this 0.05 g/kg diphacinone, and 0.60 g/kg cholecalciferol were combined in a pellet bait (C+D). Cage and field trials indicated that the pellet baits were effective at killing possums and rats. When compared to brodifacoum baits C+D displayed similar potency with a faster time to death.</p> <p>This product was registered with the MPI agricultural compound or veterinary medicine (ACVM) register on 3 May 2019.</p>
<b>Improvements to the use of 1080</b>		
Ongoing	OSPRI Ministry for Business, Innovation and Employment PF2050 Manaaki Whenua – Landcare Research	<p><b>Dual strategy for 100% possum kill and low-cost eradication of possums from native forest</b></p> <p>In work conducted in 2016–2017 rapid-repeat dual applications of 1080 cereal bait were tested with the intention of achieving 100 percent kill of possums. The approach showed very high effectiveness against ship rats (demonstrating that learned bait shyness in that species could be overcome by pre-feeding twice after an initial 1080 baiting), but only low efficacy against possums. Funding has since been used to summarise progress for key stakeholders and then develop and field test (using ground-laid 1080 baits) a new approach using two completely different bait types in quick succession (cereal bait followed by peanut butter). A 100 percent kill of 89 radio-collared possums was achieved where the possums were first pre-fed with peanut butter compared to 95 percent of 40 that were poisoned before being pre-fed.</p> <p>The planned outcome is to understand whether aerial 1080 can reliably eradicate possums at scale. The results indicate that 1080 bait aversion in possums can be reduced or overcome, suggesting that the dual-1080 strategy could provide an affordable alternative moderate-cost strategy for local elimination of possums using 1080.</p>
Ongoing	OSPRI DOC	<p><b>Tiakina Ngā Manu – Battle for our Birds</b></p> <p>Tiakina Ngā Manu is an ongoing programme, started in 2013, to protect New Zealand’s most at-risk native animals. It is supported by a research programme to assess and improve the effectiveness of 1080 operations at killing pests. This research involves collecting and collating all information on 1080 operations and the changes in pest abundances that occur during and after operations, and using statistical tools to identify important factors affecting the success of 1080 operations. Results are fed into the Tiakina Ngā Manu programme as changes to DOC’s 1080 best practice.</p>

Status	Organisation(s)	Project
Ongoing	Eco-Land Limited	<p><b>Development, manufacture and commercialisation of enviroMate100, an automatic lure and toxin delivery system</b></p> <p>Eco-Land Limited has developed a ground-based pest management system that enables lure and toxin delivery to be predetermined using time control. The system is contained within a segmented weatherproof bait station. Acutely delivered cyanide paste and capsules are used to control possums, while first-generation rat and mice bait is used in wheat, paste or sachet form to deliver lethal doses without encouraging hoarding or expedient consumption. Secondary by-kill of mustelids and cats may result, depending on the toxin used. The automated system may be used in landscapes of scale with toxin, or in combination with traps. It can also deliver wasp bait.</p>
<b>Monitoring the recovery of pest species</b>		
Ongoing	TBfree DOC	<p><b>Mast stoat control – does aerial 1080 control stoats above the treeline?</b></p> <p>Since the project's initiation in 2014 a network of tracking tunnels has been established in the alpine environment, at both areas within a 1080 aerial operation zone (treatment site) and areas with no 1080 (non-treatment sites). This network is monitored. The study is still in progress. Some preliminary analysis indicates the use of aerial 1080 up to the treeline almost completely eliminates stoats above the treeline, at least in areas where the area of land above the treeline is relatively small.</p> <p>This is long-term research that is managed through monitored tracking tunnels.</p>
New and ongoing	DOC	<p><b>Improving small mammal monitoring to evaluate guild shifts at the forest-grassland interface following predator control</b></p> <p>The goal of this project is to improve small mammal predator monitoring capability beyond rodents and mustelids to enable an improved understanding of predator behaviour. Researchers seek to determine the frequency, duration and intensity of camera monitoring needed to evaluate spatial and temporal patterns in relative abundance of a suite of small mammals in beech forest and adjacent grassland. This may aid understanding of the influence of rat, rabbit, and/or hare abundance on mustelid and cat abundance in grasslands adjacent to forests, and whether guild shifts occur in small mammalian predators in beech forest and adjacent grassland following predator control.</p> <p>The work is ongoing, and currently in the data collection phase.</p>
Ongoing	DOC	<p><b>Mast large 1080 block – does aerial 1080 control over large areas slow re-population by predators?</b></p> <p>This ongoing long-term research project is managed through monitored tracking tunnels. Some results from this work will be included in a forthcoming research paper on whio (blue duck) in Kahurangi National Park.</p>
New	ZIP PF2050	<p><b>Landscape-scale research and development to completely remove possums</b></p> <p>Work is under way to develop cost-effective approaches for wide-scale possum eradication using aerial 1080, preventing possum reinvasion, and assessing the utility of these approaches for rat and stoat management. Planned outcome: Understanding whether aerial 1080 can reliably eradicate possums at scale.</p>

Status	Organisation(s)	Project
<b>Impact on non-target species</b>		
New and complete	OSPRI Manaaki Whenua – Landcare Research	<p><b>Testing Pest Control Research (PCR) and Orillion cereal bait with deer repellent for palatability and efficacy against possums and ship rats</b></p> <p>Two formulations of deer-repellent cereal bait proposed for use in broad-scale possum and rodent control (while minimising the by-kill of deer) were tested for their palatability and efficacy on both captive wild-caught possums and ship rats. The two bait formulations were shown to be palatable to both species and both had a high efficacy against both possums and ship rats.</p>
New and complete	OSPR Manaaki Whenua – Landcare Research	<p><b>Testing efficiency of PCR 1080 baits on possums</b></p> <p>Pest Control Research (PCR) has been granted approval to produce 1080 cereal bait. The PCR bait, Pestex, was tested previously by Manaaki Whenua – Landcare Research and proved to be at least as palatable and effective as standard Orillion RS5 bait. The aim of this project was to replicate that test to confirm the result of previous testing and as a final check before broad-scale production begins. Testing showed that Pestex 1080 cereal bait was both palatable and effective for killing possums. Cereal baits containing deer repellent are routinely used in operations.</p>
New and complete	OSPRI Manaaki Whenua – Landcare Research	<p><b>Impact of aerial 1080 baiting with and without Epro deer repellent on a red deer and tahr population in Otago</b></p> <p>Although Epro deer repellent has proven to be effective in reducing by-kill of red deer elsewhere in New Zealand, its effectiveness has never been assessed in high-elevation South Island beech forest where food supplies are usually scarce and the deer are potentially hungrier. Researchers used trail cameras in areas subject to aerial 1080 baiting with and without Epro deer repellent, and in a similar area nearby where 1080 was not used. They compared the abundance of deer before and after the 1080 baiting.</p> <p>Adjusted for natural seasonal variation, deer abundance declined by about 90 percent in the areas baited with non-repellent bait compared to about 60 percent in areas baited with repellent bait. The results indicated the repellent was effective in substantially reducing deer by-kill, but did not prevent all deer by-kill in the study area (high-elevation beech forest).</p>
New	OSPRI Manaaki Whenua – Landcare Research	<p><b>Assessing trends in palatability to deer of deer repellent cereal baits in relation to exposure time (weathering)</b></p> <p>The aim of this project is to evaluate whether the effectiveness of different commercially available deer repellent cereal baits declines with increasing time (for example, due to longer exposure to field conditions, or weathering). One of two new potential repellents has been trialled with captive deer. It appeared to retain some repellence after two weeks of exposure but all of the bait was eaten after almost three weeks of weathering.</p> <p>The trial with a second new potential deer-repellent bait is ongoing.</p>
Discontinued	DOC	<p><b>Safe use of pre-feed in aerial 1080 possum control for tomtit populations</b></p> <p>This programme sought to assess the impact of aerial 1080 on tomtits using low-cost counting methods. After a few years of collecting data, it was decided that it is not possible to reliably answer this question with this tool. DOC has discontinued this research programme.</p>

Status	Organisation(s)	Project
Ongoing	DOC TBfree	<p><b>Ecological outcomes for birds of aerial 1080 baiting for pest control</b></p> <p>Population dynamics of some bird species (weka, kākā, tītipounamu (rifleman), toutouwai (robin) and ruru (morepork)) are being assessed from population studies of radio-tagged or banded birds. Three study sites were chosen: Lake Paringa, Tennyson Inlet and the Operation Kākā field site in the Tararua Range. Bird numbers, nesting success and survival of tītipounamu, kākā, weka, and ruru were monitored between 2010 and 2016. A total of six 1080 drops have been undertaken at these three sites. No 1080-associated deaths have been recorded for kākā, tītipounamu or ruru that were monitored through 1080 drops in South Westland. One weka death was recorded at Tennyson Inlet. A few native forest bird species are significantly more abundant in those parts of the Paringa study area that have been regularly treated with aerial 1080 than in those that have never been treated. No bird species are significantly less abundant in the treated area.</p> <p>Field work for this project has been completed. A publication on ecological outcomes for weka was published in 2018 (Tinnemans et al., 2018) and a paper on whio is scheduled for publication in 2019. Papers on ruru, tītipounamu, toutouwai and kākā are still in progress.</p> <p>In conjunction with this project, a related ongoing project is under way titled “Does productivity and survival of whio through a breeding season differ before and after aerial 1080 predator control?”</p>
Ongoing	DOC	<p><b>Does pīwauwau (rock wren) nesting success improve as a result of mast-driven predator control above the tree-line?</b></p> <p>This study investigated whether increasing the survey interval and spatial distribution of footprint-tracking tunnels increased sensitivity for the detection of mustelids, rats, and mice. It also found that aerially applied 1080 effectively reduced mustelid abundance in forested and alpine areas. Mice were found in this study to be unaffected by aerially applied 1080. The research also established that 21-night surveys were more sensitive than the established best practice three-night survey for mustelids in forested and alpine areas, and for rats and mice in alpine areas. The research also found aerially applied 1080 was also effective at controlling mustelids above the tree line, even when only sown to the treeline.</p> <p>The reproductive success, survival and population trends of the endangered alpine pīwauwau was intensively monitored in areas with and without 1080 predator control. Landscape scale aerially applied 1080 poison effectively reduced alpine predator abundance and resulted in substantial increases in nesting, survival and territory occupation estimates for pīwauwau, resulting in population increases where pīwauwau occur. These positive effects lasted for at least two years. The potential by-kill risk to pīwauwau was determined to be low. Alpine predators and pīwauwau were also monitored at sites without 1080 management. Monitoring at these sites indicates a higher relative abundance of mustelids and poor reproductive success in pīwauwau – an 86 percent total population decline of pīwauwau was observed at the non-treatment site in the two years following the 2014 beech mast.</p> <p>This research is ongoing.</p>
Ongoing	DOC	<p><b>Do mast-driven 1080 operations increase great spotted kiwi chick survival enough that kiwi populations increase?</b></p> <p>Research is ongoing.</p>

