Department of Conservation
Te Papa Atawhai

Deer pellet monitoring in Makawakawa Catchment, Southern Ruahines

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Summary

This report presents results from the remeasurement of pellet lines in Makawakawa catchment in the Southern Ruahines. The lines were remeasured to determine whether relative deer density in the Makawakawa catchment is increasing.

Ten of twentytwo faecal pellet lines established in summer 1982/1983 were remeasured in Makawakawa catchment, which is closed to aerial hunting, in 2003 and in 2009.

Pellet frequencies were approximately 14%, 10% higher than that recorded in 1983. Raw data from earlier surveys is not available, but comparison with results given in Forest Service reports shows that current densities are still lower than those recorded in the early 1970s. These results resemble those from faecal pellet indices in the Oroua, Pohangina and Pourangaki catchments in the past five years and support the observations of field staff and contractors.

Continued monitoring of deer pellet frequency will provide information about changes in relative deer density. This should be supplemented by monitoring pellet densities in other catchments which contain different vegetation types and have different management regimes (i.e. whether open or closed to commercial aerial hunting) and by measurement of vegetation status, particular in relation to predicted deer impacts. Results should be communicated to stakeholders.

Possum pellet counts were not consistent with other possum abundance indices indicating possum pellet counts were probably not conducted in this survey.

Acknowledgements

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Contents

Introduction

Aim

To determine whether relative deer density in the Makawakawa catchment, Ruahine Forest Park, is increasing.

Background

This report describes changes in the relative densities of feral deer in the Makawakawa catchment, Ruahine range. For the past thirty years deer have been controlled by commericial aerial hunting in the Ruahine range. Private businesses are granted concessions to hunt on land administered by the Department within specific areas and times. The wild venison is sold on national and international markets (Department of Conservation 2003). Commercial venison recovery has declined since 2002 (Department of Conservation 2003). Implications for DOC have been discussed by Keith Briden in two briefing papers to the General Management Team. Some parts of the Ruahine Range, including the Makawakawa catchment, have been closed to aerial operators since 1981.

The study area

The Ruahines are part of the axial mountain chain running through the North Island. They are rugged with sharp ridges, steep sided valleys and fast flowing rivers, formed on relatively young, shattered greywacke, with areas of limestone, sandstone and siltstone. The climate is cool and wet with high rainfall and many cloudy days (Department of Conservation 1992).

The Ruahines support many vegetation types, including alpine grasslands (*Chionochloa* species) and herb fields, sub alpine shrubs (including *Dracophyllum,*and *Brachyglottis* in the north and predominantly leatherwood in the south), high altitude forest with pahautea, pink pine and Hall's totara. Mid–altitude forest is largely beech (northern part of the range) or kamahi (below Pohangina River) dominated forests. Podocarp–broadleaved forests occasionally occur in the lower flanks, especially to the south (Elder 1965).

Most of the Makawakawa catchment was podocarp-broadleaved forest with leatherwood scrub in the upper parts (Newsome 1987) but vegetation has been modified by introduced animals.

Kamahi (and some beech) forest in the southern part of the range, including Makawakawa has partially collapsed and been replaced with small trees (horopito, rangiora, mahoe), shrubs and ferns (Department of Conservation 1992). This collapse has been related to possums, ungulate browse, and other stressors such as wind damage (Rogers and Leathwick 1997). Recent vegetation surveys conducted as part of the Carbon Monitoring System network found plots in the southern Ruahines to be tawa, mahoe, or pepperwood-hardwood forest types (Wiser and Hurst 2008).

Observations during pellet line surveys recorded shrub/hardwood, podocarp/hardwood, tree fern and pepperwood as the most common vegetation types in 1983 and 2003 (though that survey recorded relatively more pepperwood dominated plots and fewer podocarp/hardwood). In 2009, plots were dominated by treefern, broadleaf/mahoe/wineberry, shrub/hardwood and pepperwood types. This is only a casual observation and there is no training to calibrate observers between surveys so these changes may reflect personal interpretation of broad vegetation classes rather than a major shift in composition.

