The Impact of Controlled and Uncontrolled Possum Populations on Susceptible Plant Species, South Westland

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CONTENTS

1. Introduction

Brushtail possum populations are increasing and spreading in the relatively unmodified mixed beech-broadleaved forests of South Westland. Possum densities and their impact on highly susceptible plant species at key locations in South Westland were monitored by Manaaki Whenua - Landcare Research, Blenheim and Christchurch, under contract to the Department of Conservation (Investigation 799).

2. Background

Our 1990 survey of South Westland's mixed beech-broadleaved forests between the Mahitahi and Arawata Rivers concluded that 16% were affected by conspicuous canopy dieback induced by possum-browsing (Fig. 1a; Rose *et al.* 1990, unpubl. FRI contract report). This relatively low level of depletion reflected overall low possum densities and a short history of occupation consistent with colonising populations. Because of the predominance of beeches (*Nothofagus*) in the canopy, the South Westland forests were judged less susceptible to such dieback than the southern rata-kamahi (*Metrosideros umbellata - Weinmannia racemosa*) forests of central Westland (>90% affected; Rose *et al.* 1992). However, for South Westland, an estimated one-third of the forests could potentially develop conspicuous canopy dieback if possum numbers increase and at least 44% are moderately or highly susceptible to canopy and/or understorey depletion. Forests of low susceptibility include those typical of poorly-drained, highly infertile soils or lacking possum-preferred species.

The 1990 survey identified three major canopy dieback nuclei (areas with conspicuous dieback of seral forests or both seral and mature forests; Fig. 1a): in the north (Mahitahi-Paringa catchments), east (upper Haast-Landsborough), and south (Waiatoto). The location of these reflected prolonged browsing by possum populations that had invaded from three known liberation centres. Monitoring of overall canopy dieback, possum population density, and the condition of highly susceptible fuchsia stands continued at known possum invasion fronts adjacent to these dieback nuclei, and is reported here.

3. Objectives

- To assess and map the spread of canopy dieback in both mature and seral forests along possum invasion fronts.

- To determine the possum population densities at which highly susceptible fuchsia stands become heavily defoliated.
- To determine whether possum control provides sustained protection of susceptible vegetation.

4. Methods

4.1 CANOPY DIEBACK SURVEY

To determine whether visually conspicuous canopy dieback was spreading in South Westland, dieback patterns identified in the 1990 survey were re-assessed in 1992. Using methods developed for the earlier survey (Rose *et al.* 1990, unpubl. FRI contract report), dieback of both seral (primarily fuchsia) and mature forests (primarily southern rata) was scored from a helicopter or from ground-based inspections in areas adjacent to the known dieback nuclei. Canopy dieback was mapped in three classes:

- Intact: <10% dieback of the mature-forest canopy; no detectable dieback of seral forests.
- Light: <10% dieback of the mature-forest canopy; seral forests showing conspicuous dieback.
- Moderate: 10-30% dieback of the mature-forest canopy; seral forests showing conspicuous dieback.