Status	Organisation(s)	Project
Complete	DOC	<p><b>Does mast-driven predator control maintain mōhua populations at treated sites?</b></p> <p>Research has concluded. No publications have been produced at this stage.</p>
Ongoing	DOC	<p><b>Does mast-driven predator control maintain long-tailed bats at treated sites?</b></p> <p>This mark-recapture study has been going on since 1993, looking at the survival of long-tailed bats in response to predator control (Pryde et al., 2005; O'Donnell et al., 2017). Over this period there has been a variety of toxins used in bait stations for rat control as well as stoat trapping.</p> <p>The programme has now moved onto a landscape focus, primarily using aerial 1080.</p>
Ongoing	DOC	<p><b>Does mast-driven predator control maintain short-tailed bats at treated sites?</b></p> <p>This mark-recapture study has been going on since 2006 when there were initial trials to test the effectiveness of inserting transponders into short-tailed bats as an individual marking technique. This was very successful and allowed researchers to look at the response of short-tailed bats to predator control. Publications so far have looked at the risks and benefits of toxins to short-tailed bats (Edmonds et al., 2017; O'Donnell et al., 2011).</p>
Fieldwork complete, study ongoing	DOC	<p><b>Effects of aerially applied 1080 on kea populations</b></p> <p>Researchers monitored kea productivity and survival in places where predators were controlled by aerial 1080 to assess the impact of aerial 1080 on kea. They estimated productivity by radio-tracking adult kea and then finding and monitoring their nests. They also estimated survival through 1080 operations and over longer periods through regular monitoring of radio-tagged birds. Productivity was estimated at two sites on the West Coast and survival at 10 sites throughout the South Island. A total of 222 birds and 47 nests were monitored. The field work was undertaken between 2009 and 2016. Two peer-reviewed papers were published in 2018 (Kemp et al., 2018) and 2019 (Kemp et al., 2019).</p> <p>Aerially applied 1080 dramatically increased the productivity of kea by reducing the rate of predation of their nests. Some kea were found to have been killed by 1080 but researchers found kea survival was high at sites remote from human habitation, and after repeated use of the poison. This is best explained by innate neophobia (fear of new or unfamiliar things) of kea, protecting “remote” kea from being killed by 1080. Kea close to human habitation are constantly exposed to novel and rewarding foods, lose their neophobia and are at much higher risk of being poisoned. The research suggests kea deaths during 1080 operations could be minimised by discouraging kea from frequenting human habitation – for example, a “don't feed the kea” campaign.</p> <p>The researchers intend to publish one further paper assessing the overall impact of 1080 on kea through a modelling exercise.</p>

Status	Organisation(s)	Project
Ongoing	OSPRI	<p><b>Long-term bird population trend monitoring using automatic bird recorders in Hokonui Forest 2013–2022</b></p> <p>This research aims to record what happens to bird population dynamics over the long term when aerial operations occur. Acoustic recorders have been used at two Southland sites, one of which was aerially treated in 2014. The project was initiated by iwi concerns over the use of 1080 and its potential to impact on bird populations, then became a requirement of the resource consent conditions of use. Six years of the 10-year study have been completed and results to date have satisfied iwi concerns.</p>
Ongoing	OSPRI / Victoria University of Wellington	<p><b>Biodiversity response to possum control in Aorangi and Haurangi forests 2012</b></p> <p>This research aims to determine the incidental population-level effects of 1080 possum control on a range of small mammals (rodents and mustelids) and the concomitant response of a range of biodiversity indicators, primarily birds and large invertebrates (beetles, weta, and spiders) in the Aorangi forests of southern Wairarapa. Five sites have been monitored regularly since 2012, two years prior to the first application of 1080 within the 10-year TBfree programme.</p>
New and complete	ZIP	<p><b>Tahr carcasses as an attractive, preferred food for wild kea</b></p> <p>Two trials were undertaken in 2018 to evaluate the potential of using tahr carcasses as a more attractive and preferred food source than cereal bait. The footage captured during both trials demonstrated a high level of kea activity at tahr carcasses relative to bait. The authors concluded that tahr carcasses are indeed a food source that kea find highly attractive. This may be unsurprising given past anecdotal accounts but until now had not been quantified (Nichols and Bell, 2019).</p>
New and complete	ZIP Orillion	<p><b>Kea conditioned aversion to cereal bait: a captive study using anthraquinone</b></p> <p>This study examined the potential for captive kea to develop conditioned aversion to cereal baits through repeated exposures to non-toxic pre-feed cereal baits laced with a concentration of 2.7 percent anthraquinone by weight. The cereal baits used in this trial were manufactured by Orillion and dyed green to mimic the appearance of toxic baits.</p> <p>Results indicated that repeated exposures of captive kea to the anthraquinone-laced bait reduced the consumption of standard non-toxic baits encountered in subsequent presentations. This suggests that the risk to kea from aerial operations may be mitigated by exposing resident kea to anthraquinone-laced pre-feed bait.</p> <p>A parallel study assessing the repellent effect on possums demonstrated that exposure to anthraquinone-laced bait can result in bait-averse possums. This suggests that anthraquinone-laced baits should not be applied within the altitudinal range of possums. ZIP subsequently field-tested this approach in conjunction with a predator removal operation in South Westland, using tahr carcasses as site attractants, to increase the likelihood of kea being exposed to the anthraquinone-laced baits above the altitudinal treatment boundary.</p>

Status	Organisation(s)	Project
New	OSPRI Manaaki Whenua – Landcare Research	<b>Deterring kea from eating 1080 baits</b> This research is aimed at identifying an effective kea repellent. Although the key question is ultimately whether kea can be deterred from eating green-dyed cereal 1080 baits, an equally important question is whether adding the proposed repellents might reduce control efficacy against possums and rats. Until now addressing the latter question has involved cage trials, in which captive possums were offered non-toxic baits containing three known bird repellent compounds at a range of concentrations. So far researchers have identified one candidate bait formulation that warrants field testing of its efficacy against possum and rats.
<b>Other</b>		
New	DOC MPI	<b>Risk profile of 1080 with respect to freshwater wild food species</b> This project will generate a risk profile of 1080 with respect to freshwater wild food species including: <ul style="list-style-type: none"> <li>• fish such as eel/tuna, tunaga (<i>Galaxias</i> spp.), trout, salmon and other fish, that spend all or part of their life-cycle in freshwater eg, patiki mohoao (flounder), piharau (lamprey), perch and tench,</li> <li>• invertebrates (kōura/kēwai (freshwater crayfish), freshwater mussels (kākahī)</li> <li>• plants (kowhitihiti).</li> </ul> The risk profile includes a summary of the data gaps and proposed research path to improve future human exposure or risk assessments of 1080. The project started in August 2018, and currently is at the final peer-review stage.
New	PF2050 Ministry for Business, Innovation and Employment DOC Manaaki Whenua – Landcare Research	<b>Social research on novel pest control methods</b> Focus groups, funded by the New Zealand’s Biological Heritage National Science Challenge and DOC, are assessing public acceptance of innovative technologies to control pest species. Planned outcome: Social licence to operate guidance provided to inform future research.
Ongoing	OSPRI Manaaki Whenua – Landcare Research	<b>Development of alternative methods for reaching TB freedom in remote iwi land without aerial 1080</b> This research, started in 2017, aims to identify the most cost-effective combination of sentinel surveillance for the presence of TB with ground-based possum control and concurrent TB surveys. It aims to develop new approaches to eliminating TB in deep forest areas where consent to use 1080 cannot be easily obtained. TB surveillance has been initiated and small scale leg-hold and kill trapping trials have been conducted to identify optimal spacing for the combined control and TB surveillance. A further trial using cyanide poison and ground-laid 1080 is ongoing. The field trial results will be used with results from epidemiological modelling to identify the most cost-effective approach to eliminating TB in such areas by 2021.
Ongoing	OSPRI University of Otago	<b>Characterising detoxification enzymes in New Zealand possums to increase the specificity of existing toxins</b> This study identified possum-specific enzymes that might be used to increase 1080 toxicity to possums and/or to develop novel toxic compounds.

Status	Organisation(s)	Project
Ongoing	ESR Ministry of Health	<p><b>Study on 1080 dust drift</b></p> <p>Concerns were raised about the possibility of wind-blown 1080 dust being carried beyond designated drop zones. In 2016 the Institute of Environmental Science and Research (ESR) undertook a pilot study of a single 1080 drop to test methods for monitoring dust from aerial 1080 operations. The findings of the study are inconclusive for reasons explained in the report, which can be accessed on ESR website.</p> <p><a href="#">A scoping study characterising dust drift from aerial application of 1080: Waimea Kawhaka, November 2015"</a></p> <p>At the time of publication this work was ongoing.</p>

## Manufacturers' research projects in 2018

### Orillion

Orillion is working on research projects in the area of repellents for non-target species, improved bait acceptance by target animals and alternative toxins which could potentially replace 1080 for some of the broad scale aerial operations (and substantially eliminate non-target risk). Their focus is on repellents for aerial baits and research around bait palatability, lures, new toxins and coatings.

Orillion continues to investigate the type and level of hazard associated with the storage of 1080 baits in bait stores, more precise bait production equipment and worker exposure risk around 1080. Orillion has made progress to eliminate 1080 dust in the factory at the time of packing, using a system that recycles any dust generated or simply immobilising it on filters. It is making a significant investment into a safer method for mixing 1080. Orillion continues to work with its science partners at Manaaki Whenua – Landcare Research, DOC and MPI to improve the knowledge, safety and cost effectiveness of manufacturing, using and storing 1080 baits.

### Pest Control Research Limited

Pest Control Research is continuing an extended programme of research and development that includes work on repellents to reduce adverse effects on non-target organisms. One product has a provisional registration from ACVM and limited field trials are currently under way.

