The Efficacy of Possum Control in Reducing Forest Dieback in the Otira and Deception Catchments, Central Westland

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1. Introduction

In 1987-88, canopy dieback and possum densities were surveyed on permanent plots and transects in the Deception and parts of the Otira and upper Taramakau catchments (Rose *et al.* 1988, unpubl. FRI contract report). In 1992-93, a subsample of plots and transects was resurveyed to assess the effects of intensive possum control by DOC. The project was undertaken by Manaaki Whenua - Landcare Research, under contract to the Department of Conservation.

2. Background

For nearly half a century, progressive possum-induced canopy dieback in central Westland has affected canopy species such as southern rata (*Metrosideros umbellata*), kamahi (*Weinmannia racemosa*), and Hall's totara (*Podocarpus hallii*) and seral species such as fuchsia (*Fuchsia excorticata*) (Rose *et al.* 1992). Such dieback has prompted extensive possum control operations by the Department of Conservation and previous government agencies. However, the effectiveness of control in halting dieback has seldom been assessed (Pekelharing & Batcheler 1990; Stewart 1992, unpubl. FRI contract report).

Possum control was first undertaken in the Deception catchment in 1971 in response to conspicuous canopy damage (56% kill; Bell 1972, unpubl. NZFS. report), and in 1975 in the Otira catchment before dieback became conspicuous (55% kill; Spurr 1976, unpubl. NZFS report). In 1986, evidence that possum populations were were again at high levels (Chisholm 1987, unpubl. DOC report) prompted a detailed 1988 survey of canopy condition and possum densities the Otira, Deception, and upper Taramakau. This survey concluded that further canopy dieback was imminent (Rose *et al.* 1988, unpubl. FRI contract report). In the ensuing 5 years, DOC mounted extensive possum control operations in the relatively unmodified Deception and Otira. The more modified Taramakau remained untreated. A 1993 resurvey of the permanent plots established in 1988 provided the opportunity to assess the effectiveness of possum control by evaluating trends in forest condition and possum density.

3. Objectives

- To determine changes in possum population density, and in tree mortality and crown condition between 1988 and 1993.
- To assess the effectiveness of possum control in slowing or arresting canopy dieback in the Otira and Deception catchments.

4. Methods

4.1 VEGETATION SAMPLING

Plot location and design

For the 1988 survey (November 1987 - February 1988), 47 transects from valley floor to treeline were drawn on aerial photographs of the three catchments so that as many patches of highly conspicuous dieback were traversed as possible (see Rose et al. 1988, unpubl. FRI contract report). Along the transects, 266 permanent vegetation plots (20 x 20 m) were established at 100 m intervals between 500 m a.s.l. and treeline (c. 900 m). In 1993 (November 1992 - February 1993), 101 of the original plots (15 transects) were remeasured. These represented a 38% resample, selected to reflect the original (1988) distribution of crown condition scores (see below).

Tree and stem measurements

In 1988, diameter (dbh), and crown condition were recorded for all stems > 5 cm dbh of all live and dead canopy trees on the vegetation plots. In 1993, sampling was restricted to canopy stems (> 20 cm dbh) of four possum-preferred species: southern rata, kamahi, Hall's totara, and fuchsia.

Methods for estimating crown condition of live stems and trees differed between surveys. In 1988, crown condition was assessed from visual estimates of percentage defoliation (i.e., the absence of leaves) in four classes (<30; 31-60; 61-90; >90% defoliated). In 1993, percentage crown foliar cover (the presence of leaves) was estimated in ten 10% classes using reference cards adapted from those of Avery (1966). Although this may have introduced a slight but unquantifiable overestimation of any declines in crown condition, it was justified on two grounds: (1) crown cover is a more direct and consistent estimate of condition than defoliation; (2) the 1993 method is likely to become the standard DOC method for scoring crown condition. Ideally, both methods should have been used in 1993, but this was precluded by time and finance.

Statistical analyses

For compatibility with 1988 data, the ten 1993 cover classes were reduced to four and then converted to equivalent defoliation scores (100 - % cover). The defoliation scores for each species (mid-points of each class) were then compared between years, both within and between catchments, using repeated measures analysis of variance (ANOVA). Only trees scored twice (i.e., in 1988 and 1993) were used in the analysis. Between-catchment comparisons of original (1988) scores were made using one-way ANOVA, with post-hoc comparisons between pairs of catchments if the overall catchment effect was significant. Unless otherwise stated, the level of significance used throughout is $P < 0.05$.

4.2 POSSUM DENSITIES

In both surveys, the presence of one or more faecal pellets was recorded in plots of 114-cm radius spaced at 10-m intervals along the 15 transects (see Baddeley 1985). Relative possum densities were estimated from pellet frequencies on the transects. Because pellet frequencies can be affected by differences in decay rate and faecal output between years, 1993 pellet frequencies were adjusted by assuming a stable population level in the Taramakau.

5. Results

5.1 POSSUM DENSITIES

In 1988, highest possum pellet frequencies were recorded for the Deception (54%), and lowest for the Otira (20%; Table 1). By 1993, pellet frequencies had declined for both the Otira and Deception after intensive possum control by DOC. In contrast, pellet frequencies for the Taramakau increased in the absence of control. This increase was assumed to reflect differences in faecal output or decay rate between years rather than a real change in the possum population level. Adjusted pellet frequencies, assuming a stable possum population level in the Taramakau, indicated possum control had caused a 61% decline in the population in the Otira and an 82% decline in the Deception.

