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EFFECT OF DEER HUNTING ON BEECH FOREST HABITAT: KAIMANAWA RANGES

by

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ABSTRACT

Enclosure plot reassessment after seven years of deer exclusion in mountain beech forest with Kaimanawa Forest Park shows significant changes in understorey composition. The study assess two sites which are exposed to different recreational hunting pressure due to differences in their accessibility. Significant differences between these sites reflect a degree of change related to hunting pressure. Management implications are discussed and recommendations made.

1.0 INTRODUCTION

Introduced animals such as deer can have major impacts on the conservation through a variety of processes including browsing, defoliation and of regeneration. Control of such animals to minimise these impacts needs to be cost effective and the results of control need to be measurable.

Paired plots consisting of a fenced exclosure and an adjacent unfenced control are a standard tool for assessing such impacts. The basic approach is to compare abundance and diversity of plant species of differing palatability (appendix I) within the plots.

Comparison of paired plots in similar forest types but in different catchments subject to different recreational hunting pressures may highlight the effectiveness of this form of management. However, reliable data must be available on hunting effort and rate of deer before the effects of recreational hunting can be evaluated in full.

This report describes the results of such comparisons made possible by the reassessment of exclosure plots and collection of data from recreational hunters in Kaimanawa Forest Park in the Tongariro/Taupo Conservancy.

1.1 BACKGROUND

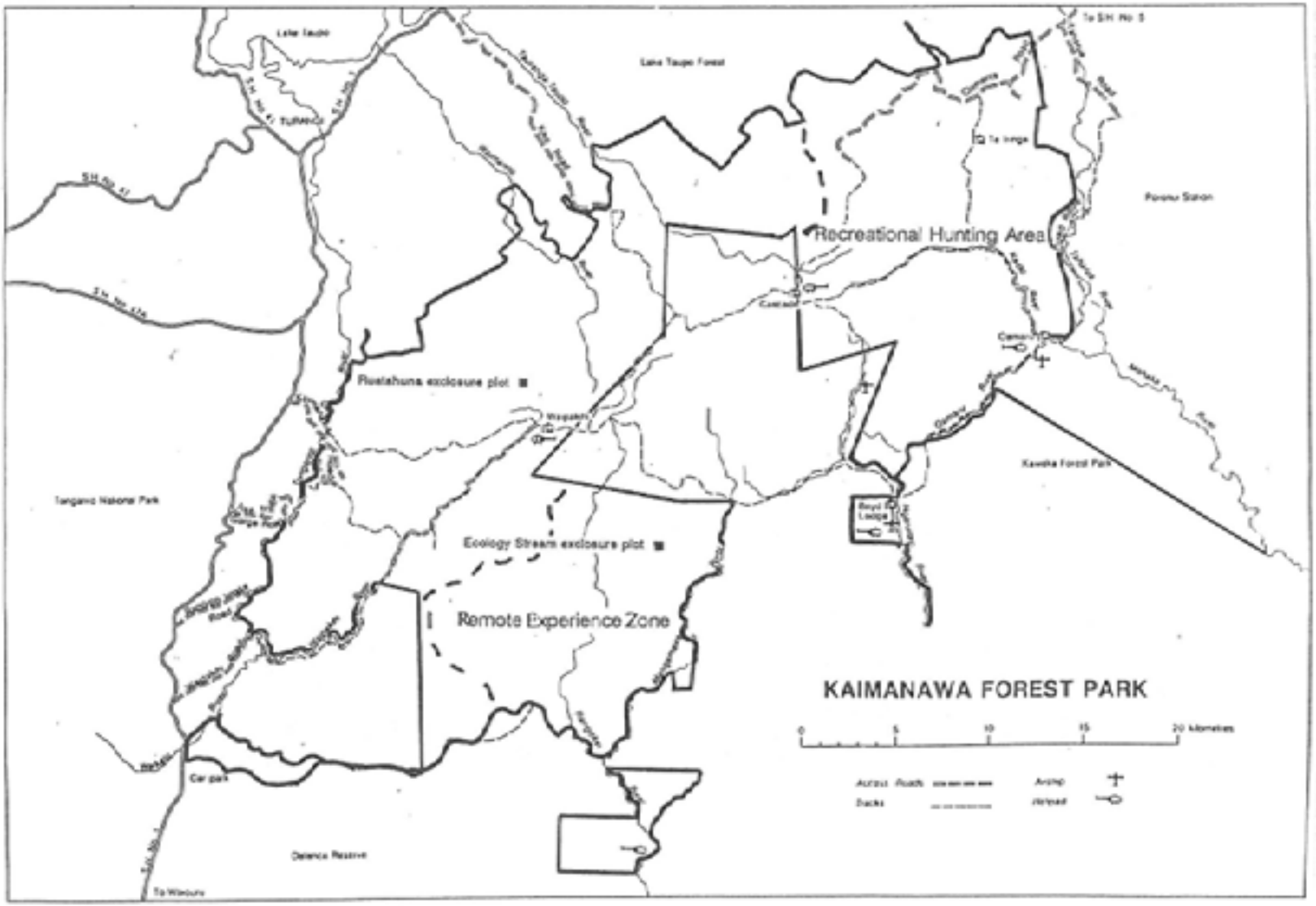
During February 1991 exclosure plots WN 335 (Ruatahuna) and WN 338 (Ecology Stream) within Kaimanawa Forest Park (figure 1) were reassessed seven years after their establishment. Both plots were in good condition with fences intact and functional as a result of regular inspection and maintenance.