11 <https://www.esr.cri.nz/assets/Uploads/FW15060-1080-dust-report-FINAL-web.pdf>

# Research projects since 2007

Past annual reports on the aerial use of 1080 formulated baits have provided a research summary for the calendar year, with many of the projects ongoing and spanning several years. This report aims to present a more extensive follow-up of these projects, and the longer-term outcomes that were obtained from that research.

The following tables present a summary of research completed since 2007, the outcome of each project, and reflections on the current usage of the knowledge acquired or product developed. The list was finalised in August 2019 by scientists at the EPA. Feedback on any studies or research missing from this list is welcome so it can be incorporated into subsequent reports. Email: [info@epa.govt.nz](mailto:info@epa.govt.nz)

## Alternatives to the use of 1080

Since our reassessment in 2007 the majority of research on the alternatives to 1080 has focused on the development of alternative toxins and the assessments of these toxins with regards to efficacy, risks to non-target species, and humaneness. The toxins studied include cholecalciferol, sodium nitrite, zinc phosphide, cyanide, and para-aminopropiophenone (PAPP). The research is summarised in Table 4.

Alternatives such as vaccines have also been investigated and are summarised in Table 5.

Research into traps that do not use toxins and non-toxic lures has been conducted over this time period, however these studies fall outside the scope of this report.

**Table 4: Alternative toxins for pest control**

Organisation(s)	Years	Detail of research and outcome
<b>Colecalciferol (also known as vitamin D3 and colecalciferol)</b>		
Animal Health Board <sup>12</sup> Pest Control Research	2008–2011	<b>Cholecalciferol – an alternative to 1080 for aerial application?</b> Field trials were conducted to determine whether a toxin and bait type other than 1080 could be used in aerial operations that covered gorse and blackberry. It was found that cereal baits containing cholecalciferol (Kolee) might be a suitable alternative to 1080 for aerial application. A field trial to determine the efficacy of aerially applied Kolee in 2011 revealed a kill rate of approximately 60 percent. Kolee baits are not yet commercially available.
Animal Health Board Connovation	2008–2011	<b>Low dose cholecalciferol baits for possum control and multi-species control</b> A new formulation of the paste-bait Feracol, containing less cholecalciferol, was shown to kill possums effectively and humanely. HSNO approval was obtained in February 2011 (Approval code: HSR100456). Feracol is now used routinely for possum control in bait stations.
Animal Health Board Manaaki Whenua – Landcare Research	2009–2013	<b>Optimising the combination of cholecalciferol and aspirin</b> Researchers sought to improve the use of cholecalciferol for possum control by establishing the minimum concentration that, in combination with aspirin (as a synergist to improve effectiveness of the poison) and masking additives, is palatable and effective. Results suggest that the combination is potentially highly cost-effective and is expected to improve the humaneness of controlling possums with cholecalciferol baits (Morgan et al., 2013). The effect of the combination in non-target species has yet to be tested.
Animal Health Board Pest-Tech Limited	2009	<b>Registration of a new chronic poison</b> This research aimed to register a toxic bait that contains cholecalciferol in combination with the anticoagulant coumatetralyl. The combination, known as C+C, is used in Europe to overcome anticoagulant resistance in rats and mice. The research determined that there was negligible risk to large birds and low risk to small passerines (perching birds). The secondary poisoning risk to dogs was also considered to be low. However this research was discontinued to pursue a less persistent and more palatable bait containing 0.06 percent cholecalciferol and 0.03 percent diphacinone (C+D).
DOC Lincoln University	2009–2012	<b>Establishing baseline concentrations of cholecalciferol in animals</b> A metabolite of cholecalciferol was analysed as a biomarker to determine a baseline for naturally occurring cholecalciferol in cattle, sheep, pig, deer, dogs, and cats. The authors concluded that this method can be used to determine non-target exposure to cholecalciferol-containing poisons and suggest that further research is required for better determination of concentrations (Fairweather et al., 2013).

12 The Animal Health Board was the entity responsible for the National Pest Management Plan. It was succeeded by TBfree New Zealand.

Organisation(s)	Years	Detail of research and outcome
<b>Cyanide</b>		
DOC Regional councils Connovation	2007–2012	<p><b>Extending the registration of Feratox to include the control of wallabies</b></p> <p>Researchers sought to provide data to support extension of the ACVM registration of cyanide pellets to include wallabies as a target species so that the pellets (Feratox) could be used as an alternative to 1080. Pen and field trials were undertaken to provide safety and efficacy data. The data showed that the cyanide pellets killed wallabies effectively and humanely. Field work was completed in 2010 and ACVM approved the product for this additional use in early 2012. Feratox pellets remain on the market.</p>
Animal Health Board Connovation	2008–2010	<p><b>Cyanide pellets for the control of feral pigs and ferrets</b></p> <p>Field trials have been completed. While cyanide is more humane than other toxins, both pigs and ferrets avoided the cyanide so further development of cyanide-based products has ceased.</p>
<b>Sodium nitrite</b>		
Animal Health Board Regional councils Connovation	2008–2011	<p><b>Red blood cell toxins for feral pigs and possums</b></p> <p>Pen and field trials with pigs were undertaken with an encapsulated formulation of sodium nitrite (NaNO<sub>2</sub>) mixed into a palatable paste bait (Shapiro et al., 2016a). Data from these studies was used to register this bait as a vertebrate toxic agent for feral pig management in New Zealand, representing the first known registration of NaNO<sub>2</sub> worldwide for use as a VTA.</p> <p>NaNO<sub>2</sub> paste, known as Bait-Rite Paste, has also been registered for controlling possums. In no-choice cage trials, 12 out of 12 possums consumed a lethal dose of toxic paste bait and died on average after 95.6 minutes (±4.9 SE). In two-choice cage trials seven out of eight possums consumed a lethal dose of toxic paste bait and died on average after 96.7 minutes (±11.4 SE). Two field trials targeting possums using this toxic paste in bait stations reduced their abundance by 81.2 percent (± 2.5 percent SE) and 72.7 percent (± 1.6 percent SE) respectively (Shapiro, MacMorran, et al., 2016). Cage trials with sodium nitrite have shown it does not cause secondary poisoning of dogs, cats or birds (Shapiro et al., 2018).</p>
Animal Health Board Connovation	2010	<p><b>Aerial application of a new toxin in solid bait for possum control</b></p> <p>The project was discontinued in 2010 due to stability issues with sodium nitrite.</p>
Animal Health Board Connovation	2011–2014	<p><b>Primary poisoning risk to non-target species and fate of sodium nitrite in baits for possum control</b></p> <p>Researchers assessed acute toxicity of sodium nitrite (NaNO<sub>2</sub>) in chickens and domestic mallard ducks by oral gavage (force-feeding) and in free-feeding trials with chickens, domestic mallard ducks, pigeons, budgerigars and wētā. Of the birds presented with toxic baits only one duck consumed a lethal dose of paste bait. There was no evidence of wētā feeding on toxic baits (Shapiro et al., 2017).</p> <p>Sodium nitrite was registered with ACVM as Bait-Rite Paste on 16 January 2014.</p>

Organisation(s)	Years	Detail of research and outcome
<b>Para-aminopropiophenone (PAPP)</b>		
DOC Connovation	2008–2011	<p><b>PAPP trials – an alternative control toxin for cats and stoats</b></p> <p>Four PAPP field trials tracked stoats and feral cats to provide data to support an application to ACVM to register the new red blood cell toxin PAPP for control of stoats and feral cats. The results showed that after five nights of PAPP baiting, tracking rates for stoats were down to 10–16 percent and that PAPP had killed over 80 percent of feral cats. This was the first new vertebrate pesticide registered for 30 years (Murphy et al., 2011; Eason et al., 2010a; Dilks et al., 2011; Shapiro et al., 2010).</p> <p>The non-target impacts to Australian magpies, blackbirds, mallard ducks and weka were assessed, and LD50 values were established for these species (an LD50 value is the average dose that is fatal for a particular species). The authors concluded that while birds are less susceptible to PAPP than stoats or feral cats (LD50 for both of these species is less than 10 mg/kg), some bird species were adversely affected, so it will be important to limit their exposure (Eason et al., 2010b).</p> <p>Further research on PAPP is ongoing in other projects, such as its use in the toxin delivery device described in Table 3. It is commercially available as a paste that is combined with minced meat for use in bait stations.</p>
<b>Zinc phosphide</b>		
Animal Health Board Pest-Tech Limited Connovation CE Research Associates	2007–2017	<p><b>Developing and registering a new cereal bait containing zinc phosphide for possum control</b></p> <p>These projects aimed to seek HSNO approval for microencapsulated zinc phosphide as a poison for vertebrates. Data was collected and submitted, and approval was granted under the HSNO Act in 2011 for a raw material and paste bait (Approval codes: HSR100556/HSR100557). This project was later discontinued due to manufacturing issues with the stability of the zinc phosphide toxin, and health and safety concerns with the manufacturing of the encapsulated zinc phosphide.</p>
Animal Health Board CE Research Associates	2010–2013	<p><b>Underpinning zinc phosphide use in New Zealand</b></p> <p>Research underpinning the use of zinc phosphide found the main advantage to be a reduced risk of secondary poisoning, likely to be considerably lower than that of 1080. Despite low secondary poisoning risks, this research found it has the potential to cause primary poisoning of non-target species and treatment of accidental poisoning is difficult (Eason et al., 2013).</p>
Animal Health Board Connovation	2011–2017	<p><b>Researching safe and effective use of zinc phosphide paste baits for controlling possums</b></p> <p>Zinc phosphide paste baits were registered with ACVM but discontinued due to health and safety concerns with the manufacturing of the encapsulated zinc phosphide.</p>
<b>Other</b>		
Animal Health Board CE Research Associates	2010–2012	<p><b>Staying proactive and reducing non-target risk</b></p> <p>This research sought to clarify New Zealand-based non-target toxicity research and testing requirements for new vertebrate toxic agent product registrations for possums and TB vectors. A review of non-target toxicity testing of vertebrate pesticides was published with suggested testing guidelines (Eason et al., 2013).</p>