Red deer have occupied the Ruahines since about 1900, and numbers were high by the 1920s, when forest degradation was obvious (Cunningham 1979). Deer appear to have reached higher densities in the northern part of the range and spread south more slowly. By 1935 deer were seen along the tops from Kereru to the Ngamoko Range (Elder 1965). In the early 1960s, the vegetation of the Pohangina catchment showed evidence of severe animal damage in the early 1960s (Cunningham 1971). Goats were common in the southwestern Ruahines in the 1950s and 1960s but were only occasionally observed in surveys in 1971, 1976 and 1983 (James and Beaumont 1971, Cuddihy 1977, Oaks 1983). There is an ongoing goat control operation to maintain current very low densities of goats in the area (DOC PestLink Database accessed June 2009). There have been occasional reports of other deer species in the area but there are not thought to be permanent populations of any species other than red deer.

Deer control began in 1938 and numbers dropped rapidly, especially in the northern part of the range where food was scarce. By the 1950s there was some evidence of vegetation recovery in this area. However, numbers were still increasing in the Southern Ruahine (Elder 1965). The Forest Service undertook widespread (all catchments from Whakarekau south) shooting from helicopters in 1972–1978, which further reduced deer numbers (Oaks 1983). For example, in the Tukituki catchment, kills per hunter day dropped from 1.28 in 1959-60 to 0.42 in 1973-74 (Austin

1975). Commercial helicopter hunting began in 1975 and also contributed to the decline (Oaks 1983). Since 1981, helicopter hunting has not been permitted in the Pourangaki, Mangawhakariki and Oroua catchments, and all catchments to the south of Takapari Rd (ibid).

Possums, hares, rodents and mustelids are present in the park. Goats and pigs were controlled in the past (Austin 1975) and may be present in localised areas (Department of Conservation 1992). Some possum control was carried out in the 1960s and 1970s (Cunningham 1971)

Past monitoring

The Ruahines have a long history of monitoring vegetation condition and animal abundance (refer to WANCO 35016). Relative animal (deer, goat, sheep, possum, hare and pig) abundance has been measured using faecal pellet counts along transects in the southern Ruahine (including Makawakawa catchment) in 1969, 1975 and 1982/1983 (when the entire range was surveyed). Since 2000, small subsets of the 1983 pellet transects have been measured annually. Table 2 summarises results of these and surveys in other parts of the Ruahine Ranges.

Fenced exclosure plots were constructed throughout the 1960s and 1970s. Seven in the Tukituki and one in Ngaruroro were inspected and the vegetation briefly described in 1981. Fifteen more were relocated and photographed in 1983 and a qualitative description of the vegetation was made.

Four plots on the eastern side were measured in the 1990s: one in Tamaki catchment, the existing Ngaruruoro exclosure at Waitutu stream and two more that were constructed in 1983, known as Dead Dog/Big Hill Stream and No Mans/Hollowback. No Mans was remeasured in 2009. Results have not been reported. The current status of the other eastern exclosures is not known.

Eleven exclosures on the western side of the range have been re-measured since 1997 using the method described in (Allen 1993). In the western exclosures, beech species (not highly palatable to deer) show little difference between exclosures and unfenced plots, suggesting that recruitment is possible with current deer densities. More palatable species (broadleaf, raukawa, mahoe, coprosmas and *Pseudopanax)* tended to be more abundant in exclosures suggesting that their regeneration is inhibited. Several species (notably kamahi) that are highly palatable to deer and possums and suffered severe dieback in the 1950s and 1960s show minimal recruitment, even inside exclosures. This suggests that those species can no longer establish even in the absence of

browse (Steffens and Hawcroft in preparation). However, the exclosures are a small sample and results varied from plot to plot. A new exclosure was constructed near Diggers Hut in the Makawakawa catchment in May 20089, but this has not yet been measured.

Data from the extensive network of unfenced permanent plots (established in the 1960 and 70s and remeasured in 1984–5) has not yet been analysed.

Grassland transects were established in the 1960s – and remeasured in 1975–76 – to quantify deer impacts. These were 40m long. Vegetation and pellet presence in 15cm radius plots was recorded at 40cm intervals. In 1977 these showed an increase in ground cover density and sward height - reduced deer impact (Cuddihy 1977).

Methods

The faecal pellet index (Baddeley 1985) is widely used method for determining change in relative ungulate density. Data collection using this method, based on permanently marked lines, is comparable with earlier measurements at the study site.