4.2 PERMANENT REFERENCE SITES IN FUCHSIA FOREST

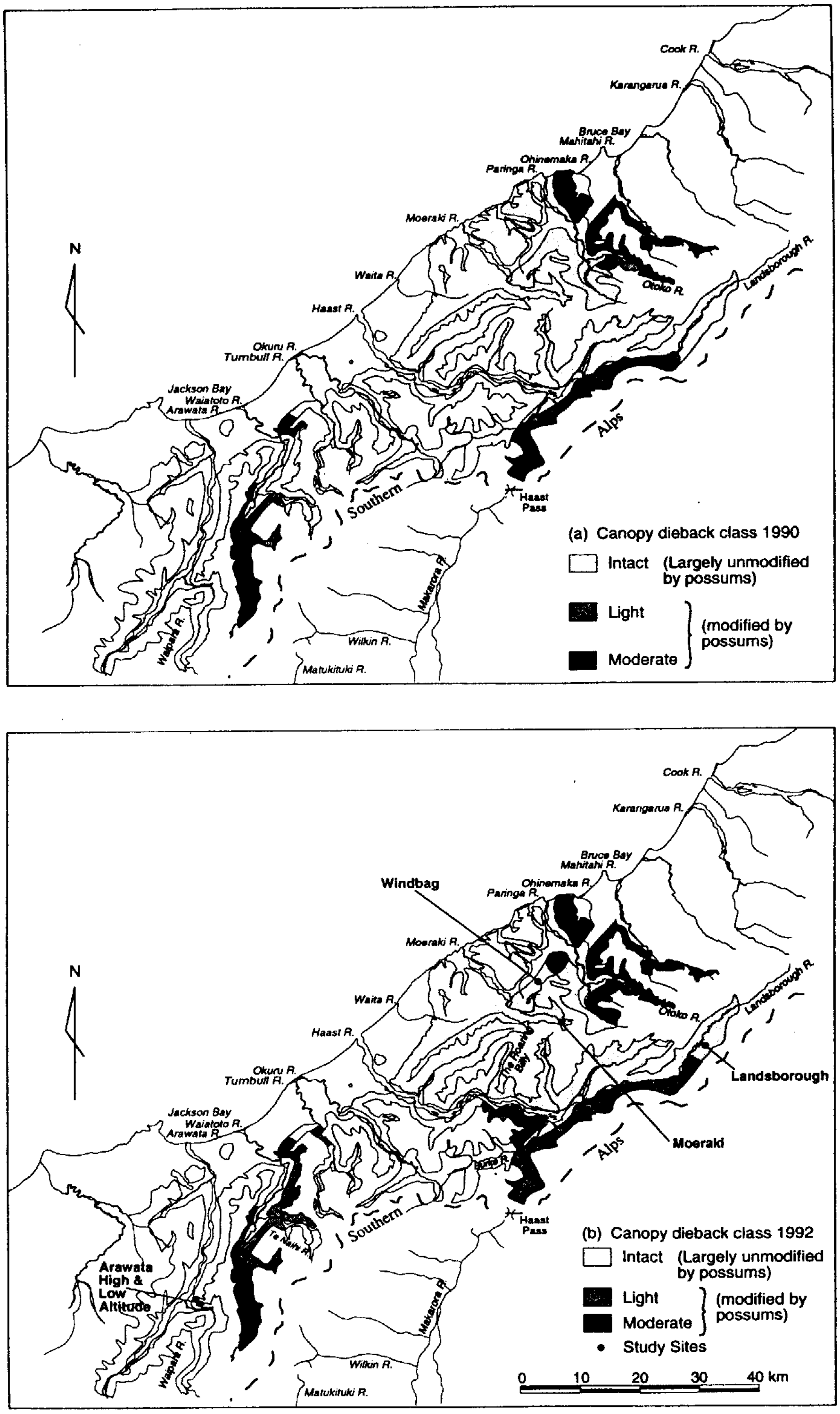
Site selection

Based on dieback and possum invasion patterns identified by the 1990 survey and further field inspections in 1990 - 1991, five permanent reference sites were selected in fuchsia forest classified as largely unmodified by possums, where possum population densities were assumed to be low. Two sites were located in the upper Moeraki and Windbag Valleys (Fig. 1b), areas recently selected by DOC for ongoing control of colonising possum populations with low densities (James 1990, unpubl. DOC report). Three sites were located at possum invasion fronts where official control has not been attempted: in the Landsborough Valley (one site) and the Arawata Valley (Arawata Low Altitude and Arawata High Altitude sites).

We initially intended to also sample an invasion front in the Waiatoto Valley. However, field inspections in 1991 indicated most fuchsia trees were already dead or severely defoliated (Section 6.1).