The plots are located in mountain beech forest habitat and were established to monitor the impacts of the deer browse. Possums are not excluded by the type of fence used on the plots so the differences between exclosure and control plots discussed in this report are attributed to deer alone, unless otherwise stated.

The Ruatahuna plot is located at an altitude of 1225 metres above sea level near the bushline on the northern Umukarikari Range in the head of the Waipakihi Valley. The Ecology Stream plot is located at 1020 metres above sea level on the first river terrace above the main river on the valley floor of a major tributary in the upper Rangitikei River catchment.

Sika deer and red deer occur at both sites. However, as over the majority of the Kaimanawa Ranges, sika deer are more common at lower altitudes while red deer predominate at higher altitudes near or above the bushline.

MAP OF KAIMANAWA FOREST PARK SHOWING FEATURES REFERRED TO IN TEXT



1.2 METHODOLOGY

The paired 20 by 20 metre vegetation plots associated with both exclosures were remeasured according to the techniques described in the Forest Research Institute vegetation manual (Allen and McLennan 1983). This included diameter measurements for all trees greater than two centimetres in diameter at breast height (DBH); total counts by species of all trees and shrubs greater than 1.4 metres high but less than two centimetres DBH; total counts by species of all seedlings at 24 circular seedling plots (0.49 metres radius); and the completion of forest reconnaissance description forms for each plot.

Paired plots are located at sites where two 20 by 20 metre plots can be established which are as similar as possible in terms of species composition, structure, basal area, aspect, slope, topography, etc.. This ensures comparisons of the plots are not biased by physical influences other than those placed on the forest by deer.

Data analysis was undertaken using a pocket calculator and simple sorting routines.

Hunting effort and harvest data for the conservancy is obtainedc through a hunting permit/diary system. This information is also stored and sorted using dBase III+.

2.0 RESULTS

2.1 ECOLOGY STREAM : GENERAL IMPRESSIONS

There was a significant visual difference between the fenced and control plots. Seedling and small sapling growth inside the fence were prolific up to approximately one metre. Ferns were vigorous having greater density and species diversity. In contrast the control plot appeared to have a near-naked understorey except for a few very small seedlings and moss up to about 10 centimetres. Deer sign was very obvious in the general area of the exclosure.

Canopy:

The paired plots occur under the intact canopy of an even aged pole stand of mountain beech. The stand has a mean top height of 17 metres, a basal area of 47.8 square metres per hectare and a stem density of 1625 stems per hectare. The dense canopy of the stand has resulted in the continuation of natural stand thinning since the plots were established, with 28 and 29 stems standing dead in the fenced and control plots respectively. The only visual difference between the canopy trees on the two plots was the lack of foliage on the lower branches in the control plot, below about 1.5 metres.

Sub Canopy:

The forest type here has a sparse sub canopy of broadleaf (*Griselinia littoralis*) and mountain toatoa (*Phyllocladus alpinus*). A small number of trees about six metres in height are present. Browse on epicormic growth (shoots sprouting from the base) was noted on broadleaf within the control plot.

Sampling Tier:

The number of shrubs and saplings taller than 1.4 metres and with diameters less than two centimetres were totalled for each plot on a species by species basis. Table I summarises these data.

SPECIES	PLOT 1 (fenced)	PLOT 2 (unfenced)
MEDIUM PALATABILITY		
Coprosma 'taylorise'	1	-
LOW PALATABILITY		
Myrsine divaricata	7	32
Phyllocladus alpinus	1	1
Total	9	33

Table I

Comparisons of the numbers of shrub/sapling (taller than 1.4 metres) for fenced and unfenced plots associated with the Ecology Stream exclosure plot - Upper Rangitikei River Catchment, Kaimanawa Forest Park 1991.

Seedling/Sapling Counts:

All seedling and saplings present in each of 24 0.49 metres radius seedling plots were counted by species and by height class. Table II summarises these data. Species of high, moderate and low palatability (appendix I) are grouped for easier identification of trends.

SPECIES	Percentage Frequency of Occurrence < 15 cm at 24 x 0.49 m radius Seedling Plot Centres		Seedling Plot Centre Totals 16-45 cm		Seedling Plot Centre Totals 46-75 cm		Seedling Plot Centre Totals 96-105 cm		Seedling Plot Centre Totals > 106 cm	
	Plot 1	Plot 2	Plot 1	Plot 2	Plot 1	Plot 2	Plot 1	Plot 2	Plot 1	Plot 2
HIGH PALATABILITY										
Griselinia littoralis	87.5	41.6	20	-	-	-	-	-	-	-
Coprosma tenuifolia	4.1	-	6	-	-	-	-	-	-	-
Pseudopanax simplex	37.5	20.8	6	1	1	-	-	-	-	-
MEDIUM PALATABILITY										
Coprosma 'taylorae'	95.8	95.8	153	48	15	-	3	-	1	-
Coprosma microcarpa	16.6	16.6	3	1	-	-	-	-	-	-
Coprosma pseudocuneata	16.6	12.5	4	-	-	-	-	-	-	-
Coprosma foetidissima	4.1	8.3	1	-	-	-	-	-	-	-
Nothofagus var.cliffortioides	95.8	95.8	66	2	-	-	-	-	-	-
Hebe stricta	8.3	-	2	-	-	-	-	-	-	-
LOW PALATABILITY										
Myrsine divaricata	87.5	41.6	19	4	1	-	1	-	-	-
Phyllocladus alpinus	37.5	20.8	5	1	1	-	-	-	-	-
Leucopogon fasciculatus	-	8.3	-	-	-	-	-	-	-	-
TOTALS			279	57	18	-	4	-	1	-

Table II

Summary of seedling plot data for woody species in the fenced (1) and unfenced (2) plots of Ecology Stream exclosure plot.

