Impacts of 1080-poisoning for possum control on non-target invertebrates

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Abstract

Impacts of a 1080-poisoning operation for possum control on non-target ground-dwelling invertebrate populations were monitored in Titirangi Scenic Reserve, Wanganui. The baits used were Wanganui No. 7 cereal-based baits containing 0.08% 1080 spread from the air at 5 kg bait/ha on 23 June 1992. Invertebrates were collected in 100 pitfall traps containing 50% ethylene glycol set 10 m apart on two transects 100 m apart in the poison area and also in a non-poison area (Dress Circle Scenic Reserve) from March 1992 to June 1993. Bait density within 2 m of traps in the poison area was measured on the day of poisoning. The traps were open continuously and were emptied and reset monthly by DoC staff four times before poisoning and 12 times after poisoning. Trapped invertebrates were sorted into orders and/or families. Only samples from March-September 1992 and from the 10 traps with most baits around them in the poison area were analysed for this report. There were no significant differences in the immediately pre- to post-poison (June to July) population trends or in the seasonal fluctuations from March to September (autumn to spring) of amphipods, ants, chafer beetles, leiodid beetles, weevils, other beetles, collembolans, millipedes, mites, slugs and snails, spiders, and cave wets in the poison area compared to the non-poison area. Further research is required to determine the impacts of 1080-poisoning on invertebrate species not adequately monitored in this study (e.g., cockroaches and tree weta), and to assess the sub-lethal effects of 1080 on invertebrate species known to feed on baits.

1. Introduction

The impacts of 1080-poisoning for possum control on non-target invertebrate populations were investigated by Manaaki Whenua - Landcare Research, Christchurch, for the Department of Conservation (DoC), Wellington, from July 1991 to June 1994. This information is required to ensure that 1080-poisoning operations are done in a way that has minimum environmental impact.

2. Background

invertebrates have been seen feeding on carrot and cereal-based baits containing sodium monofluoroacetate (1080) used in New Zealand for control of the introduced brushtail possum (*Trichosurus vulpecula).* Residues of 1080 have been found in a range of invertebrate species collected after 1080-poisoning operations (Eason *et al.* 1993). Compound 1080 has been used experimentally as an insecticide for control of fleas, aphids, and wasps (Spurr 1994), and at least nine orders of invertebrates, including Acari, Blattodea, Coleoptera, Collembola, Diptera, Hemiptera, Hymenoptera, Lepidoptera, and Siphonaptera, are reported to be prone to 1080 poisoning (Notman 1989). Sub-lethal doses of 1080 affected the behaviour of native cockroaches (McIntyre 1987) and tree weta *(Hemideina thoracica)* (J. Hutcheson 1989, unpubl. FRI contract report).

The impacts of aerial 1080-poisoning operations for possum control on non-target invertebrate populations were monitored in the Whitecliffs Conservation Area in July 1991 (M. Meads 1993, unpubl. Landcare Research contract report) and in Puketi Forest in March 1992 (Spurr 1994). At Whitecliffs, the non-treatment controls were believed to be contaminated by 1080 and the results were difficult to interpret. There may have been a decline in some invertebrate groups after 1 month but the results were inconclusive. At Puketi Forest, there were no impacts on populations of Acarina, Amphipoda, Araneida, Coleoptera, Collembola, Diplopoda, Hymenoptera, Mollusca, and Orthoptera monitored up to 6 months after the poisoning operation.

3. Objectives

To determine impacts (if any) of a standard DoC aerial 1080-poisoning operation for possum control on absolute numbers, seasonal fluctuations, and long-term trends of ground-dwelling invertebrate populations.

To determine the effect of bait density on invertebrate numbers.

To determine the relative susceptibility of different taxa of ground-dwelling invertebrates to 1080-poisoning operations.

4. Methods

4.1 POISONING OPERATION

The poisoning operation monitored was in Titirangi Scenic Reserve, Wanganui (39°49'10"S, 175°52'0"E), a podocarp/hardwood forest. Wanganui No. 7 cereal-based baits (average 4 g each) containing 0.08% 1080 (Animal Control Products, Wanganui) were spread from the air at 5 kg bait/ha (c. 1 bait/8 m^2), equivalent to 4 g 1080/ha, on 23 June 1992. Bait density within 2 m of traps used to monitor invertebrate populations was measured on the day of poisoning. The average density of baits was 1 bait/12 m^2 (Appendix 10.1). The area had not been poisoned with 1080 before. Initial possum density was very high (perhaps >15/ha), and about 96% of the possums were killed (B. Warburton pers. comm.). Rodent density was unknown. The first heavy rain (31 mm) fell between 11 and 14 days after poisoning.