FIG. 1 DISTRIBUTION OF VISUALLY CONSPICUOUS CANOPY DIEBACK, ASSESSED FROM AERIAL AND GROUND-BASED SURVEYS IN 1990 (A) AND 1992 (B).

Three major dieback nuclei (Mahitahi-Paringa, Landsborough, and Waiatoto) are indicated by the areas showing light dieback (i.e., only seral forest affected) or moderate dieback (both seral and mature forest affected; see Methods). The location of the five permanent reference sites used for detailed monitoring of possum density and fuchsia crown condition in 1992 and 1993 is also shown.



Field methods

At each reference site, fuchsia crown condition and possum population density were assessed along a 10 or 20-m wide, permanently marked belt transect in 1992 and 1993 (i.e., November 1991–January 1992 and December 1992–January 1993).

Tree measurements

Approximately 100 live fuchsia stems ≥ 5 cm dbh were permanently marked along each belt transect. For each stem, the following parameters were recorded:

- Crown condition, assessed from visual estimates of percentage crown foliar cover using a reference scale adapted from Avery (1966). Cover was assessed in five classes in 1992 (≤ 10; 11-40; 41-70; 71-90; >90%) and in 10% classes in 1993.
- Recent possum browsing damage and visually obvious use of the trunk (scratches, runs, bite marks), each in four classes (absent, light, moderate, heavy).
- Recent damage from natural disturbances (e.g., windthrow, snowbreak).

Possum population assessment

Relative possum population densities were assessed from percentage trap-catch rates for one fine night. Leg-hold traps (35) were located at permanently marked sites, approximately 20 m apart, along the belt transects. Where necessary, trap lines were extended into similar forest at either end of the transects.

Effects of intensive localised possum control

The recovery potential of heavily defoliated fuchsia was investigated by trapping possums more intensively at the Arawata Low Altitude site (Fig. 1b). For the 1992 season, 24 possums were trapped over 3 nights during early fuchsia bud-burst (November 1991) and 36 were trapped over 2 nights after complete bud-burst (January 1992). For the 1993 season, 45 possums were trapped over 3 nights after complete bud-burst (December 1992).

Statistical analyses

For statistical analyses, % crown cover for each fuchsia stem was assigned the mid point of the appropriate cover class (five class scale used). Only stems that were live and standing in both years were included in analyses. Within years, mean fuchsia crown cover was compared between areas using analysis of variance (ANOVA) and Fisher's Least Significant Difference Test. Trends over time were assessed by univariate repeated measures ANOVA. The level of probability used throughout was $P<0.01$.

5. Results

5.1 CANOPY DIEBACK SURVEY

For mature forests, the area affected by conspicuous canopy dieback did not increase between 1990 and 1992 (moderate dieback class, Figs 1a, b). In contrast, the area of affected seral forest increased at all known possum invasion fronts (light dieback class, Figs 1a, b).

Northern invasion front

In the upper Paringa-Otoko catchment, seral forest dieback had progressed southward from the Otoko to reach the north bank of the Paringa headwaters by 1992.

A new dieback nucleus was recorded for the lower south bank of the Paringa. This is of concern as the area is part of a buffer zone for the Moeraki-Windbag possum control area and has been trapped intensively for DOC by contract hunters. However, no areas of seral forest dieback had developed in the Moeraki-Windbag (Fig 1).

Southern invasion front

Ground inspections in the lower Waiatoto revealed severe damage to fuchsia (Section 5.2). Discussions with a local runholder (K.J. Eggeling *pers. comm.*) suggested fuchsia in the Te Naihi tributary was similarly affected (this should be investigated further). It is not clear how much of this dieback is new. The fuchsia stands would not have been readily visible from a helicopter in 1990 because they are typically small and are over-topped by surrounding silver beech forest.

Aerial inspection indicated a new nucleus of seral forest dieback had developed on the lower south bank of the Turnbull catchment (Fig. 1b), an area selected in 1993 by DOC for ongoing possum control. This, combined with the mature forest dieback between the Waiatoto and Turnbull observed in 1990, probably indicates that possums have spread down the Waiatoto and are now spreading through the western front country and up nearby valleys.