Species Density and Abundance:

Forest reconnaissance description forms were completed for both fenced and control plots listing all species present in each tier and identifying those species which dominated (appendix 2A). Both plots were the same above two metres reflecting the fact that the exclosure has been operating for seven years only. Below two metres, however, species density and diversity has changed significantly on the fenced plot. This plot contains numerous species, mostly of moderate or high palatability (see appendix I), which are absent from the control. These include:

- *Cordyline indivisa*
- *Hebe stricta*
- *Astelia fragrens*
- *Dicksonia lanata*
- *Coprosma tenuifolia*

(Refer appendix 2A).

Some species present as small seedlings outside the fence were considerably more numerous and vigorous inside the exclosure. The most notable changes in this respect again related to palatability were (in order of magnitude):

- *Pseudopanax simplex*
- *Griselinia littoralis*
- *Polystichum*
- *Uncinia* species
- *Coprosma 'taylorae'*
- *Coprosma pseudocuneata*

(Refer Table II).

Both *Myrsine divaricata* and *Phyllocladus alpinus* do not appear to be greatly affected by deer browse. *Phyllocladus alpinus* appeared with similar frequency in both plots. *Myrsine divaricata* despite showing better regeneration inside the fence appears to be one of the few species, due to its low palatability, which remains competitive in the browse range on the control plot with 32 shrubs present.

Antler thrashing of young *Phyllocladus alpinus* has resulted in the death of some smaller individuals on the control plot.

2.2 RUATAHUNA : GENERAL IMPRESSIONS

There was a significant visual difference between the fenced and control plots at this site also. Seedling and small sapling growth inside the fence was prolific up to a height of one metre. Ferns were considerably more diverse and vigorous. While the shrubs and larger saplings on the control plot formed a moderately dense understorey, the absence of seedlings and ferns on the ground tiers gave the forest floor a more open look in comparison to the exclosure.

Of major significance was the canopy damage to the fenced plot since establishment of the exclosure. This has allowed higher light intensity to reach the forest floor and has undoubtedly influenced the prolific growth inside the fence. Because the unfenced control plot still has an intact canopy, future comparisons between the paired plots will be less conclusive, unless canopy collapse also begins on the control.

Red deer sign was obvious in the general area of the exclosure.

Canopy:

The exclosure has been established in a mixed age stand of mountain beech, just below the bush line. The forest has a mean top height of 12-14 metres with a canopy stem density of around 2950 stems per hectare and a basal area of around 45 square metres per hectare. Wind damage to the canopy trees in the fenced plot since establishment has reduced basal area on this plot to 36.8 square metres per hectare. Crown damage associated with wind fall has also opened the canopy considerably. The range in age classes of the canopy species in the general area suggests the canopy has undergone frequent break down in the past and that this is a typical and regular event in this forest type.

Sub Canopy:

The forest type in which the exclosure is sited has a low density sub canopy of broadleaf (260 stems per hectare), haumakoroa *(Pseudopanax simplex)* (135 stems per hectare) and mountain toatoa (225 stems per hectare). Despite some minor possum browse to the haumakoroa, epicormic browsing by deer on broadleaf and occasional antler thrashing by deer on mountain toatoa, the sub canopy appears healthy.

Shrub Understorey Tier:

The two to five metre tier at this site was moderately dense with *Coprosma 'taylorae', Myrsine divaricata* and *Coprosma pseudocuneata* dominating up to a height of approximately three metres. A number of dead specimens of *Coprosma 'taylorae'* and *Coprosma foetidissima* with diameters up to 8.7 centimetres suggest many of the individuals in this tier are very old.

Sapling Tier:

Shrubs and saplings greater than 1.4 metres high and with diameters of less than two centimetres were totalled for each plot on a species by species basis. Table III summarises this information. Species of high, moderate and low palatability (appendix I) are grouped for easier identification of trends.

SPECIES	PLOT 1 TOTALS (fenced)	PLOT 2 TOTALS (unfenced)
HIGH PALATABILITY		
Pseudopanax simplex	12	-
MODERATE PALATABILITY		
C 'taylorae'	34	18
Coprosma pseudocuneata	59	7
C foetidissima	10	4
Nothofagus var. cliffortioides	7	10
Hebe stricta	1	-
LOW PALATABILITY		
Myrsine divaricata	25	35
Phyllocladus alpinus	17	17
Podocarpus hallii	-	1
Leucopogon fasciculatus	1	-
Pseudowintera colorata	-	2
TOTALS	166	94

Table III

Comparisons of the numbers of shrub/sapling (taller than 1.4 metres) for fenced and unfenced plots associated with the Ruatahuna exclosure plot - Waipakihi Valley, Kaimanawa Forest Park 1991.