Organisation(s)	Years	Detail of research and outcome
Animal Health Board Connovation	2009–2010	<b>Death by chocolate</b> Chocolate, methylxanthines and/or caffeine did not prove humane or effective for possum control.
DOC CE Research Associates	2008–2009	<b>A re-evaluation of potential rodenticides for aerial application</b> Researchers sought to identify an existing rodenticide that could be aerially applied as an alternative to 1080. The review outlines the advantages and disadvantages of various rodenticides and their suitability for aerial application. The authors concluded that diphacinone (an anticoagulant) is the logical first choice as an alternative to 1080 for rodents, followed by cholecalciferol (Eason and Ogilvie, 2009).
DOC	2008–2011	<b>Diphacinone and coumatetralyl persistence in deer</b> This study gathered information about effects on deer from residues of sub-lethal doses of diphacinone and coumatetralyl. Three deer were sub-lethally dosed with diphacinone and three with coumatetralyl. The research found it took longer for coumatetralyl to be eliminated from the deer's system than diphacinone. Residues were still present in liver tissue after 50 days versus 12 days for diphacinone. The study concluded that bioaccumulation on repeated field use is unlikely (Eason et al., 2011).
MBIE Lincoln University Connovation	2008–2011	<b>Red blood cell toxins for rodents</b> This research into novel candidates for rodenticide was discontinued. Researchers were unable to develop the red blood cell toxins in a form that was suitable for cage or field use under normal operating conditions.
DOC Pest Control Research	2006–2008	<b>Environmental fate of toxicants used for mouse, rat, and possum control</b> This study aimed to determine toxin breakdown of baits containing diphacinone (RatAbate Paste) and coumatetralyl (Racumin Paste) and estimate potential risks to non-target species. The results from this study largely showed that RatAbate and Racumin will retain their toxicity for at least 12 months provided they are protected from the weather in rat and/or mouse specific bait stations.
AHB Connovation	2009–2010	<b>Natural plant toxin for pest control</b> Research found that the estimated cost of a natural plant toxin would be 1,300 times greater than for synthetic 1080. Given the very high cost compared with synthetic 1080 this approach was not considered to be a viable option.
AHB National Research Centre for Possum Biocontrol (NRCPB) University of Otago AgResearch	2007–2010	<b>New possum-specific toxins</b> Researchers sought to find a possum-specific toxin that does not affect other species. They investigated compounds that induce the secretion of water across intestinal tissue in possums, an effective way of killing animals very quickly. Later research included screening more than 90,000 compounds for their ability to switch on one of the transporters involved in secretion in possums. This identified 987 compounds with potential. A secondary dose-response screening identified the 45 best bet compounds, 10 of which have been used in an array of in vitro tests. All showed high potential for use as toxins, however programme funding ended 30 September 2010.

**Table 5: Non-VTA alternatives to 1080**

Organisation(s)	Years	Detail of research and outcomes
AHB Manaaki Whenua – Landcare Research	2004–2017	<p><b>Orally delivered Bacille Calmette-Guerin vaccine</b></p> <p>Researchers sought to establish whether an orally delivered Bacille Calmette-Guerin (BCG) vaccine could be used to protect possums from TB. Possums were trapped and orally vaccinated with BCG vaccine. Significantly fewer TB cases were recorded in vaccinated possums (1/51) compared with control animals (12/71). Vaccine efficacy was estimated at 95 percent for females and 96 percent for males (Tomkins et al., 2009). The research has been published in two international journals (Nugent et al., 2017; Nugent et al., 2016). However, the research has not progressed to further trials or use in the field as OSPRI has (since 2016) adopted the goal of completely eradicating TB from New Zealand suppression of TB by vaccination is no longer a relevant strategic approach to management of TB in livestock. Eradication of TB in possums by vaccination would be both prohibitively expensive and take a long time relative to lethal control of possums.</p>
AHB Manaaki Whenua – Landcare Research	2008–2010	<p><b>Vaccinated buffers for managing possums in forest areas</b></p> <p>This study aimed to evaluate the idea of using a vaccinated buffer which would involve vaccinating possums that live near farmland against TB. The vaccinated possums present would act as a buffer to discourage unvaccinated possums moving into the area. The study sought to compare this against a poisoned buffer, which is an area where the possums have been reduced or eradicated.</p> <p>Researchers used GPS collars to monitor movements or reinvasion rates of adult possums in two areas of mixed beech forest in the Kaimanawa Range over 12 months. One area had no possum control (emulating a vaccinated buffer of resident animals) and the other area was next to a strip where the possum population had been reduced to very low levels by 1080 poisoning (a poisoned buffer). Possums in the uncontrolled buffer zone moved shorter distances than those in the area next to the poisoned buffer zone. This indicates that buffers could be narrower if vaccination was used (Pech et al., 2010).</p>
AHB FRST Manaaki Whenua – Landcare Research	2009–2010	<p><b>Possum fertility control vaccines</b></p> <p>Trials showed that fertility control vaccines were able to stimulate antibodies in female possums. The results, while promising, were not sufficiently effective for field use as fertility control agents in wild possum populations and further improvements were required. This research also assessed the potential of a replication-limited recombinant vaccinia virus (recVV). When recVV was applied on possums (to simulate eating bait) a single dose elicited an immune response in most animals. The next step would be to modify the virus and study the long-term fertility and immunity responses.</p> <p>This technology shows potential for the delivery of fertility or disease control vaccines to wild possums and vertebrate pests such as wallabies, stoats and rabbits. Funding for this project finished in 2010 and no further work has been conducted.</p>

## Optimising the use of 1080

We have summarised the research into the optimal use of 1080 in four categories: improving operational procedure, improving the targeting of pest species, minimising impacts on deer, and minimising impacts on birds. If a project fits into more than one category, we have summarised it under the most appropriate category.

**Table 6: Projects aiming to make improvements to and optimise the use of 1080**

Organisation(s)	Years	Details of research and outcome
<b>Improving operational procedures</b>		
AHB Manaaki Whenua – Landcare Research	2006–2010	<p><b>Local elimination: tracking and ground control as an alternative to repeat aerial sowing of 1080</b></p> <p>This project sought to reduce the aerial use of 1080 by researching other ways to eliminate possums from an area. It assessed the effects of pre-feeding, localised baiting regimes in place of repeated 1080 broadcast-sowing operations, and the use of long-life cholecalciferol gel baits for perimeter control. Modelling suggested pre-feeding before aerial 1080 poisoning would be cost-effective over a 30-year timeframe because it would probably reduce the need for repeat operations.</p> <p>The researchers suggested that allowing gaps of up to 120 metres between baited areas could reduce the sowing rates required. For areas where aerial 1080 cannot be used and which are accessible on foot, cyanide and cholecalciferol were successfully used to reduce possum numbers, albeit at a higher cost. A ground-based detection and mop-up strategy potentially provides an alternative to aerial 1080 poisoning for areas accessible on foot and where possum numbers are already low. This strategy is currently limited by low success in killing possums at detection sites.</p> <p>This study also found that reducing the speed of aerial bucket spinner attached to the helicopter (or removing the spinner altogether) reduces fragmentation of broadcast 1080 bait, reducing the risks to non-target species (Nugent et al., 2010).</p>
DOC	2009–2017	<p><b>Achieving multi-pest control by pre-feeding with non-toxic baits</b></p> <p>The first study of the effects of pre-feeding on possums and ship rats was completed in June 2009. This showed pre-feeding ensures effective control of ship rats and low rates of pre-feeding (200 pellets per hectare) were equally as effective as high rates (400–1,000 pellets per hectare). The rates of repopulation by rodents and stoats after aerial 1080 operations were monitored. A database of this information was established from over 30 case studies over a range of forest types. No official work has been conducted on this project since 2011 as funding ceased.</p>
DOC Manaaki Whenua – Landcare Research	2008–2009	<p><b>Effect of pre-feeding and 1080 concentration on bait acceptance by house mice</b></p> <p>This study suggested that wild-caught house mice can rapidly identify and avoid food containing 1080. This feeding response partly explains the variable success of 1080 baiting operations against wild mouse populations (<i>M. musculus</i>) in New Zealand (Fisher et al., 2009).</p>

Organisation(s)	Years	Details of research and outcome
AHB Manaaki Whenua – Landcare Research	2008–2015	<p><b>Using less 1080, cluster sowing and pre-feeding, low-cost aerial baiting</b></p> <p>Researchers sought to establish whether the 1080 sowing rate could be reduced by 92 percent without compromising effectiveness (Nugent and Morriss, 2013). Trials conducted up until 2015 showed that very high kills can be achieved at sowing rates as low as 300 g/ha by sowing bait in clusters instead of evenly distributing it. However, in recent years the pest control goal for possums has moved from management of TB to eradication. The approach of using cluster sowing has not been operationalised for three reasons.</p> <ul style="list-style-type: none"> <li>• Improvements in bait manufacturing processes have reduced the level of bait fragmentation, so ability for cluster sowing to deliver a lethal amount of toxin is not as important as it once was.</li> <li>• Rat densities are sometimes extremely high and home ranges very small, so leaving gaps in bait coverage through cluster sowing can sometimes result in poor rat control outcomes.</li> <li>• A shift toward the aim of guaranteeing achievement of extremely high kills (&gt;99 percent) for either rapid eradication of TB or to locally eradicate possums and rats has led to use of moderate sowing rates rather than very low sowing rates that might sometimes result in poor kills.</li> </ul> <p>Nonetheless, the demonstration that low sowing can be effective has supported the ongoing reduction in sowing rates, with sowing rates as little as 1.0 kilograms per hectare (kg/ha) now commonly used.</p>
AHB Manaaki Whenua – Landcare Research	2009–2013	<p><b>Better aerial baiting systems and strategies</b></p> <p>A prototype sowing bucket for aerial GPS-controlled baiting at low application rates was designed, tested and further refined. However, it is now no longer used operationally. The bucket was developed to help achieve sowing rates as low as 0.17 kg/ha, which is much lower than the now-normal range of 1–2 kg/ha for control and 4–8 kg/ha for local elimination of rats. See above for the reasons the bucket is not used operationally.</p>
TBfree Manaaki Whenua – Landcare Research	2010–2015	<p><b>Halving the cost of ground control</b></p> <p>Researchers investigated a new approach to ground-based control that combined aerial distribution of non-toxic pre-feed baits followed by sparse ground-distribution of toxic baits at regular intervals along the GPS tracked pre-feeding flight paths. This approach was tested in two field trials in which both 1080 baits and cholecalciferol baits were used in separate areas. By measuring the time taken to complete ground baiting from GPS tracks, the study predicted that the combined aerial and ground-distributed 1080 method would be similarly cost effective to aerial 1080 operations for controlling possums and rats, and considerably less expensive than ground-based control. The main limitations to the use of the method are the access to and the size of the operational site, along with topography and vegetation density (Morgan et al., 2015).</p>