Possum populations, probably originating from the Waiatoto, are increasing in the Waipara and Arawata valleys (Fraser 1992, unpubl. FRI contract report). Although dieback was not visually conspicuous in 1992, ground inspections revealed defoliation of southern rata in the lower Waipara Gorge, and of fuchsia (Section 6.2) and mistletoe (*Peraxilla colensoi*) near the Waipara-Arawata junction.

Eastern invasion front

In the Haast-Landsborough catchment, by 1992 seral forest dieback had spread down the south bank of the Haast, from the confluence of the Burke to opposite The Roaring Billy (Fig. 1b). Such dieback had also spread further up the east bank of the Landsborough to about the upper-valley limit of fuchsia forest. The west bank of the Landsborough and north bank of the Haast were unaffected.

6.2 PERMANENT REFERENCE SITES IN FUCHSIA FOREST

Possum population density

In 1992, 1-night catch rates indicated marked differences in possum population density between sites (Table 1). Highest relative densities were recorded for the Arawata Low Altitude site, (40% catch rate), and the lowest for sites in the Moeraki (3%) and Windbag (6%), within the DOC possum control area.

TABLE 1. RELATIVE POSSUM POPULATION DENSITIES AT THE FIVE STUDY SITES (1-NIGHT % CATCH RATES).

	CATCH RATE (%)	
	1992	1993
Arawata Low Altitude	40	37
Arawata High Altitude	17	23
Landsborough	14	6
Windbag	6	3
Moeraki	3	0

For all sites, catch rates showed little change between 1992 and 1993, confirming that such trapping had little impact on possum population densities (Table 1). Even for the more intensely trapped Arawata Low Altitude site (trapped for 5 nights in 1992), population levels had recovered by 1993, suggesting possums immigrated from surrounding habitats.

For the three sites with sufficient sample size, populations consisted of predominantly light-coloured animals (76%, Arawata and Landsborough).

Fuchsia crown condition

Although the forests at all study sites were mapped as largely unmodified by possums in the 1990 and 1992 surveys, more intensive investigation showed that average fuchsia crown condition differed markedly and significantly between sites (Table 2). This emphasises the under-estimation of possum-induced modification based on visually conspicuous canopy dieback alone (Rose *et al.* 1992; 1990, unpubl. FRI contract report). For example, fuchsia was in best condition at the Moeraki site (83% average crown cover), but appeared to be on the threshold of extensive mortality at the Arawata Low Altitude site (only 31% average crown cover).

TABLE 2: AVERAGE FUCHSIA CROWN COVER (%) AT THE FIVE STUDY SITES.

	1992	1993	n
Arawata Low Altitude	31	44a	99
Arawata High Altitude	39a	42a	96
Landsborough	61	52b	94
Windbag	76	54b	84
Moeraki	83	63	89

Notes: n = number of standing live stems scored in both years. Values followed by the same letter are not significantly different.