Sample design

Data collection was restricted to a single catchment to reduce cost. The Makawakawa catchment was selected because it has been monitored in the past 10 years and comprises podocarp-broadleaf and collapsed kamahi (now largely pepperwood) forest, which is typical of the southern Ruahine The Makawakawa is a ‘no-fly zone’, closed to commercial aerial hunting so might be expected to show a more rapid increase in deer numbers than areas which are only hunted on foot.

Lines follow a compass bearing from stream to ridge top and are of variable length. The start point on the stream was determined by breaking the stream into equal sized blocks and randomly placing a line in each block (Oaks 1983).

Twenty two lines were measured and marked with permolat in 1983. A subset of 10 lines was re-measured in 2003 and 2009.

Field work

Data collection followed Oaks (1983). The start and end points of each line were marked with permolat and line locations were recorded in a diagram and with a GPS. Plots are located at 20m intervals along transects.

Observers recorded the presence/absence of animal pellets in a plot with radius of 1.14m (at least 1 deer pellet, meeting certain intactness criteria, other animal pellets - goat, sheep, hare, possum and pig - may be recorded in any condition) and two distances: the distance from the plot centre to the nearest valid deer pellet group (more than 6 pellets) within a 3m search radius and the distance from the centre of that group to the next nearest group within a 3m search radius.

Information about habitat: slope; altitude; aspect; vegetation type and physiography were recorded, as was basic metadata – Catchment, Date, Observers, Line number, Plot number.

Data was collected in January 1983, between January and June 2003, and in March 2009. In 2009 data was collected by Backcountry Contracting Ltd for a contract of $9000.

Analysis

Two kinds of data were collected: presence/absence (p/a) of deer pellets[1] and point distance information about pellet spacing (Bell 1973). This report uses the presence/absence data. Earlier reports treated the plot as a sample unit to calculate pellet frequency (Jenkins 1981, Oaks 1983). It is more correct to treat each transect as a sample unit (C. Veltman pers. comm.) and that approach was taken here to derive frequency (proportion of plots containing pellets) for each line which is displayed in a box plot.

R version 2.8.0 was used to create a generalised linear model (assuming a Poisson distribution, which is appropriate for count data) relating the number of plots containing deer pellets on each line to year. An offset term, log(number of plots), was used to account for variation in the number of plots on each line.

[1] In 1982/83 presence of possum, goat, pig hare and sheep sign was also recorded. In 2003 presence of possum sign was also recorded. In 2009 only deer pellets were recorded.

Paired t-tests were used to determine whether there was a significant difference between pellet frequencies on the ten lines which have been repeatedly measured.

The relationship between pellet frequency and deer density depends on two other variables: the rate at which deer defecate and the rate at which pellets decay. These, especially the latter, may vary between sites and over time. Rates of defecation and decay were not measured in this study. Earlier work in the Ruahines found rates of decay to be reasonably consistent in different catchments and in different years (Oaks 1983).

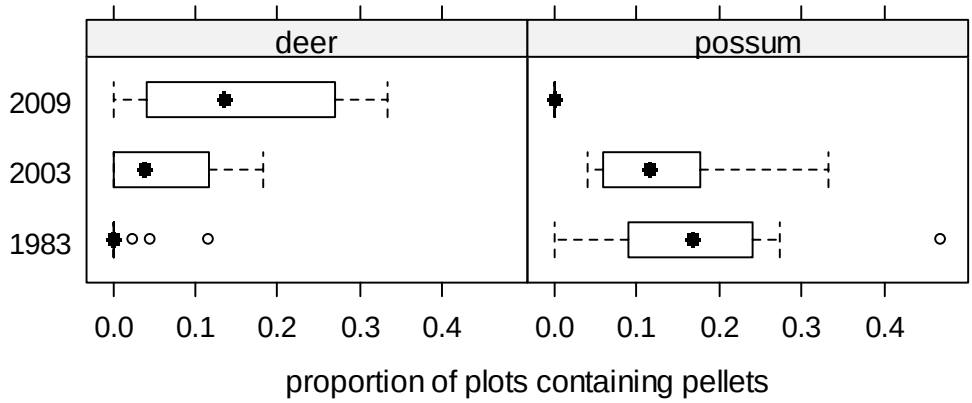
Comparison with earlier surveys

Original data from 1983 was only obtained for the Oroua catchment. Pellet frequencies were extracted from reports which quote density (Cunningham 1966, James and Beaumont 1971, Cuddihy 1977, Jenkins 1981) using the equation frequency = 1–e^(–density)[2].