Organisation(s)	Years	Details of research and outcome
TBfree Manaaki Whenua – Landcare Research	2012–2017	<p><b>Optimal size of cereal pellet baits for aerial control of possums: A field study</b></p> <p>This research aimed to identify the minimum effective size for cereal baits used in pre-feed aerial baiting. Results showed that smaller bait is generally effective, but not all animals ate the entire lethal dose at once. It also found that possums that had been repeatedly exposed to 1080 were more cautious feeders compared to possums that had not been repeatedly exposed. The researchers concluded that the current bait size is operationally the best fit.</p>
ZIP DOC	2016–2017	<p><b>1080 to zero</b></p> <p>ZIP has investigated a modified approach to the aerial application of 1080 that aims to completely remove (rather than suppress) possums and rats from large mainland areas of New Zealand. This comprises pre-feeding the area twice (as opposed to once in a standard operation), overlapping the sowing of pre-feed and toxic baits, and using twice the amount of 1080 (compared to a standard operation). The model was trialled in 2016/2017 in a 1,600 hectare site on Mount Taranaki, and in 2017 at a 2,300 hectare block at the confluence of the Jackson and Arahata rivers in South Westland.</p> <p>The Mount Taranaki trial resulted in a complete removal of possums. The results for rats were less conclusive, however the researchers suggest that the technique may be capable of completely removing rats. In South Westland, in the 55 days following application of 1080, no possums or rats were detected in the intensively monitored 394-hectare detection area. The possum numbers were high in the area before the operation, though the initial rat numbers were low. Some non-target deaths were observed, however the impact on these species' populations overall was considered low, and comparable to standard 1080 operations (Bell, 2017).</p>
TBfree Manaaki Whenua – Landcare Research	2010–2017	<p><b>Maintaining low possum and rat densities</b></p> <p>This project aimed to determine whether using low-intensity aerial 1080 poisoning applied at two-year intervals could maintain lower possum and rat densities over a four-to-five-year period compared to conventional five-yearly broadcast poisoning. It also sought to determine if it could achieve this at lower or comparable cost; and if this higher-frequency but lower-intensity method of control increased the abundance of small birds and wētā. Results suggest that low-sowing operations at shorter intervals are an effective possum control tool. However, this method appeared to be less effective on rodents. This was possibly due to the faster recovery of these populations after control, and/or due to the amount of bait laid not being sufficient to reduce the populations to very low levels.</p>

Organisation(s)	Years	Details of research and outcome
<b>Improving the targeting of pest species</b>		
AHB Manaaki Whenua – Landcare Research	2009–2015	<p><b>Effect of thermogenic compounds on bait acceptance and progression of 1080 poisoning in possums, rat and possum acceptance of thermogenic compounds in baits and commercial manufacturing to encapsulated 1080 bait</b></p> <p>Laboratory trials identified a thermogenic (heat-producing) compound acceptable to possums when used in cereal pellet bait, which produced increased metabolic rate after ingestion.</p> <p>Possums ingesting the compound and 1080 in bait subsequently spent less time in states associated with pain or distress and had a reduced time to death, compared with possums ingesting bait containing 1080 alone. Of the candidate formulations identified, one encapsulated formulation was shown to improve first-encounter bait acceptance and palatability, especially by ship rats. When included at a 2 percent concentration in 1080 pellet baits this encapsulated formulation retained the reduced times to death in both possums and ship rats, without reducing the efficacy of toxic bait.</p> <p>However, when manufactured using commercial bait production specifications of temperature and pressure, the test baits had low acceptance and very low palatability to both species, indicating that the commercial pelleting processes compromised the encapsulation coating to the extent that it no longer masked the taste of the compound.</p>
AHB Manaaki Whenua – Landcare Research	2009–2012	<p><b>Effect of rat interference on possum kill during aerial 1080 poisoning</b></p> <p>Researchers sought to determine whether the presence of high rat numbers reduces the percentage of possums killed when 1080 bait is aerially applied at much lower rates than current practice.</p> <p>In the first stage, rat populations were experimentally reduced by 16–75 percent in four test area, to test whether possum kills would be highest in the area with the fewest remaining rats. However, after aerial 1080 poisoning at just 0.25 kg/ha, no possums were detected in any of the test areas. In the second stage of this project, reduction in rat populations prior to possum control did not appear to have any effect on efficacy to possums when bait was sown at levels <math>\leq 0.7</math> kg/ha.</p> <p>Nonetheless, the researchers report that there remains circumstantial evidence from other trials suggesting that moderate or high rat densities may sometimes adversely affect possum control efficacy. The absence of any evidence of a rat interference effect in this study suggests that if such an effect is real, it is unlikely to involve bait depletion or interference.</p>
FRST Manaaki Whenua – Landcare Research	2009–2012	<p><b>Small mammal control</b></p> <p>This project aimed to reduce the cost and the amount of 1080 bait sown during aerial 1080 rabbit control operations, determine the extent to which anticoagulant residues are accumulating in wildlife, and determine if rodents in New Zealand are developing genetic resistance to anticoagulants.</p> <p>In winter 2011, five experimental treatments were trialled and kill rates compared with those for standard practice. The experimental treatments were as effective at killing rabbits as standard practice, but were 25–50 percent cheaper. A review of the basis for the standard 1080 baiting practice for rabbits at the time was produced (Nugent et al., 2012) and an evaluation of wildlife cameras for monitoring rabbits before and after control operations (Latham et al., 2012).</p>

Organisation(s)	Years	Details of research and outcome
<b>Minimising impacts on non-target species – deer</b>		
AHB Manaaki Whenua – Landcare Research Enviro Research Limited RMB Consultants and Epro Limited.	2008–2017	<p><b>Effects and effectiveness of deer repellent on non-target species during aerial 1080 poisoning</b></p> <p>The EPA-approved Epro Deer Repellent (EDR) as a coating for 0.15 percent cereal 1080 and pre-feeding baits for field trials in 2009 (HSNO approval number HSC000315). There has been a variety of projects to assess aspects of EDR.</p> <p>The impact on non-target species has been assessed for tomtits and kea. Mortality rates for tomtits were examined during an aerial 1080 operation using deer repellent in northern Otago. Results indicate no greater mortality of tomtits when EDR additives are used. This supports the findings of similar studies in 2003 and 2005.</p> <p>Captive kea displayed no preference for cereal baits with added deer repellent and preferred plain carrot bait over carrot bait with added deer repellent.</p> <p>Trials indicated that EDR-coated RS5 1080 cereal bait should not affect possum kill, but would reduce non-target deer kill. In one study in the Hauhungaroa Ranges, no dead deer were found in the areas treated with EDR bait, whereas 15 were found through systematic searches where standard bait was used. Another in the Blue Mountains that also involved pre-feeding with EDR-coated non-toxic cereal baits found that only 10 percent of deer were killed (compared with 2001, when 66 percent of the fallow deer population was found dead after an aerial 1080 operation in the same area).</p> <p>A study on sika deer indicated that EDR can be used to limit incidental by-kill of sika deer in poison control operations, in addition to its already known bait-aversion effects on red and fallow deer. This study also highlighted the use of trail cameras as a promising new means of monitoring changes in pest populations following poison baiting (Morriss et al., 2018).</p> <p>In Otago, a trail camera monitoring study of the impact of using aerial 1080 with and without EDR found that the repellent was somewhat effective in reducing by-kill of red deer and tahr. It was more effective on female red deer than males.</p> <p>Cereal baits containing deer repellent are now routinely used.</p>
AHB Manaaki Whenua – Landcare Research	2009–2010	<p><b>Welfare of wild deer – where does 1080 poisoning sit on a relative scale of welfare impact?</b></p> <p>This research could not be completed due to logistic and regulatory constraints. No data was generated to address questions around the humaneness of 1080 poisoning in deer.</p>

Organisation(s)	Years	Details of research and outcome
<b>Minimising impacts on non-target species – birds</b>		
DOC	2004–2013	<p><b>Operation Ark</b></p> <p>Operation Ark was an initiative that used intensive control, including aerial 1080 operations and trapping, at specific sites in the South Island. It aimed to protect vulnerable populations of endangered species – pekapeka (short-tailed and long-tailed bats), mōhua (yellowhead), whio (blue duck) and kākārīki karaka (orange-fronted parakeets) – by countering the effects of predator plagues in beech forests (Elliott and Suggate, 2007). After six years:</p> <ul style="list-style-type: none"> <li>• Whio (blue duck) populations were sustained at three sites, with increases most marked where there was egg removal, captive rearing and reintroductions of young birds;</li> <li>• Kākārīki karaka (orange-fronted parakeet) populations in the Hawdon and Poulter valleys and South Hurunui were stabilised and protected off-shore island populations established;</li> <li>• Mōhua (yellowhead) populations were stabilised or increased at all sites (Landsborough, Dart and Caples valleys, Blue Mountains and Catlins) and reintroductions to the Eglinton Valley and South Hurunui undertaken; and</li> <li>• Pekapeka (long-tailed and short-tailed bat) populations in the Eglinton Valley have stabilised or are increasing after the decline experienced when they were unprotected from rats in 2001–02.</li> </ul> <p>The findings from Operation Ark<sup>13</sup> have provided valuable input into the species management of other mainland sites around the country.</p> <p>One finding was that rat trapping was ineffective in protecting threatened species in plague situations, but aerially broadcast 1080 and variable-toxin bait stations were shown to reduce rat numbers sufficiently to protect bird and bat populations.</p> <p>This work also found that stoat trapping lines along river valley floors and in networks were successful at keeping stoat numbers down and enabling protected species recovery. The relationship between climate, beech seed and rat and stoat plagues is also now much better understood.</p>

13 Operation Ark research informed DOC's Battle for our Birds/ Tiakina Ngā Manu predator control programme.

Organisation(s)	Years	Details of research and outcome
TBfree DOC Manaaki Whenua – Landcare Research	2012–2015	<p><b>Development of a bird repellent to protect kea in aerial 1080 cereal operations</b></p> <p>Trials were conducted to test the effectiveness of bird repellents to use in cereal pellets at aerial 1080 operations to protect kea. Pen trials were conducted in 2013 with ship rats and possums to evaluate the palatability and efficacy of repellent pre-feed and 1080 bait (Cowan et al., 2015).</p> <p>In a case study at Otira, Central Westland, kea survival was monitored in an aerial 1080 operation where the repellent d-pulegone was used. Five kea died out of the 34 monitored kea present at the time of the operation. All of the dead kea had consumed 1080 pellets (Klink et al., 2015).</p> <p>The stability of repellents (d-pulegone and anthraquinone) in manufacturing and storage was monitored. The estimated rate of decay of d-pulegone in storage was such that none of the batches of bait met the operational target concentration at 4 to 12 weeks after manufacture. The study found the concentration of anthraquinone in one batch of repellent toxic baits did not decline over a six-month period (Crowell, Booth, et al., 2016).</p> <p>In an efficacy trial near Haast, West Coast, the proportional reduction in possum and rat population indices were monitored under two repellent treatments (one d-pulegone alone and one combined d-pulegone and anthraquinone) and in a standard 1080 treatment with no repellent. The combined repellent treatment was less effective for controlling rats than the standard 1080 treatment. All three treatments were effective for controlling possums (Crowell, Martini, et al., 2016). The project has not been further investigated due to lapse of funding. Alternative repellents that could be investigated in the future have been reviewed by Cowan et al. (2016).</p>

## Other related research

Research on 1080 that does not fit into the categories listed above (namely, alternatives to 1080 and optimising the use of 1080) is reported in Table 7. The projects fall into the following subcategories: studying effects on non-target species, such as birds, deer and plants; and other research, such as water and soil studies, behavioural studies and cost comparisons.