TABLE 1. CHANGES IN RELATIVE POSSUM POPULATION DENSITY (FAECAL PELLET % FREQUENCY) ON 15 REMEASURED TRANSECTS BETWEEN 1988 AND 1993

	OTIRA		DECEPTION		TARAMAKAU	
	1988	1993	1988	1993	1988	1993
Number of pellet plots	349	339	343	417	358	353
Pellet frequency (%)	20	11	54	14	34	48
Change in frequency 1988-93 (%)		-45		-74		+41
Adjusted population change 1988-93 (%)		-61		-82		0

5.2. TREE MORTALITY AND CROWN CONDITION

Mortality

Between 1988 and 1993, no remeasured canopy stems or trees died standing in any catchment, indicating that none had been killed by possum browsing. The few deaths recorded had been caused by natural windthrow.

Crown condition

In 1988 for the Otira and Deception, live southern rata, kamahi, and fuchsia were in good condition (>75% crown cover) and Hall's totara was in moderate condition (56-64% crown cover; Table 2). In the Taramakau, all four species were in poorer condition, reflecting a longer history of high possum population levels ($P < 0.01$ for southern rata, kamahi, and Hall's totara; see also Rose *et al.* 1988, unpubl. FRI contract report).

By 1993, most species measured showed evidence of small but significant declines in crown condition since 1988. Despite this, southern rata, kamahi, and fuchsia were in moderate to good crown condition in all catchments (58-74% crown cover; Table 2). In the Deception, mean crown cover declined by between 9% and 16% for all four species. In the Otira, Hall's totara, southern rata, and fuchsia declined by between 7% and 10%. In the Taramakau, southern rata and kamahi declined by 5% and 3% respectively.

The magnitude of these declines differed between catchments. For Hall's totara, the decline was significantly greater in the Otira and Deception (about 10%) than in the Taramakau. For kamahi, the decline was greater in the Deception (16%) than in the Otira (8%) or Taramakau (3%). In contrast, for southern rata and fuchsia, declines of 3-13% were not significantly different between catchments.

In 1993, southern rata was still in significantly poorer condition in the Taramakau than in other catchments. However, kamahi was now in worst condition in the Deception and there was no significant difference in Hall's totara and fuchsia crown condition between the three catchments (Table 2).

TABLE 2 CHANGES IN CROWN CONDITION (MEAN % FOLIAR CROWN COVER) FOR CANOPY STEMS OF FOUR MAJOR POSSUM-PREFERRED SPECIES IN EACH CATCHMENT BETWEEN 1988 AND 1993.

	OTIRA 1988		OTIRA 1993	DECEPTION 1988		DECEPTION 1993	TARAMAKAU 1988		TARAMAKAU 1993	AREA X TIME INTERACTION
Hall's totara (n = 295)	56	**	46	64	**	53	44		45	**
Southern rata (n = 371)	77	**	70	76	**	67	63	**	58	
Kamahi (n = 683)	81		73	83	**	67	77	*	74	*
Fuchsia (n = 90)	76		69	76	**	63	(69		66)	
n		454			556			429		

*Notes: Within each catchment, significant changes in crown condition for each species are indicated (blank = not significant; * = P<0.05; ** = P<0.01; brackets indicate insufficient sample size). Significant area x time interactions indicate different rates of change between catchments.*

6. Conclusions

Although 5 years of intensive control (at a direct cost of $212,000) has lowered possum populations in the Otira and Deception catchments by approximately 70%, there has not yet been any detectable improvement in crown condition for four major possum-preferred tree species. Instead, most show evidence of significant deterioration. If taken literally, these declines indicate no beneficial effect from possum control after 5 years. However, four factors suggest that a more conservative interpretation is appropriate:

(a) The remeasurement interval was relatively short. It is possible that trees previously stressed by browsing will take longer than 5 years to show signs of recovery after a 70% reduction in possum densities.

(b) The Taramakau is not an ideal non-treatment catchment for statistical comparisons. In the Taramakau, unlike the Deception and Otira, possum populations had already peaked and then crashed after severely depleting the most preferred forest types and causing extensive canopy mortality by 1988 (Rose *et al.* 1988, unpubl. FRI contract report). It is therefore likely that canopy deterioration would have been naturally slower over the past 5 years than in the less modified Otira and Deception. This highlights the difficulty of selecting non-treated and treated catchments with identical possum and dieback histories for statistical comparisons.

(c) Possible seasonal differences in crown cover within and between catchments could not be quantified. At three South Westland study sites, the average fuchsia crown cover declined by up to 22% as a result of heavy snow-break in winter 1992. At two other sites, snow-break had no detectable effect (Rose *et al.* 1993, unpubl. Landcare Research contract report.).

(d) Conversion from 1993 crown foliar cover scores to equivalent 1988 defoliation scores slightly overestimated the magnitude of any declines (Section 5.1.2).

However, as the Otira and Deception still contain some of the least modified montane conifer-broadleaved forests in central Westland and have been selected for long-term maintenance of relatively unmodified canopies (James 1991, unpubl. DOC report) it is advisable that DOC err on the side of caution. Although any beneficial effects of possum control in the Otira and Deception may take at least another 2 years to become large enough to mask other influences, the apparently greater deterioration of Hall's totara and kamahi than in the Taramakau suggests that the objective of arresting canopy dieback has not yet been met.

We therefore recommend that possum population levels should be reduced in the Otira and Deception by at least 90% within the next two years. DOC should then attempt to hold populations at this lower level. If resources are limited, effort should be concentrated on the less modified Otira. The transects and plots should be remeasured again in 2-5 years.

Because of a short history of monitoring canopy recovery after possum control, it is difficult to extrapolate results from a single study such as this to other areas. This highlights the need for long-term monitoring of possum populations and canopy condition in all areas selected for control, to assist development of control strategies that will provide sustained forest protection. Ideally, adjacent untreated areas should also be monitored. These will seldom act as adequate "controls" for statistical comparisons, but it is essential that DOC gain better knowledge of the likely fate of unprotected ecosystems.

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