Seedling/Sapling Counts:

The understorey tiers showed significant differences, related to both removing the influence of deer browse from the fenced plot and canopy damage which has allowed greater light penetration through the canopy to the forest floor inside the exclosure. Table IV shows the differences in seedling and sapling density and diversity in the different height classes, between the fenced and unfenced plots after seven years.

SPECIES	Percentage Frequency of Occurrence < 15 cm a' 24 x 0.49 m Radius Seedling Plot Centres		Seedling Plot Centre Totals 16-45 cm		Seedling Plot Centre Totals 46-75 cm		Seedling Plot Centre Totals 96-105 cm		Seedling Plot Centre Totals 106-135 cm		Seedling Plot Centre Totals > 135 cm	
	Plot 1	Plot 2	Plot 1	Plot 2	Plot 1	Plot 2	Plot 1	Plot 2	Plot 1	Plot 2	Plot 1	Plot 2
HIGH PALATABILITY												
Griselinia littoralis	70.8	66.7	52	-	2	-	6	-	-	-	-	-
Pseudopanax simplex	83.3	83.3	29	-	3	-	-	-	1	-	-	-
MODERATE PALATABILITY												
Coprosma 'taylorae'	79.1	83.3	45	23	29	3	2	1	-	-	2	-
Coprosma microcarpa	-	8.3	-	2	-	-	-	-	-	-	-	-
Coprosma pseudocuneata	66.7	58.3	17	3	21	-	19	-	4	-	4	-
Coprosma foetidissima	25.0	54.2	8	1	-	-	1	-	-	-	-	-
Nothofagus var. cliffortioides	37.5	16.7	30	-	9	1	5	-	3	-	-	-
Hebe stricta	-	16.7	-	2	-	-	-	-	-	-	-	-
LOW PALATABILITY												
Myrsine divaricata	54.2	91.7	40	1	9	-	-	1	-	2	1	2
Phyllocladus alpinus	37.5	41.7	14	3	6	1	5	-	2	-	1	-
Podocarpus hallii	4.2	8.3	1	1	-	-	-	-	-	-	-	-
Leucopogon fasciculatus	-	-	1	-	1	-	5	-	-	-	-	-
Pseudowintera colorata	8.3	50.0	5	2	2	1	-	-	-	1	-	-
TOTALS	-	-	242	38	82	6	43	2	10	3	8	2

Table IV

Summary of seedling plot data for woody species in the fenced (1) and unfenced (2) plots of Ruatahuna exclosure plot.

Species Diversity and Abundance:

Forest reconnaissance description forms were completed for both fenced and control plots, listing all species present in each tier and identifying those species which dominated (appendix 2B). The exclosure and the control plots at Ruatahuna have similar species composition in all tiers above two metres as a result of site influences before the exclosure was established. Some physical changes have occurred independent of deer browse (that is canopy damage by wind and/or snow) since establishment which have altered the structure of upper tiers in the fenced plot.

The ground tiers of the two plots (below two metres) show significant differences in species diversity and abundance (table IV) as a result of deer presence/exclusion. Some species such as *Pseudowintera colorata* and *Myrsine divaricata* are relatively unpalatable to deer (appendix I). They have become more competitive outside the fence due to the removal of more palatable species, hence increasing their abundance.

Inside the exclosure a number of species have established which do not occur in the control plot. These include the ferns *Blechnum discolor, B. capense, Paesia scaberula* and *Histiopteris incisa, Coprosma tenuifolia*, toe toe and bush rice grass.

While some of these species are highly palatable to deer (for example *Coprosma tenuifolia*) others (*H. incise, P. scaberula* and bush rice grass) are not. These unpalatable species are occurring inside the fence more because of the light environment created by the canopy damage on this plot.

Saplings and taller seedlings of a number of palatable species, however, are clearly absent from the control plot (table III, IV) because of deer browse. The lack of larger *Pseudopanax simplex* and *Griselina littoralis* seedlings and saplings in the control plot, despite a high frequency of occurrence below centimetres, is evidence of the impacts deer are having in the understorey.

Other species of moderate palatability (*Coprosma 'taylorae', Coprosma foetidissima*, *Coprosma pseudocuneata*) occur in both plots but with lower density in the control (tables III, IV).

2.3 HUNTING EFFORT AND HARVEST DATA

All hunters hunting in the Tongariro/Taupo Conservancy are asked to complete and return a hunting diary upon expiry of their hunting permits (appendix 3). During 1990 a total of 6868 hunting permits were issued and so far some 2170 hunting diaries (31.6% of issues), recording 8122.0 days of hunting, have been returned. These data are stored and analysed on dBaseIII+.

Table V summarises the data obtained for selected sites within the conservancy.

AREA/BLOCK	DAYS HUNTED	PERCENTAGE OF SPECIFIED HUNTING EFFORT	KILLS			CPUE KILLS/ DAY
			SIKA DEER	RED DEER	PIG	
Kaimanawa Forest Park	4588.5	65.6	692	273	24	0.216
Waipakihi*	732.0	10.5	80	76	-	0.213
Rangitikei*	174.0	2.5	13	41	-	0.322
Clements Road*	1304.0	18.6	170	8	2	0.136
Tongariro National Park	1251.0	18.0	16	313	6	0.281
Conservancy	8122.0	-	821	968	81	0.221

*Clements Road, Waipakihi Valley and Rangitikei Valley hunting blocks within Kaimanawa Forest Park are of a similar area (figure 1)

3.0 DISCUSSION

3.1 ECOLOGY STREAM

Deer do not appear to be affecting the existing canopy or the natural stand dynamics of this particular pole stand of mountain beech, which is slowly thinning down in terms of stem density as the basal areas of stronger individuals increase. Deer browse on lower branches on the control plot has not seriously affected this process.