**Table 7: Other research on 1080, such as the effects on non-target species, environmental effects, toxicology and animal behaviour**

Carried out by	Years	Title and outcome
<b>Studying effects on non-target species – birds</b>		
AHB Ecological Networks Limited	2005–2009	<b>Long-term benefits of 1080 operations on South Island miromiro</b> This study looked at the conservation benefit of a 1080 operation on the South Island miromiro. Surveys of bird numbers were done in summer and winter between 2005 and 2009. Miromiro density decreased temporarily after a 1080 possum control operation, before increasing significantly in the following breeding season. Miromiro populations were found to be higher in treatment areas than in non-treatment areas.
TBfree Manaaki Whenua – Landcare Research	2014–2015	<b>Publication on the by-kill of birds</b> Observational data was collected, suggesting relatively low mortality of native birds during modern aerial 1080 operations. The results led the authors to conclude that modern 1080 baiting operations pose only a negligible threat to native forest bird communities and a small threat to individuals, especially relative to the threats they face from the introduced mammals targeted in pest-control operations (Morris et al., 2016).
<b>Studying effects on non-target species – deer</b>		
OSPRI Manaaki Whenua – Landcare Research	2017	<b>Estimating deer density in Molesworth Station</b> This project compared the relative abundance of red deer in an area of Molesworth Station subject to an aerial 1080 operation for possum control in spring 2017 and their abundance in nearby areas of the station where 1080 had not been used (to establish a baseline deer population estimate). If it is assumed that before the 1080 operation in 2017 the deer densities in the poisoned area were similar to those in the areas that were not poisoned, the results suggest the operation caused an 87.6 percent reduction in deer density.
<b>Effects on plants</b>		
DOC Manaaki Whenua – Landcare Research	2006–2011	<b>Quantifying gains in natural character</b> Data from three study sites (Coromandel, Haast and Northern Urewera) indicated high mortality for some palatable tree species at sites where 1080 has not been used. Unpalatable tree species did not appear to be affected. The study provided evidence that sustained, extensive control of invasive herbivores can result in significant conservation benefits for susceptible tree species, and that both impacts and benefits can be measured using data typically collected in herbivore impact studies (Gormley et al., 2012).

Carried out by	Years	Title and outcome
AHB Manaaki Whenua – Landcare Research	2010–2011	<b>Ecological outcomes for plants from aerial 1080 operations</b> This study aimed to determine the rate at which trees die under a regime of possum control using aerial 1080 compared with no control, by re-measuring tagged trees at Haast, Coromandel and Northern Urewera and analysing tree survival rates in blocks that have and have not received possum control. The results showed that extensive possum control was effective in reducing possum browse on preferred tree species. This leads to an increase in foliage cover and a decreased probability of tree mortality.
AHB Lincoln University	2007–2010	<b>Uptake of 1080 by kowhitiwhiti and pūhā</b> Researchers sought to provide information to members of the Māori community on the uptake and elimination of 1080 in kowhitiwhiti (watercress) and pūhā. The results showed that both kowhitiwhiti and pūhā took up 1080. Pūhā eliminates 1080 within 38 days and kowhitiwhiti eliminates 1080 within three days. The researchers recommend withholding periods after any aerial 1080 operation. Results also indicated that sodium fluoroacetate occurs naturally in pūhā (Miller et al., 2009).
AHB Eco Research Associates Limited	2009–2010	<b>Māori interest in natural occurrence of 1080 in New Zealand plants</b> Following indications of naturally occurring 1080 in pūhā in the above study, researchers surveyed other New Zealand plants to see if the natural occurrence of sodium fluoroacetate was more widespread. The closest New Zealand relatives of at least 48 plant species internationally that had been reported to naturally contain 1080 were included in a set of 17 plant species that were sampled and analysed for 1080 content. None of the sampled plants contained 1080, indicating the previously observed presence of 1080 in pūhā is an unusual phenomenon for New Zealand. The natural occurrence of 1080 in plants in New Zealand is therefore likely to be rare.
DOC Manaaki Whenua – Landcare Research	2009	<b>Effects on kamahi</b> Data analysis showed more heavily possum-browsed trees had lower growth rates and lower foliage cover. They had much higher chance of death than trees with more healthy-looking canopies (Duncan et al., 2011).
DOC Manaaki Whenua – Landcare Research	2009	<b>Meta-analysis of the tree canopy</b> Information was reviewed from 47 accounts of responses of native biota to possum control. The analysis demonstrated that both ground and aerial control of this invasive pest in New Zealand has provided substantial collateral benefits for native wildlife (Byrom et al., 2016). The analysis also suggested that both proportional leaf cover and the current level of browse by possums are adequate indicators of potential tree mortality.
<b>Other</b>		
AHB Manaaki Whenua – Landcare Research	2007–2011	<b>OECD test 307: Aerobic transformation of 1080 in soil</b> This study demonstrated that biological degradation was the dominant mechanism for the transformation of 1080 in New Zealand soils, and the microorganisms in New Zealand soils readily transformed and degraded residues of 1080 under suitable climatic conditions. Degradation time of 1080 (to the point that half the 1080 has been degraded) in the three soils varied from six to eight days at 20°C, 10 to 21 days at 10°C and 22 to 43 days at 5°C (Northcott et al., 2014).

Carried out by	Years	Title and outcome
AHB National Institute of Water and Atmospheric Research (NIWA)	2008–2009	<p><b>Determining levels of 1080 in drinking water</b></p> <p>A hydrological-based model was developed to predict 1080 concentrations in waterways. This model has been turned into a graphic user interface tool to allow those planning 1080 operations to enter relevant parameters to show predicted 1080 concentrations in surface waters following aerial application.</p> <p>A field study was conducted to monitor potential 1080 contamination of surface waters during rainfall after an aerial drop. The researchers also monitored soil water in three locations in the catchment directly adjacent to 1080 baits. 1080 did leach into the soil water, but the pattern was highly variable among the three locations. This was thought to reflect differences in topography, soil and rainfall falling on baits. Soil water samples indicated the persistence of 1080 for six days following the rain. The results suggested the loss of 1080 from baits is more affected by the duration of rain than the amount of rainfall (Srinivasan et al., 2011).</p>
AHB / NIWA	2010–2012	<p><b>Improvements to modelling 1080 concentrations in surface waters – adding spatial sensitivity and soil-water transport mechanisms</b></p> <p>A series of sequentially arranged laboratory and plot – and hillslope-scale field studies were conducted. These studies investigated the influence of rainfall conditions on 1080 release rates from cereal baits and the transport of released 1080 in rainfall-runoff via surface and subsurface pathways to streams and groundwater. The results were used to improve the previously developed 1080 hydrology model (above) (Srinivasan, M.S., Suren, A., et al., 2012), building into it a degree of conservatism with regards to transport via overland flow, considering the lack of a usable relationship observed in this study between 1080 release rates and rainfall intensity or duration and considering the contribution of subsurface pathways to the model. The model will provide resource managers with robust information as to the likelihood that surface waters will be contaminated with 1080 (Srinivasan, Suren et al., 2012).</p>
AHB Manaaki Whenua – Landcare Research	2008–2009	<p><b>Movement behaviour of 1080-poisoned possums</b></p> <p>The movement of possums poisoned by 1080 was assessed by fitting them with radio transmitters. Their movements appeared to be more influenced by population density and habitat than by ingestion of poison.</p>
Manaaki Whenua – Landcare Research	2009–2011	<p><b>Mouse behavioural resistance to 1080</b></p> <p>Researchers tested whether a micro-encapsulated 1080 formulation would delay absorption so that mice would eat a lethal dose. Data from an initial trial confirmed the encapsulation material did not impair palatability or affect uptake compared with the standard 1080 pellets alone. However when this trial was repeated, it did not appear to have any effect on efficacy. Further trials are required to determine if a non-toxic surrogate and/or encapsulation has a definitive effect or not. To our knowledge, no further work has been conducted.</p>
AHB Manaaki Whenua – Landcare Research	2009–2010	<p><b>Fluoroacetate in tea – a source of human exposure?</b></p> <p>Researchers evaluated existing data on fluoroacetate levels in tea and plants used for food and medicine and compared this with updated acceptable levels of exposure. Regular consumption of tea would not exceed the tolerable daily intake of fluoroacetate concentrations. Based on current knowledge of the sub-lethal effects of fluoroacetate exposure in mammals, such consumption is not expected to pose a significant long-term risk to human health.</p>