[2] Defecation density = –log e (1–(% plots occupied)). This is calculated for each line; multiplied by a coefficient reflecting the proportion of the sample that line represents; weighted line values are added to give a total value for the block. (Baddeley 1985)

Results

Figure 1 Frequency of deer and possum pellets in the Makawakawa catchment over time. Black dots show median value; bars show the middle quartiles and lines show range of the data. White dots are outliers.



The proportion of the plots that contain deer pellets in the Makawakawa catchment has increased since 1983. The generalised linear model found a significant positive relationship between deer pellet counts and year. Paired comparisons of the 10 lines measured in every survey confirmed a significant increase between 2009 and 1983 (Table 1).

The proportion of plots containing possum pellets appears to have decreased.

Table 1 Difference in proportion of plots containing pellets on lines with repeated measurements

Comparison	Mean difference	Significance of paired t test
1983 to 2003	0.044	0.104
1983 to 2009	0.125	0.008
2003 to 2009	0.081	0.089

Table 2 summarises frequency of pellets derived from all previous measurements for which data is available. The trend observed in Makawakawa from 1983 to 2009 is similar to that in the Pohangina and Pourangaki catchments. Variance is very high in the Oroua. There is no evidence that restricting aerial hunting allows a greater increase in relative deer use.

Table 2 Frequency of animal pellets in Ruahine FP (% of plots measured to 1 dp ± 95% CI where available)[3]

Year	Catchment or Block	deer	possum
2009	**Makawakawa (*closed)***	**14.4 ± 9.6**	**0.0**
2007	Oroua (*closed)*	9.9 ± 4.0	
	Tukituki (*open)*	7.6 ± 4.4	
2006	Pourangaki *(closed)*	13.0 ± 6.7	12.8
	Pohangina (*open)*	7.3 ± 4.1	6.1
2005	Kawhatau Tussock (*closed)*	0.4 ± 0.8	0.3
	Oroua Tussock	0.7 ± 1.6	0
2003	**Makawakawa**	**6.3 ± 5.1**	**11.9**
	Ross *(open)*	3.5 ± 3.1	17.1
2000	Oroua	8.4 ± 6.4	17.2
	Pohangina	1.4 ± 2.3	11.3
1983	Ikawakea/Makirikiri	8.9	29.6
	Ngaruroro	1.7	47.5
	Tukituki	3.6	29.3
	Whakarekau/Mangatera	7	21
	Maropea/Waikamaka	1	22
	Kawhatau/Pourangaki	3.8	19.9
	Oroua	3. 1 ± 2.2	19.8
	Pohangina	2.3 ± 0.04	16.28
	Makawakawa	**1.0 ± 1.2**	**16.2 ± 5.1**
	South West	3.4	17.18
	South East	3.2	26.1
1981	Ikawatea/Makirikiri	6.0	44.0
	NE Ruahines	4.5	66.7
	Makaroro	3.9	28.1
	Gold Creek	2.1	23.7
	Waipawa	0.8	4.9
	Tukituki	0.6	34.3
	Makaretu	1.7	17.3
1976	Oroua	11.0	5.8
	Pohangina	8.1	7.2
	Opawe	16.9	17.1
	Ross	10.9	3.0
	Makawakawa	**.**	**13.5**
1974[4]	Makaroro	8.6 to 25.2	.
	Gold Creek	14.0	.
	Waipawa	12.2 to 18.0	.
	Tukituki	11.3 to 22.1	.
	Makaretu	9.5	.
1971	Oroua	26.3	10.7
	Pohangina	18	15.4
	South–West	**43.4**	**15.2**

[3] Data from before 2000 is mostly derived from graphs showing the total proportion of plots containing pellets. It is likely to be inexact. In some cases the displayed value (density) had to be back-transformed to give frequency.

[4] This data was presented for different vegetation types within each catchment. The maxima and minima are given here.