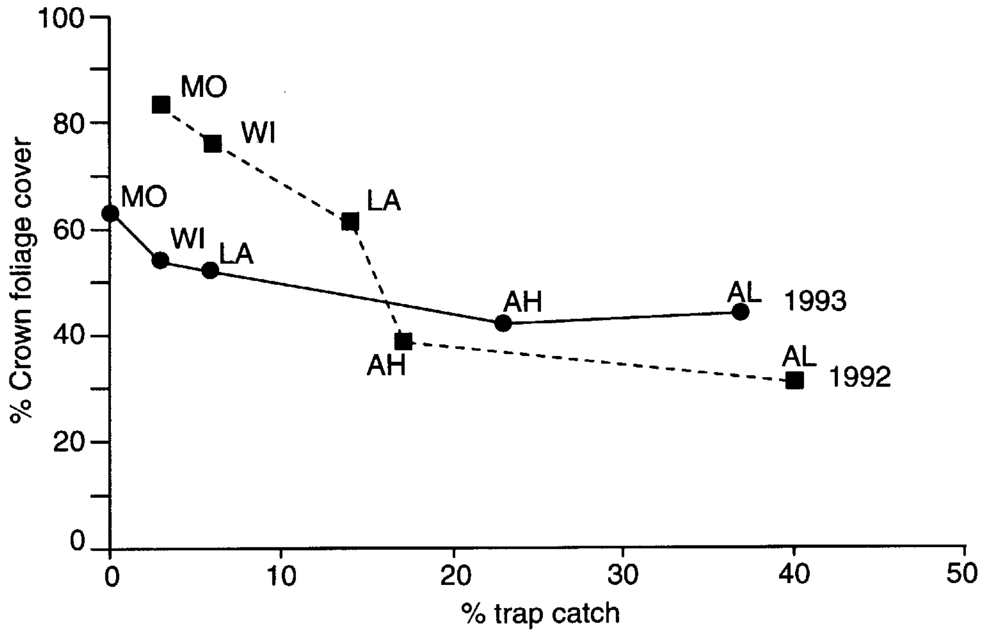
For all sites except Arawata High Altitude, fuchsia crown condition changed significantly between 1992 and 1993 (Table 2). However, the direction and degree of change also differed significantly. The only significant improvement in condition was recorded for the Arawata Low Altitude site (31% to 44% crown cover). In contrast, marked decreases were recorded for the Landsborough (61% to 52%), Windbag (76% to 54%), and Moeraki (83% to 63%).

Impact of possums on fuchsia

Average fuchsia crown condition declined sharply with increasing possum population density (Fig. 2). In 1992, low possum densities were reflected in high average crown cover (Windbag and Moeraki; $\leq$ 6% catch rate, >75% crown cover). Where catch rates approached or exceeded 20%, crown cover was markedly reduced (<40%; Arawata High and Low Altitude). In 1993 although the relationship was less pronounced, fuchsia crown condition was still inversely related to possum density.

There was a general trend of declining crown condition with increasing evidence of browsing and trunk-use in both years (Figs 3, 4). However, any differences in the relationships between years should be treated with caution. Both factors were difficult to detect consistently and were therefore under-estimated. Whole leaves, petioles, and small twigs were removed by possums and evidence of trunk-use was often indistinct because fuchsia bark peels off naturally. For example, even at highest possum densities (Arawata Low Altitude) only 15% of crowns showed obvious sign of browsing and 43% of stems showed sign of use by possums in 1992.

FIG. 2 RELATIONSHIP BETWEEN MEAN FUCHSIA CROWN CONDITION AND RELATIVE POSSUM DENSITY AT THE FIVE STUDY SITES IN 1992 AND 1993.



Site abbreviations are:

MO = Moeraki

WI = Windbag

LA = Landsborough

AH = Arawata High Altitude

AL = Arawata Low Altitude

n = 462

(see Table 2).

Effects of snow-break and trapping

Differences in the relationship between average crown condition and percent trap catch between 1992 and 1993 (Fig. 2) were influenced by the opposing impact of snow-break and reduced browsing pressure after intensive trapping. Heavy snow falls in winter 1992 caused extensive damage to forest canopies over much of the South Island. In the study area, the impact of snow-break on fuchsia crowns varied between sites. Heavy snow damage significantly reduced fuchsia crown cover at the three sites with lowest possum densities (Moeraki, Windbag, Landsborough), with 8-21% of stems obviously damaged or completely collapsed in 1993 (Tables 2, 3). Observed damage under-estimated the actual loss of small branches and twigs.

FIG. 3 RELATIONSHIP BETWEEN MEAN FUCHSIA CROWN CONDITION AND PROPORTION OF STEMS WITH OBVIOUS POSSUM-BROWSING DAMAGE TO THE CROWN; n = 462.