Deer are, however, continuing to have a significant influence in the understorey. Only plants classified as low palatability species occur above 10 centimetres in the browse tier. While the present canopy is not at risk species diversity and density in the understorey is clearly being inhibited significantly by the current level of deer browse. If this situation continues or if deer numbers increase further, canopy regeneration following natural collapse may be hindered. Observations on sites favoured by deer (for example sheltered slopes) within the catchment, suggest this is already occurring (author's observation; D Lumley pers. comm).

The upper Rangitikei River Catchment of which Ecology Stream is a major tributary, has some of the highest recreational hunter CPUE* figures in the Tongariro/Taupo Conservancy (table V). The 174 days of hunting recorded in 1990 resulted in a CPUE of 0.322 kills per day, well above the conservancy average of 0.221 kills per day.

This catchment' currently receives little hunting pressure because of its remoteness (2.5% of the specified reported hunting effort). The situation is further compounded by the remote experience designation over the area which restricts the use of helicopters as a means of access except for management purposes.

Fraser (1989) suggests improving access for hunters can influence deer density and distribution. Improving access for recreational hunters would be likely to reduce deer impact in Ecology Stream.

3.2 RUATAHUNA

At this site the presence of moderately palatable plant species in the browse tier of the control plot suggests deer are not nutritionally stressed to the degree that they are forced to eat out all but the most unpalatable plant species. The close proximity (30 metres) of alpine tussock/herb fields above bush line allows deer a wider range of fodder species at this location which may be influencing this situation.

Recreational hunting pressure is also likely to be an influence. The Waipakihi Valley area generally, is the second most targeted hunting destination in the conservancy (table V). There is a hut in the head of the valley within one hour's walk of the plot and a major access track is located within 30 minutes' walk (see figure I). In 1990, 10% of the specified hunting effort within the conservancy was undertaken in the Waipakihi Valley. (This is second only to the effort recorded for the Clements Road area in the north

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*Catch Per Unit Effort = kills per day hunted.

eastern corner of the Kaimanawa Recreational Hunting Area (RHA) which receives 18.5% of the conservancy's total hunting effort). The higher effort resulted in a CPUE figure of 0.213 kills per day during 1990, slightly below the conservancy average of 0.221 kills per day (table V). The large amount of hunting effort in the Waipakihi Valley already, means that it would be difficult to increase recreational hunting pressure on deer there.

4.0 MANAGEMENT IMPLICATIONS

Deer are having a greater impact on the mountain beech forests of the Ecology Stream Catchment, than those in the upper Waipakihi Valley area. There is little growing above 10 centimetres outside the exclosure at the Ecology Stream site, except species which are unpalatable to deer. At the Ruatahuna site, some moderately palatable understorey species survive within the browse range on the control plot although at lower density than in the exclosure. This difference can be attributed to deer density although deer species is also likely to be a factor. (Sika deer tend to dominate at lower altitudes while red deer are most numerous near and above bushline.)

CPUE is higher where hunter effort is lower (table V). CPUE and deer density are positively correlated and current work aims at quantifying this correlation (Fraser in progress). The higher CPUE in Ecology Stream reflects higher deer numbers than at the Ruatahuna site.

The differences in CPUE (that is, deer density) are related to the relative accessibility of the two areas to ground hunters. Hunting pressure in the remote Rangitikei Catchment is low resulting in a CPUE figure 51% greater than that for the Waipakihi Catchment which is readily accessible to hunters and hence considerably more popular as a destination (table V). (Note: it is the author's opinion that these two areas have similar hunting conditions and would attract hunters of similar ability.)

An increase in recreational hunting pressure in the Ecology Stream catchment is desirable to reduce deer impact. The restrictive policy on aerial access to the area, however, would need to be relaxed to achieve a significant increase in hunting effort due to the remote nature of the catchment. This would require some compromise to the existing 'remote experience zone' designation on the area.

The potential conflicts between aerial access and the wilderness values of the upper Rangitikei River catchment could be minimized by restricting helicopter access for hunters to a specified period in the autumn. Access could be opened up for the late March to early May period during which breeding age classes are most vulnerable to (Speedy and Fraser 1990). Improved access during this short period would allow an increased level of harvest because this is the most popular period for hunting. The desirability of the area as a hunting destination could also be enhanced by carefully targeted marketing.

5.0 RECOMMENDATIONS

5.1 A decrease in deer density in Ecology Stream is required to reduce significant deer impact on mountain beech forest there.

5.2 An increase in recreational hunter effort in the Ecology Stream Catchment could be encouraged by relaxing the current restrictions on helicopter access during autumn.

5.3 This will require discussion and approval by the Conservation Board as it would compromise the 'remote experience' designation of the area.

5.4 If this relaxation is permitted for a short period each year, continued monitoring of exclosure plots and collection of hunting effort and deer harvest data should continue, to assess the impact of increased recreational hunting pressure on mountain beech forest condition in Ecology Stream.

6.0 ACKNOWLEDGEMENTS

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Fraser, K W (in progress). The effect of recreational hunters on deer populations inPureora Forest Park. FRI Contract Investigation 57010/534.