Carried out by	Years	Title and outcome
AHB Lincoln University and DOC	2008–2010	<p><b>Updated Toxicology Review Paper on 1080</b></p> <p>This was an updated review of the toxicology and ecotoxicology of sodium fluoroacetate in relation to its use as a pest control tool in New Zealand. It concluded that considerable care must be taken when using 1080 to ensure the risks of its use are outweighed by ecological benefits achieved and the risks and measures taken to mitigate adverse effects must be clearly communicated (Eason et al., 2011).</p>
Manaaki Whenua – Landcare Research Massey University	2009–2011	<p><b>How humane are our pest control tools?</b></p> <p>This project applied a recently developed Australian assessment framework to produce a ranking of the relative welfare impacts of lethal control methods used for vertebrate pest management in New Zealand (Landcare Research, 2010). The welfare impact of 1080 was ranked as intermediate for all species considered (possums, rodents, mustelids, and rabbits). The authors suggest further work is needed to assess the suggestion that the neural effects of 1080 result in a progressive reduction in the level of consciousness, and therefore reduced durations of negative experiences.</p>
Animal Control Products Manaaki Whenua – Landcare Research	2010–2013	<p><b>The palatability and efficacy of baits held in storage</b></p> <p>This study found the concentration of 1080 remained stable throughout a 13-month trial in both RS5 and No. 7 bait types (made by Animal Control Products). Cinnamon is used to make the bait more attractive to target species. Cinnamon levels had declined by about 50 percent after five months for No. 7 and seven months for RS5. Palatability of toxic No. 7 baits declined after seven months but efficacy was still 70–90 percent over the 13-month trial. Palatability of toxic RS5 baits declined to around 10 percent at 13 months. Mortality was 90–100 percent until baits were 10 months old but dropped to 70 percent in the final trial after 13 months in storage.</p>
TBfree	2012–2017	<p><b>TB eradication – effectiveness and cost of alternative operational strategies</b></p> <p>This research aimed to compare the cost-effectiveness of different strategies for confirming the eradication of TB from wildlife hosts. Possum population reductions of up to 60 percent can be achieved in deep forest areas with low density populations by leg-hold trapping with traps set every 50 metres on transects 500 metres apart for \$20/ha. Similar possum kills can be attained using detection and targeted control on 500-metre spaced transects during fine weather.</p>
AHB Hawke’s Bay Regional Council	2010–2012	<p><b>The cost-effectiveness of integrating bait stations and low-cost detection devices into possum maintenance control/proof-of-freedom programmes</b></p> <p>This study aimed to determine the efficacy of integrating bait stations and detection devices into maintenance/proof-of-freedom programmes by determining the cheapest and most effective way of identifying the location of possums and the most effective way to control them. Bait stations are used regularly, but no follow up is available for this project.</p>
Ministry of Science and Innovation Manaaki Whenua – Landcare Research	2010	<p><b>Vertebrate pest decision support</b></p> <p>A decision support system was set up to provide a wide range of users with advice on the most appropriate options, including 1080, for the control of possums, rats, stoats, ferrets and feral cats. The system uses answers given to a series of questions about the proposed control operation, systematically evaluating the potential constraints that may be operating in the area, and provides the user with best practice advice and other information about recommended options.</p> <p><a href="#">Vertebrate pest decision support system</a><sup>14</sup></p>

# Incidents and matters of public concern

Incidents involving 1080 are defined as any non-compliance with HSNO controls imposed on the hazardous substances or non-compliance conditions of permission issued under section 95A of HSNO, or any event resulting in an increased risk to public, operator, and/or environmental safety.

An important HSNO control is that anyone undertaking aerial application of 1080 baits must report the application to the EPA as soon as reasonably practicable, but no later than six months after that application. This enables the EPA to monitor aerial applications for best practice. HSNO controls also allow enquiries to be made into incidents involving hazardous substances although this exercise is typically monitoring and reviewing reports to monitor best practice and consistency.

A complaint could be reported on matters not relevant to the HSNO controls.

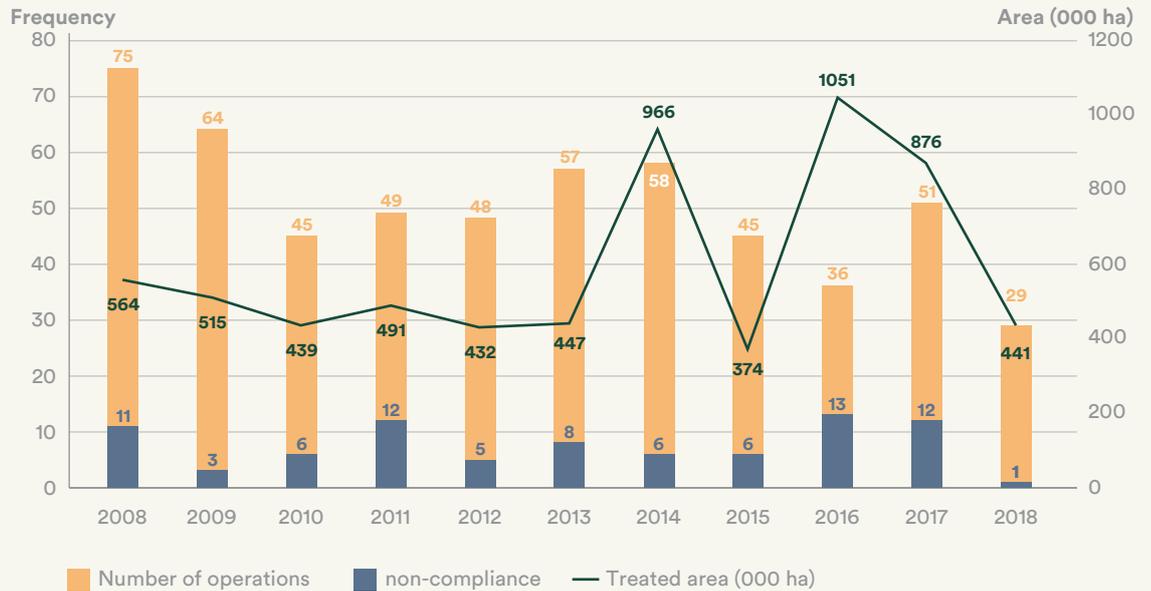
In 2018 just one incident of non-compliance was reported and confirmed by the EPA, as summarised in this section. We are still inquiring into one incident. This is the lowest number of non-compliance incidents since the 2007 reassessment.

Figure 3 on the following page shows the total number of operations per year and the total reported incidents for the past 11 years.

We received eight reports involving domestic animal deaths in 2018. As a result, the EPA has taken the following steps.

- We will now report on domestic animal deaths in the 1080 aerial operations annual report, starting with this report.
- Following the review of the Mapara operation (see page 52), the EPA recommended that DOC provide more guidance to operators, as part of its consultation standard operating procedures, with respect to instances where operators are seeking to obtain private landowners' consent for their land to be included in aerial 1080 operations. The EPA also recommended that DOC's processes would be assisted by higher quality maps to support the consultation process.

**Figure 3: Incidents relating to aerial 1080 operations reported to the EPA**



## Incident summaries

We receive information from operators and the general public about matters involving 1080.

Operators relay complaints they have received, and people advise us when they think someone is breaking the rules. We follow up to understand the full story, often working with other agencies.

The incidents and complaints reported to the EPA in 2018 are listed by region.

We have reported the details of the incidents as they were reported to the EPA by operators and other agencies.

In addition to the information provided here we have:

- received 14 reports on protest activities during 2018 aerial 1080 operations. These are listed in the post-operation reports published on the EPA website.

### [1080 aerial operators' reports](#)<sup>15</sup>

- received and responded to 10 requests for information under the Official Information Act 1982 during the 2018 calendar year. These requests included public concerns about the effects of 1080 on native species, wild life and human health.

<sup>15</sup> <https://www.epa.govt.nz/resources-and-publications/1080-aerial-operators-reports/>

## Northland region

Type	Date	Description
<b>Operation: Russell Forest and Cape Brett</b>		
Animal death	12 September 2019	<p>The owner of a sick horse and pig on a property in Punaruku feared her horse and pig may have drunk from a stream where there may be 1080 in the water. However, the owner was assured that the animals had not been near the stream. A vet saw the animals and diagnosed the horse with colic. The horse then died. The owner is comfortable with this diagnosis and does not require follow-up testing for 1080. The pig had been known to be unwell for a while.</p> <p>Our inquiry found no evidence of breach of HSNO controls.</p>

## Auckland region

Type	Date	Description
<b>Operation: Hunua Ranges</b>		
Animal death	29 October 2018	<p>Auckland Council was advised by a farmer that four of his calves had died following the operation. Its investigation confirmed only one calf had been assessed and tested with the results showing that the animal had been exposed to 1080.</p> <p>A sub-lethal amount of 1080 was present in the calf at the time of testing. The test itself did not confirm the animal had died as a result of 1080 poisoning, however the vet report noted this as a possible cause of death.</p> <p>The other calves were not assessed or tested. The property where the calf was being grazed was not within the operational area or adjoining the operational area.</p> <p>A comprehensive review of the helicopter operational data was undertaken by Auckland Council and determined that no helicopter involved in the operation flew over the property or applied bait outside the operational area.</p> <p>The Auckland Council investigation showed that the most likely cause of the calf being exposed to 1080 was as a result of it straying from the property into the operational area.</p> <p>Our inquiry found no evidence of breach of HSNO controls.</p>
Animal death	15 October 2018	<p>One dog death was reported on the day after the park was re-opened following completion of the track clearance programme.</p> <p>Auckland Council was contacted by the dog owner and determined that the dog had consumed bait after being walked off-lead in the park on a walking track that had been included in the operational area. The tracks had been thoroughly cleared of bait but the dog owner confirmed the dog went off the track. The dog owner had passed several caution signs and an information panel on a park information board containing information on the requirement to keep dogs on lead.</p> <p>Our inquiry found no evidence of breach of HSNO controls.</p>

Type	Date	Description
Animal death	15 October 2018	<p>A dog owner emailed Auckland Council that their dog had died after being walked in the park. A vet report attached to the email did not confirm 1080 poisoning, but noted a dog had been assessed. No testing for 1080 had been done. The dog owner had declined the vet's advice to leave the dog for monitoring overnight. The dog died.</p> <p>On the date the dog was assessed by the vet and when it was alleged it was in the park the Hunua Ranges Regional Park was formally closed to the public, all gates were locked, with the park closed and warning signage in place. Other entrances were physically blocked and also had warning signage in place. The dog owner reported the incident to the Council weeks after the event occurred and did not respond to the Council's request for further information so the Council was not able to follow up any further.</p> <p>Our inquiry found no evidence of breach of HSNO controls.</p>
Complaint	27 September 2018	<p>A landowner raised concerns about the proximity of a helicopter to their property – a review of flight data by the Auckland Council showed no breach or misapplication had occurred. Council staff also visited the properties involved as requested and walked boundaries. No bait was found in any location outside the operational area.</p> <p>Our inquiry found no evidence of breach of HSNO controls.</p>