The non-poison area was about 4 km away in Dress Circle Scenic Reserve (39°51'0"S, 175°54'0"E).

4.2 INVERTEBRATE POPULATION MONITORING

Abundance of invertebrate populations was monitored using pitfall traps with an interior diameter of approximately 73 mm (Moeed & Meads 1985) containing a mixture of 50% ethylene glycol and water and a few drops of detergent. The traps were set 10 m apart on two transects 100 m apart (n=100) in both the poison and non-poison areas. Traps were open continuously and were emptied monthly by DoC staff for 3.5 months before poisoning and 12 months after poisoning. Trapped invertebrates were counted and sorted into orders and/or families (Appendix 10.2). Counts from the half-month pre-poison samples were multiplied up to represent a full month.

The 10 traps with most baits around them in the poison area and 10 traps selected at random in the non-poison area were analysed for this report. The average bait density around these traps was 1 bait/3 m^2, four times the average bait density. These samples therefore represent a worst-case scenario. Only samples from March to September 1992 (4 months before to 3 months after poisoning) were analysed. The remaining samples (October 1992 to June 1993) have been stored awaiting analysis.

The effect of poisoning was determined by a repeated measures analysis of variance (Green 1993) of the month vs month counts for each invertebrate group in the poison vs non-poison area. The time x area interaction term was used to determine whether there were significant differences in monthly population trends in the poison vs non-poison areas. Because of the small number of samples analysed and the large variance between samples, the population changes in the poison area had to be at least twice or less than half those in the non-poison area for the analysis to detect a significant difference (a=0.05, B=0.20). The monthly counts were transformed with In (x+l) for analysis, and back-transformed for graphing. Least significant differences were calculated from the formula given by Andrews *et al.* (1980).

5. Results

There were no significant differences in the immediately pre- to post-poison (June to July) invertebrate population tends in the poison area compared to those in the non-poison area (Table 1). The few significant differences in population trends from month to month in poison and non-poison areas that did occur did not coincide with the 1080-poisoning (Table 1; Appendix 10.3). For example, amphipods declined significantly more in the poison area than in the non-poison area from May to June before poisoning, and again from August to September 2-3 months after poisoning, but not at other times (Table 1; Appendix 10.3 b). Collembolan population trends in the poison and non-poison areas were significantly different in the 2 months before poisoning and from July to August 2 months after poisoning, but were not significantly different 1 or 3 months after poisoning (Table 1; Appendix 10.3 a).

Population trends from March to September (autumn to spring) were similar in the poison and non-poison areas for all invertebrate taxa analysed (Appendix 10.3). These included invertebrates that feed on decaying vegetable matter, such as amphipods, ants, chafer beetles, collembolans, millipedes, mites, weevils, slugs, and cave wets, and predatory invertebrates such as leiodid beetles, other beetles (listed in Appendix 10.2), spiders, and snails. Too few centipedes, cockroaches, earthworms, earwigs, harvestmen, plant bugs, pseudoscorpions, tree weta, and woodlice were caught to determine impacts of 1080-poisoning on their numbers.

TABLE 1. PROBABILITY VALUES FROM ANALYSIS OF VARIANCE FOR DIFFERENCES IN THE POPULATION TRENDS OF INVERTEBRATES FROM MONTH TO MONTH IN THE POISON AREA COMPARED TO THE NON-POISON AREA, TITIRANGI SCENIC RESERVE (POISONED 23 JUNE 1992).
KEY: INSUFFICIENT DATA TO TEST, ' P<0.05, " P<0.01 (D.F. = 1,18).