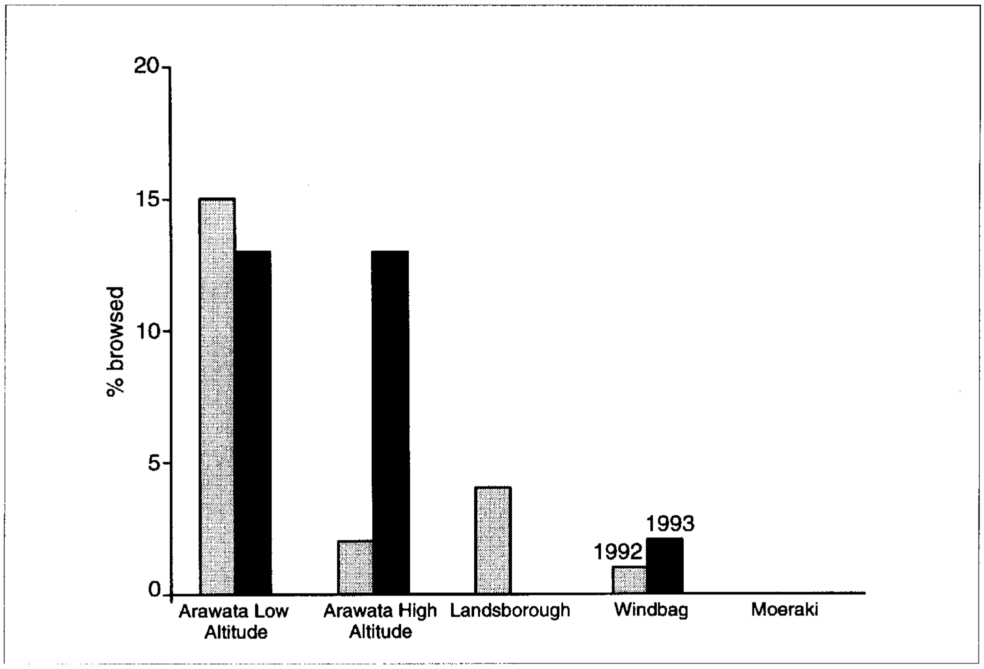


FIG. 4 RELATIONSHIP BETWEEN MEAN FUCHSIA CROWN CONDITION AND PROPORTION OF STEMS WITH OBVIOUS SIGN OF USE BY POSSUMS (RUNS, SCRATCHES, BITE MARKS); n = 462.