## Waikato region

Type	Date	Description
<b>Operation: Mapara</b>		
Animal death	9 September 2018	<p>DOC was notified of the death of eight cattle following a pest control operation in Mapara on 6 September 2018. MPI investigated this incident. In November 2018, the EPA was approached by DOC and the owners of the dead stock to review the incident. The scope of the EPA enquiry was limited to whether DOC's operation complied with the HSNO Act, and the circumstances around the cattle's deaths.</p> <p>We concluded that the operation did not breach HSNO controls.</p> <p><a href="#">Enquiry into an Aerial 1080 Pest control Operation at Mapara Wildlife Management Reserve<sup>16</sup></a></p>
<b>Operation: Pihanga-Kākāramea</b>		
Complaint of contaminated water	26 August 2018	<p>Many people claimed their water supply was contaminated. Water samples from the Pihanga/Karamea SIRL intake were tested for 1080. Testing results were below the method detection limits of 0.0001 ppm.</p> <p>Our inquiry found no evidence of a breach of HSNO controls.</p>

16 <https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Compliance-reports/enquiry-aerial-pest-control-operation-mapara-reserve-dec19-with-Annexe-links.pdf>

## Taranaki region

Type	Date	Description
<b>Operation: Moki Makino Mt Messenger</b>		
Animal death	25 August 2018	<p>Two sheep and one bull at two separate locations died and confirmed traces of 1080 were found in tissue samples. The bull pushed into the treatment area (unfenced boundary), accessed bait and died in a paddock adjacent to the treatment area.</p> <p>It is unknown how the sheep accessed the bait. There are no records of over-sowing or helicopters flying outside of the treatment area adjacent to where the sheep were being held.</p> <p>We are inquiring into this incident.</p>

## Manawatū/Whanganui region

Type	Date	Description
<b>Operation: Kia Wharite Mangapurua and Whitianga</b>		
Complaint of not being notified of operation	13 October 2018	<p>Two staff of Whanganui River Adventures complained they were not notified about the track closure. They had an international group booked in for the day the track was closed.</p> <p>The DOC communication plan showed that emails were sent to Whanganui River Adventures on 12 July 2018 along with all the other concessionaires (prior to the operation), and they were also notified 24 hours prior to the operation.</p> <p>Our inquiry found no evidence of a breach of HSNO controls.</p>

## West Coast region

Type	Date	Description
<b>Operation: Karamea Bluffs and Stormy Ridge</b>		
Animal death	9 May 2018	<p>A landowner whose property is beside the Stormy Ridge control area found two dead feral deer near the bush pasture interface on their farming property. No complaint was made. The carcasses were recovered and disposed of within the consented area.</p> <p>Our inquiry found no evidence of a breach of HSNO controls.</p>
Complaint about the timing of an operation	9 May 2018	<p>A locally based permit holder for commercial deer recovery operations in the control area expressed frustration at the timing of the operation and duration of the caution period following toxin application. The complainant was advised that the end-point for the caution period is determined by monitoring carcasses and bait decomposition. He was also advised that taking game animals for sale for human consumption is regulated by MPI and objections to such rules should be discussed with MPI directly.</p> <p>Our inquiry found no evidence of a breach of HSNO controls.</p>
<b>Operation: Karnbach Poerua and Mikonui</b>		
Complaint of poisoning of cows	28 August 2018	<p>An anonymous complaint was made alleging poisoning of cows on adjacent farmland. The landowner wasn't the complainant nor were they aware of any incident of the type alleged. No evidence of non-target by-kill was found and records of bait application confirmed no consent breaches had occurred.</p> <p>Our inquiry found no evidence of a breach of HSNO controls.</p>

Type	Date	Description
Animal death	10 September 2018	<p>An adjoining landowner found dead feral deer near the bush line on their property. The landowner did not allege any misapplication had occurred, and a review of aircraft GPS data by the operator found no evidence to suggest this had occurred.</p> <p>The landowner was subsequently engaged by the operator to bury the animals.</p> <p>Our inquiry found no evidence of a breach of HSNO controls.</p>
Complaint of toxin in water	29 August 2018	<p>An adjoining landowner alleged that toxin had been applied in the Harold Creek catchment bed and banks, outside the approved area.</p> <p>The operator inspected the excluded area the following day. No toxin was found during this inspection, and aircraft GPS data indicated no misapplication had occurred.</p> <p>The complainant provided GPS data which was compared with the aircraft GPS data, and both data confirmed that no toxin misapplication had occurred.</p> <p>Twenty-five water samples were tested and no 1080 was detectable.</p> <p>The operator also noted that the Harold Creek water supply is sourced from a small spring-fed waterway with its catchment outside of the Poerua treatment area.</p> <p>Our inquiry found no evidence of a breach of HSNO controls.</p>
Unmapped hut discovered inside the control area	5 September 2018	<p>Toxic bait was found to have been applied to a previously unidentified hut inside the control area. The hut is not managed by DOC, and was not marked on the map DOC provided to the 1080 contractor. The 1080 contractor visited the area, found and removed a small amount of baits. It was determined that water at the hut is obtained from a roof-sourced supply. The supply intake was disconnected, the tank flushed and an alternative drinking water supply in containers provided as a precautionary measure.</p> <p>A standard warning sign was installed at the site as the nearest sign was otherwise located several kilometres away.</p> <p>The Public Health Unit (PHU), which was contacted on 6 September 2018 by the 1080 contractor, was satisfied with the actions taken due to the fact that DOC had not informed the contractor of the old hut site during the planning phase.</p> <p>Our inquiry found no evidence of a breach of HSNO controls.</p>

Type	Date	Description
Complaint of misapplication	27 August 2018	<p>A member of the public complained that toxin had been misapplied to a track, and indicated they had been removing toxin from the track surface and burying it. The person questioned the presence of an alternative water supply at the nearby Kiwi Flat Hut which was excluded from the application area.</p> <p>The complainant provided GPS data of the removed baits and several photos of this alleged non-compliance. The GPS data was compared against boundaries for the approved treatment area and aircraft GPS data recorded during toxin application to the area, and no evidence of non-compliance was identified.</p> <p>The water container at Kiwi Flat Hut was labelled as being potable drinking water, however no information was provided as to the reason for its presence.</p> <p>Personnel of the operator encountered a member of the public while they were working to make sure there was no toxic bait on the Scamper Torrent Route, as required by the PHU and DOC permissions.</p> <p>The complainant indicated they had also been removing toxin from the track surface and burying it, as they were of the view that the track shouldn't have been sown. A complaint of this nature was subsequently made to DOC, who contacted the operator for evidence to prove completion of track clearance completion and that warning signage was in place at the road-end entrance to the affected track. The contractor provided all requested documents to DOC in an email dated 29 August 2018. DOC accepted the provided information on 30 August 2018.</p> <p>The complainant also queried (via DOC) why an alternative supply of drinking water was being provided at the Kiwi Flat Hut, which was excluded from toxin application. The container was labelled as being potable drinking water, however no information was provided as to the reasons for its presence. DOC advised the contractor that when they disconnect the hut water supply and leave potable water, they should add information to the nearest sign or in the hut stating the reasons for providing potable water and advising that after the first rain event, the water will be reconnected and potable water removed.</p> <p>Our inquiry found no evidence of a breach of HSNO controls.</p>
Complaint about excessive dust drift	27 August 2018	<p>The PHU received a complaint relating to excessive dust-drift and inadequate personal protective equipment at the site. The operator advised they were unaware of any issue with dust at the site and all personnel were wearing appropriate protective gear. The operator advised PHU that the bait was of high quality and no dust drift was identified. They said Police and security personnel were not stationed in the toxin zone, and that all people working within toxin zone were wearing protective equipment.</p> <p>Our inquiry found no evidence of a breach of HSNO controls.</p>
Complaint about workers being exposed to 1080	27 August 2018	<p>Post-operation toxic health monitoring identified four workers had been exposed to 1080 above the MDL. WorkSafe was notified to follow up on this matter.</p> <p><i>Addendum: Post publication, OSPRI provided the following additional information.</i> Post-operation toxic health monitoring identified four workers had been exposed to 1080 above the Minimum Detectable Level "MDL", which is 0.001 micrograms/millilitre. The four tested samples were above the detection level, however only one sample was above the Biological Exposure Index (BEI) set by the Ministry of Health. It was investigated internally and the matter was discussed with WorkSafe. WorkSafe agreed that it was not a notifiable injury or illness.</p>

Type	Date	Description
<b>Operation: Paparoa Range</b>		
Mechanical failure	27 June 2018	<p>While completing the pre-feed bait application, the pilot returned to the loading site to get another load and was notified by the ground crew that the spinner on the bucket was missing.</p> <p>An investigation by the helicopter company concluded that the spinner stub axle had shorn off, possibly due to being out of balance at some stage during the operation.</p> <p>The helicopter company said it had learned from this incident to ensure through pre- and post-operation inspections all buckets are free from areas of visible fatigue. It would also follow internal procedures around bucket inspection checklist and maintenance schedules.</p> <p>We found no evidence of a breach of HSNO controls.</p>
Aircraft parking	27 June 2018	<p>A pilot parked the aircraft nose upslope and on a slight knob between loads. The pilot secured the controls and the aircraft at a ground idle and disembarked to look at the spreading bucket. The aircraft slowly sat back on its heels and the tail rotor stinger possibly rested on the clay ground.</p> <p>The aircraft company said that the pilot should have ensured that the aircraft was sitting flat on both skids rather than a slight knob. A better load site possibly could have been found.</p> <p>The operator considered it had learned from this incident that it must continue to raise awareness of all pilots and crew about the risks of load sites with multiple aircraft operating and about uneven terrain with rotors turning.</p> <p>We found no evidence of a breach of HSNO controls.</p>

## Otago region

Type	Date	Description
<b>Operation: Timaru Creek</b>		
Track not cleared following the operation. Breach of PHU permission. Breach of HSNO controls.	26 June 2018	<p>Track clearance was not completed for this track on the day that tracks were being cleared following the aerial 1080 application. When OSPRI requested data from the operator on track clearance, the operator realised this had not happened for the Corner Peak Route Track. The operator immediately cleared this track and notified PHU and DOC on 26 June 2018, Both organisations were satisfied with the outcome and did not require further action.</p> <p>We reviewed the details of this incident, and found that it was a breach of HSNO for failing to clear the track, which was rectified by the operator as soon as they were notified. We decided that no further action is required as both DOC and PHU were satisfied with the mitigation action. We did not receive complaints or have injuries reported due to this incident.</p>

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