APPENDIX I

PALATABILITY GROUPING USED IN THIS ANALYSIS

The groupings are based on:

A personal observations made by the author over a period of eight years working in central North Island beech forests including deer rumen content analysis;

B Stewart, Wardle, Burrows (1986); and Hayward (1985) for red deer and possums in Fiordland and Nelson respectively.

	HIGH	MODERATE	LOW
A	Griselinia littoralis	Coprosma 'taylorae'	Myrsine divaricata
	Rubus cissoides	Coprosma foetidissima	Pseudowintera colerata
	Coprosma tenuifolia	Coprosma pseudocuneata	Podocarpus hallii
	Cordiline indivisa	Coprosma microcarpa	Leucopogon fasciculata
	Pseudopanax simplex	Hebe stricta	Phyllocladus alpinus
	Coprosma grandifolia*	Astelia fragrens	Gaultheria antipoda
	Coprosma lucida*	Uncinia species	Histiopteris incisa
	Carpodetus serratus*	Nothofagus cliffortioides	Paesia scaberula
		Polystichum vestitum	Microlaena avenacea
		Blechnum fluviatile	Blechnum discolor
B	Griselinia littoralis	Coprosma foetidissima	Pseudowintera colerata
	Rubus cissoides	Coprosma microcarpa	Podocarpus hallii
	Coprosma tenuifolia	Myrsine divaricata	Leuopogan fasciculata
	Coprosma grandifolia*	Nothofagus cliffortioides	Phyllocladus alpinus
	Coprosma lucida*	Pseudopanax simplex	Gaultheria antipoda
	Carpodetus serratus*		

* Not present on either exclosure site but observed in adjoining areas of Ecology Stream where deer could not browse (that is, steep stream banks, bluffs or as epiphytes).

The discrepancies in the two lists could be related to the presence of sika deer and/or variance in local conditions.

FOREST RECONNAISSANCE (RECCE) PLOT SHEET

Protection Forestry Division
Forest Research Institute
NZ Forest Service
P O Box 31-011
CHRISTCHURCH

APPENDIX II

Site records

Forest Type

Line Plot: Plot 1

		CODE
SURVEY	Kaimanawa Exclosures	
CATCHMENT	Rangitikei River	
SUB/CATCHMENT	Ecology Stream	
AREA	Fenced Plot 1	
AERIAL PHOTO NO.		
DAY/MONTH/YEAR	21.02.91	
ALTITUDE (m)	1020 m	
ASPECT (°)	NW	
SLOPE	5°	
PHYSIOGRAPHY	Face/river terrace	
PARENT MATERIAL	Greywacke	
DRAINAGE	Good	
CULTURAL (human interference logging fires etc.)		
	Deer	
GROUND COVER	30 V	
	50 M	
	20 L	
APPROACH		

		CODE
MEASURED BY	Cam Speedy/Cathy Jones	
RECORDED BY	Cam Speedy	
		CODE
MEAN TOP HEIGHT	16-18 m	
BASAL AREA	45-50 m^2/ha	
CANOPY %	70	
SOIL DEPTH		
SURFACE SUITABILITY	Good	
ROCK ON SURFACE	No	
BEDROCK ON SURFACE	No	
QUANTITY -	BROKEN ROCK %	
-	SOIL %	
SIZE OF LOOSE ROCK	> 30 cm <	
DESCRIPTION -	MORAINE TALUS	

LOCATION DIAGRAM

NOTES

Good regeneration of understorey.

Coprosmas, broadleaf, ferns and grasses all very vigorous up to about one metre.

Small patch (5 x 3 metres) of umbrella fern growing inside fence and extending outside - not browsed.

Very little beech regeneration due to low light intensity reaching forest floor.

Canopy very dense!

SPECIES	LOW	MOD	HEAVY	ANIMAL
Pre sim	√			Possum
Gri lit	√			Insect
BIRDS	L T Cuckoo	Rifleman	Fantail	Robin
	Tomtit	Warbler	Falcon	Thrush

e Plot:

Mountain Beech

	T1 EMERGENT	T2 12 m+	T3 12-5 m	T4 5-2 m	T5 2 m-30 cm	T6 < 30 cm
HEIGHT		16-18		4	1	30
DENSITY	Nil	65 live stems	Nil	Sparse	Dense	Dense
DIAMETER		10-30 cm		3-5 cm	0-2 cm	not applicable
		Not cli*			✓	✓
				Phy sly	✓	✓
				Myr div	✓	✓
					Copy tay*	✓
					Cop foe	✓
					Cop pse	✓
					Gri lit	✓
					Heb str	✓
					Cor inf	✓
					Rubus	✓
					Pse sim	✓
					Dic lan	✓
					Gle cun	✓
						Cop mic
						Cop tan
						Uncinia
						Hymeno x 2*
						Pol ves
EPIPHYTES						Blc pen
Gra bil						Pra ang
Rubus						Leg str
Hymeno						Chi cor
Asp fla						Cor tri
						Calandenia
						Ran rcf
						Ast fla
						Nertera x 2
						Acaena
						Gra bil
						Vio fil
						Oxyomyrrhia
						Hydrocotyli
						Mosses*
						Grasses
						Lichens
						Fungi
						Hyd dia

FOREST RECONNAISSANCE (RECCE) PLOT SHEET

Protection Forestry Division
Forest Research Institute
NZ Forest Service
P O Box 31-011
CHRISTCHURCH