Discussion

Deer pellet frequencies in the Makawakawa catchment have increased since 1983, and are moderately high, although not approaching levels recorded in the early 1970s. The deer population in the southern part of the Range probably peaked in late 1960s, especially in kamahi forest like the Makawakawa catchment (Elder 1965) before a sharp drop in pellet frequency from the mid 1970s to the early 1980s, attributed to Forest Service hunting, supplemented by aerial venison recovery since 1976 (Oaks 1983).

Since 2006, remeasurement of pellet lines established in 1983 has shown increases for five catchments monitored, but not all increases have been statistically significant. The change from 1983 reported here is both larger and more significant which could indicate that the difference has grown over the past 3 years (number of lines sampled being similar), but could also indicate a difference between the Makawakawa and the other catchments monitored.

There is no evidence that restricting aerial hunting caused a larger increase in relative deer use, mostly because variance is high and there has not been consistent repeated measurement of the same pairs of open and closed catchments. Deer move between catchments and it is likely that the effects of aerial hunting affect the whole Range.

Repeated measurement of the same catchments will provide more reliable information, but this must be balanced against the need to evaluate deer use in other places. A compromise of remeasuring 4-8 catchments on an approximately five year rotation (long enough to expect a change in deer density that could be detected by this crude monitoring technique, but not so long that substantial change could take place and go undetected).

Given this increase in relative deer use, and the link previous research established between deer use and vegetation condition, ongoing monitoring of the deer population and the vegetation in the Ruahines is needed to determine whether changes to the ecosystem are within acceptable limits. The exclosure plots have provided some information about the state of the forest and suggest vegetation is in reasonable condition, but some species and plant communities may become less common, especially if deer densities rise. For instance, species such as raukawa, broadleaf and mahoe, and communities such as high altitude broadleaf-pahautea forest may be particularly susceptible (James and Beaumont 1971, Cuddihy 1977).

There is an immediate need to record the status of vegetation on the open tussock tops, which are not represented by exclosure plots and which will at risk from increased deer use if aerial hunting is reduced and/or densities increase. A pilot study of the feasibility of relocating and measuring grassland vegetation transects conducted in 2007 indicated good potential for relocating and comparing plots in sites open and closed to aerial hunting.

Pellet counts can give a crude index of possum density (Baddeley 1985). Results presented here suggest a dramatic decrease but it is likely presence was not recorded in 2009. This should be corrected in future as there is considerable interest in possum density in the southern Ruahines. A recent student project ran 12 trap lines over three fine nights in podocarp-hardwood forest near Diggers Hut and found 31.4 possums caught per 100 trap nights, which indicates high density (Algie 2009).

Conclusion

Relative deer density in the Makawakawa catchment, southwestern Ruahine Forest Park, has increased since 1983.

Recommendations

- Continue to monitor deer use of the Ruahines by periodic remeasurement of pellet lines.

- Ensure that future field teams are aware of the need to record presence of other animal pellets (especially possum but also goat, pig, hare and sheep).

- Supplement this index of deer use by measurement of vegetation condition in fenced exclosures and the tussock grassland. Ideally, concurrent measurement of vegetation should be conducted, to determine the correlation between levels of relative deer density and acceptable rates of change in vegetation composition and structure.

- This information should be shared with other groups that have an interest in deer and/or the Ruahines.

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Proposed Ruahine and Hihitahi monitoring timetable (from Conservancy longterm monitoring timetable DOCDM-269023)

Site	Method	Place	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
Ruahine FP	**Pellet lines**	Pohangina		x					x					x			
		Oroua		x					x					x			
		Kawhatau			x					x					x		
		Pourangaki			x					x					x		
		Makawakawa				x					x					x	
		Ross				x					x					x	
		NW catchment	x					x					x				
		NW catchment	x					x					x				
	Exclosures	Pohangina		r			x										x
		Pohangina		r			x										x
		Alphabet							x								
		Triangle							x								
		Maropea Forks								x							
		Waterfall								x							
		Maharahara									x						
		Wakelings									x						
		Whakarekau										x					
		Peg Creek										x					
		Ruahine Corner											x				
		Diggers											x				
		Takapari Rd	x											x			
		Lake Collenso	x											x			
	Grassland plots	subset of 60			x										x		
	Permanent Forest & Scrub Plots	subset of 60				x										x	
Hihitahi FS	**Permanent forest plots**	includes Paengaroa						x									
	pellet lines	includes floating catchment					x					x					x