	PRE-POISON			POST-POISON		
	Mar-Apr	Apr-May	May-Jun	Jun-Jul	Jul-Aug	Aug-Sep
Amphipods	0.545	0.665	0.006 '"	0.914	0.069	0.034 '
Ants		0.499	0.668	0.868	0.582	0.365
Chafer beetles	0.399	0.075	0.565	0.839	0.886	0.596
Leiodid beetles	0.325	0.240	0.591	-	-	0.955
Weevils	0.435	0.079	0.019 '	1.000	0.332	1.000
Other beetles	0.315	0.140	0.772	0.388	0.188	0.896
Collembolans	0.217	0.002 "	0.000 "	0.581	0.040 '	0.340
Millipedes	0.487	0.104	0.497	0.297	0.558	0.268
Mites	0.002 "	0.691	0.367	0.575	0.404	0.192
Spiders	0.546	0.137	0.026 `	0.126	0.442	0.417
Slugs/snails	0.443	0.561	0.750	0.674	0.646	0.965
Cave weta	0.573	0.045 `	0.587	1.000	-	-

6. Conclusions

The lack of impact of the 1080-poisoning for possum control on non-target ground-dwelling invertebrate populations at Titirangi Scenic Reserve was similar to the result at Puketi Forest (Spurr 1994). However, some invertebrates at Puketi Forest fed on bait intended for possums because residues of 1080 were found in tree wets, cave weta, and cockroaches collected after the poisoning operation (Eason et al. 1993). Residues were not found in beetles, millipedes, centipedes, spiders, or earthworms. The amount of 1080 eaten by cave weta was apparently insufficient to cause death, or caused too few deaths to affect overall population numbers (Spurr 1994). The 1080-poisoning operations in Titirangi Scenic Reserve and Puketi Forest, like most 1080-poisoning operations, were done in autumn and winter when invertebrate populations were declining naturally. If there was any mortality from 1080-poisoning in these operations, it presumably replaced mortality from natural causes such as winter weather and food shortage.

The absence of even a short-term impact of 1080-poisoning on ground-dwelling invertebrate populations at Titirangi Scenic Reserve and Puketi Forest contrasts with the findings of Meads (1993, unpubl. Landcare Research contract report) in Whitecliffs Conservation Area. All three operations used the same bait type, bait toxicity, and application rate, and were done in autumn or winter.

By sorting invertebrates only to order or family, I may have missed impacts on species. Some studies have shown that although numbers within a family remained similar above and below a pollution source in a river, the species were different; i.e., there was species replacement as a result of pollution (T.K. Crosby pers. comm.). Pollution in these rivers was on-going, and the studies were made some time after the pollution started, giving the species time to reach an equilibrium. Poisoning with 1080 is a one-off, point-impact event, and I believe there would not have been enough time over winter for species replacement at Titirangi Scenic Reserve.

There are many limitations to pitfall trapping, but most apply to comparisons between species, seasons, and habitats (Topping & Sunderland 1992). I believe relative abundance measured by pitfall trapping can be related validly to absolute abundance in repeated measures environmental impact assessment (before vs after and poison vs non-poison) trial designs, which are paired comparisons between times within species and habitats. The relative difference in pitfall trap capture rates between poison and non-poison areas over time will be related to invertebrate density not behaviour, because factors such as activity and escape rates will be similar in the two areas and within species, seasons, and habitats.

The 1080 poisoning for possum control probably reduced rodent populations temporarily in Titirangi Scenic Reserve as it has in other areas (B. Warburton 1989, unpubl. FRI contract report, J. Innes & D. Williams 1991, unpubl. FRI contract report). Consequently, rodent predation on invertebrates in the poison areas may also have been reduced temporarily. Reduced rodent predation could result in increased invertebrate numbers. Although there was no evidence that invertebrate numbers in Titirangi Scenic Reserve had increased 3 months after poisoning, there may not have been enough time for them to respond to reduced rodent predation. Data from 12 months after poisoning have yet to be analysed.

There is no need to analyse invertebrate samples from traps where bait density was lowest because no impact of 1080-poisoning was detected where bait density was greatest. However, some invertebrate groups that may be susceptible to 1080-poisoning (e.g., tree wets and cockroaches) were not adequately monitored because too few were caught in the traps used. Also, sub-lethal doses of 1080 may have delayed effects on the reproduction of invertebrates (Smith & Grosch 1976) that would not be detected 3 months after autumn or winter poisoning operations.

7. Recommendations

Further research is required to determine the impact of 1080 poisoning on invertebrate species not adequately monitored in these studies (e.g., cockroaches and tree wets), and to assess the sub-lethal effects of 1080 on invertebrate species known to feed on baits.

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