Forest Type

Line Plot: Plot 2

		CODE
SURVEY	Kaimanawa Exclosures	
CATCHMENT	Rangitikei River	
SUBCATCHMENT	Ecology Stream	
AREA	Unfenced Control Plot 2	
AERIAL PHOTO NO.		
DAY/MONTH/YEAR	21.02.91	
ALTITUDE (m)	1020 m	
ASPECT (°)	NW	
SLOPE	5°	
PHYSIOGRAPHY	Face/river terrace	
PARENT MATERIAL	Greywacke	
DRAINAGE	Good	
CULTURAL (human interference logging fires etc.)		
	Deer	
GROUND COVER	15 V	
	25 M	
	60 L	
	- R	
	- R	
APPROACH		

		CODE
MEASURED BY	Cam Speedy/Cathy Jones	
RECORDED BY	Cam Speedy	
		CODE
MEAN TOP HEIGHT	16-18 m	
BASAL AREA	45-50 m²/ha	
CANOPY %	70	
SOIL DEPTH		
SURFACE SUITABILITY	Good	
ROCK ON SURFACE	No	
BEDROCK ON SURFACE	No	
QUANTITY -	BROKEN ROCK %	
-	SOIL %	
SIZE OF LOOSE ROCK	> 30 cm <	
DESCRIPTION -	MORAINE TALUS	

LOCATION DIAGRAM

NOTES

A lot of deer sign in and around plot.

New naked understorey except for a few Myr div. and moss. A few small seedlings < 10 cm.

Beech branches even browsed!

Stand is continuing to thin down with a number of tagged dead stems.

SPECIES	LOW	MOD	HEAVY	ANIMAL
Cop ley.			✓	Deer
Uncinia			✓	Deer
Myr div.	✓			Deer
Not cli	✓			Deer
BIRDS	L T Cuckoo	Rifleman	Fantail	Robin
	Tomtit	Warbler	Falcon	Thrush

ine Plot:

Mountain Beech

	T1 EMERGENT	T2 12 m+	T3 12-5 m	T4 5-2 m	T5 2 m-30 cm	T6 < 30 cm
HEIGHT		16-18	6	4	1.5	10
DENSITY	Nil	65 live stems	sparse	sparse	sparse	moderate
DIAMETER		10-30 cm	15 cm	2-5 cm	2-5 cm	not applicable
		Not dli*				✓
			Gri fir			✓
				Phy alp	✓	✓
					Myr dac*	✓
					Cop tay.	✓
						Cop mic
						Cop foe
						Cop gae
						Pse sim
						Cor tri
						Bel pen
						Pol vac
						Uncinia
						Leg str
						Nertera x 2
						Hymeno x 2*
						Gra bil
						Vio fil
EPIPHYTES						Rubus
Hymeno						Schizelema
Grabil						Caladenia
Asp fla						Orthorrhynchus
						Hydrocotyle
						Acaena
						Pra ang
						Chi car
						Mosses*
						Grasses
						Lichen
						Fungi

FOREST RECONNAISSANCE (RECCE) PLOT SHEET

Protection Forestry Division
Forest Research Institute
NZ Forest Service
P O Box 31-011
CHRISTCHURCH

Forest Type

Line Plot: Ruatahuna Exclosure
Fenced Plot 1

		CODE
SURVEY	Kaimanawa Exclosures	
CATCHMENT	Tongariro River	
SUB/CATCHMENT	Waipakihi/Whitikau	
AREA	Northern Urenkeikei Range	
AERIAL PHOTO NO.		
DAY/MONTH/YEAR	26.02.91	
ALTITUDE (m)		
ASPECT (°)	NW	
SLOPE	5°	
PHYSIOGRAPHY	Face/ridgetop	
PARENT MATERIAL	Greywacke	
DRAINAGE	Good	
CULTURAL (human interference logging fires etc.)		
	Deer	
GROUND COVER	30 V	
	20 M	
	35 L	
	5% B	
	Trace R	
APPROACH		

		CODE
MEASURED BY	Cam Speedy	
RECORDED BY	Cam Speedy	
		CODE
MEAN TOP HEIGHT	12-14 m	
BASAL AREA	45-50 m^2/ha	
CANOPY %	20-30 %	
SOIL DEPTH		
SURFACE SUITABILITY	Good	
ROCK ON SURFACE	Yes*	
BEDROCK ON SURFACE	Yes	
QUANTITY -	BROKEN ROCK < 1 %	
-	SOIL 5 %	
SIZE OF LOOSE ROCK	> 30 cm <	
DESCRIPTION -	MORAINE TALUS	

LOCATION DIAGRAM

*Small amount of rock exposed along with soil by uprooted beech buttresses

NOTES

Umbrella fern makes up significant component of ground cover. Lots of rubus! Healthy regeneration of broadleaf; psom; cop pse and cop tay. Very dense ground tier up to about 1.0 metres.

Very open canopy due to wind/snow damage since established. Fence has required a lot of maintenance in the past. Two plots no longer comparable due to control having intact canopy.

Hares using plot - some browse/droppings.

Possum sign also

Many bellbirds!!