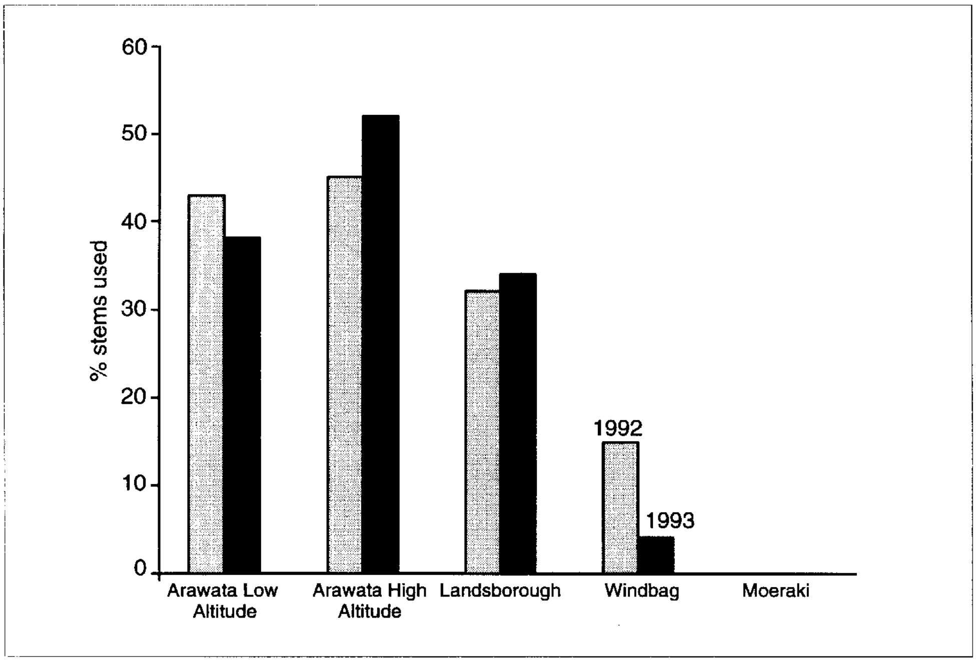


TABLE 3. DAMAGE TO FUCHSIA FROM SNOW-BREAK AT THE FIVE SITES DURING THE WINTER OF 1992

	PROPORTION OF STEMS AFFECTED (%)		n
	WHOLE STEM COLLAPSED	PARTIALLY DAMAGED	
Arawata Low Altitude	0	0	100
Arawata High Altitude	0	0	101
Landsborough	1	12	99
Windbag	4	4	91
Moeraki	14	7	104

Note: n = total number of standing live stems in 1992.

In contrast, no obvious snow damage was seen at the two sites with highest possum densities (Arawata High and Low Altitude). Here, the different trends in fuchsia crown condition between 1992 and 1993 (Table 2) reflected differences in trapping intensity. For the Arawata Low Altitude site, a significant improvement in fuchsia crown condition reflected partial recovery after relatively intensive localised trapping. In contrast, at the Arawata High Altitude site, crown condition remained unchanged in the absence of intensive control.

For the Arawata Low Altitude site, although the annual trap catches revealed little change in possum density between 1992 and 1993, this underestimated the effects of our trapping, which removed some 60 animals in the early and mid 1992 growing season (compared with a maximum of only six possums at other sites). Therefore, intensive trapping apparently lowered the population sufficiently and for long enough to allow some vegetation recovery before immigration restored possum densities by December 1993.

6. Conclusions

Continuing spread and build-up of possum populations in South Westland, reflected in increased amounts of dieback in seral fuchsia forest between 1990 and 1992, pose an ongoing threat to susceptible species and ecosystems.

Seral forest dieback is increasing in the Paringa catchment adjacent to the DOC possum control area in the Moeraki-Windbag catchments. Recent development of such dieback in the newly selected possum control area in the Turnbull catchment indicates this area is similarly threatened. The Department should therefore continue or increase control effort and monitor its effects in the Moeraki, Windbag, Turnbull, and surrounding areas.

An increase in seral forest dieback on the south bank of the Haast catchment indicates the forests of this area are under direct threat from possums. The mature forests are relatively rich in unmodified southern rata and flank the Haast Pass highway. We recommend that the Department urgently considers protecting these ecosystems.

Our study suggests that for a given forest type there is a general relationship between possum densities and canopy damage. However, widespread application of such a relationship will be confounded by differences in the composition of surrounding habitats, the length of occupation by possums, and chance factors such as natural disturbances. Assessments of canopy damage to highly susceptible, rapid-response indicator species, such as fuchsia, provide a reliable framework for gauging the need for, or success of, possum control and give a more direct estimate than possum density alone.

The rapid response of heavily defoliated fuchsia to relatively intense, localised possum control at the Arawata Low Altitude site suggests that such control may provide an alternative, cost-effective means of protecting highly-preferred habitats threatened by possums. This may prove especially useful in otherwise beech-dominated forests. The utility of such an approach, and its effects on possum impact on surrounding habitats should be further investigated.

Only long-term monitoring can indicate whether possum control is sufficient to provide sustained protection. In possum control areas and adjacent untreated areas, assessments of vegetation condition should be continued on an annual or biennial basis, with longer remeasurement intervals as trends dictate. The sites used for this study should be remeasured.

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