SPECIES	LOW	MOD	HEAVY	ANIMAL
Cop tay.	✓			hare
Blc cap.		✓		possum?
Pol ves.	✓			possum?
Pse sim		✓		possum
BIRDS	Bellbird	Silvereye	Tomtit	Warbler
	Riflemen	Fantail	L T Cuckoo	Whitehead

e Plot: Rustaluren Exclosure Plot
Fenced Plot 1

Forest Type

	T1 EMERGENT	T2 12 m+	T3 12-5 m	T4 5-2 m	T5 2 m-30 cm	T6 < 30 cm
IEIGHT		12-14	8-10	3	1.5-2	30
ENSITY	Nil		Moderate	Moderate/Dense	Dense	Dense
IAMETER		6-35 cm	5-12 cm	2-4 cm	not applicable	not applicable
		Not cli*	√	√	√	√
			Gri lit ¹*		√	√
			Pse sim ¹*	√	√	√
			Phy alp	√	√	√
			Rubus	√	√	√
				Heb str	√	√
				Myr dir	√	√
				Cop tay*	√*	√
				Cop pse*	√*	√
				Pod hal	√	√
					Cop fos	√
					Cop tas	√
					Ble cop	√
					Ble dis	√
					Hia inc	√
					Gle cun	√*
					Hia inc	√
					Pse col	√
EPIPHYTES					Heb vos	√
Mosses					Leu fas	√
Uncinia					Ast fra	√
Grobil					Pse sca	√
Hymeno					Mic acu	√
Asp fla					Uncinia	√
Lichen					Hob ang	
					Gau ant	√
						Pod nir
						Ble flu
						Nertera x 2
						Hymeno x 2
						Chicor
						Leg str
						Ble pen
						Vio cun
						Acaena
						Mosses
						Grasses
						Orchids
						Vio phil

FOREST RECONNAISSANCE (RECCE) PLOT SHEET

Protection Forestry Division
Forest Research Institute
NZ Forest Service
P O Box 31-011
CHRISTCHURCH

Forest Type

Line Plot: Ruatahuna Exclosure
Unfenced Plot 2

		CODE
SURVEY	Kaimanawa Exclosures	
CATCHMENT	Tongariro River	
SUB/CATCHMENT	Waipakihi/Whitikau	
AREA	Northern Umukaritari Range	
AERIAL PHOTO NO.		
DAY/MONTH/YEAR	26.02.91	
ALTITUDE (m)	1225	
ASPECT (°)	NW	
SLOPE	5°	
PHYSIOGRAPHY	Face/ridgetop	
PARENT MATERIAL	Greywacke	
DRAINAGE	Good	
CULTURAL (human interference logging fires etc.)		
	Deer	
GROUND COVER	20 V	
	25 M	
	40 L	
	5 B	
APPROACH		

		CODE
MEASURED BY	Cam Speedy	
RECORDED BY	Cam Speedy	
		CODE
MEAN TOP HEIGHT	12-14 m	
BASAL AREA	45-50 m²/ha	
CANOPY %	50-60	
SOIL DEPTH		
SURFACE SUITABILITY	Fair*	
ROCK ON SURFACE	No	
BEDROCK ON SURFACE	No	
QUANTITY -	BROKEN ROCK	
-	SOIL	
SIZE OF LOOSE ROCK	> 30 cm <	
DESCRIPTION -	MORAINE TALUS	

LOCATION DIAGRAM

*Water has been flowing through plot and some minor scouring has occurred.

NOTES

A lot of rubus on plot. Deer sign (red) very obvious with foot prints, pellets, browse and antler thrashing evident. Mountain beech canopy is NOT even aged ranging from small to very large (50 cm+ DBH). Canopy is still very much intact. Gloomy understorey.

Very little broadleaf or Pse sim regeneration above 10 cm. Many shrubs however up to about four metres. Cop fos, Cop pse, Cop Tay. are reasonably palatable but still present in browse tier.

Very few ferns on forest floor.

SPECIES	LOW	MOD	HEAVY	ANIMAL
Gri fil			epicormic	Deer
Pse sim		✓		Possum
Rubus	✓			Deer
Phy alp	Antler thrashing has killed some			
BIRDS	Riflemen	Bellbird	Warbler	Fantail
	Silvereye	Tomtit	L T Cuckoo	Whitehead

ine Plot: Rustahuna Enclosure
Unfenced Control Plot 2

Mountain Beech

	T1 EMERGENT	T2 12 m +	T3 12-5 m	T4 5-2 m	T5 2 m-30 cm	T6 < 30 cm
HEIGHT		12-14	8	3-4	2	10 cm
DENSITY	Nil	Moderate/dense	Sparse/moderate	Moderate/dense	Moderate	Sparse
DIAMETER		10-50 cm	5-12 cm	2-6 cm	2-4 cm	not applicable
		Not sli*	✓	✓	✓	✓
			Gri lit*	✓	✓	✓
			Phy alp	✓	✓	✓
			Pse sin	✓	✓	✓
			Rubus	✓	✓	✓
				Cop tay.*	√*	✓
				Cop pse*	√*	✓
				Myr div	✓	✓
				Pod hal	✓	✓
				Pse col	✓	✓
				Cop foe	✓	✓
				Hab str	✓	✓
					Gle cun	Grahil
						Lag str
						Cor tri
						Hymano
						Usclnla
						Acaena
EPIPHYTES						Nertera x 2
Hymeno						Ble pen
Gra bil						Ast fra
						Chi cor
						Vio cun
						Vio phil
						Hydrocotyli
						Grasses
						Mosses*