Department of Conservation
Te Papa Atawhai

Deer pellet monitoring in two catchments in the Ruahines

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Summary

This report presents results from measurement of pellet lines in two catchments in the Ruahines. The lines were measured to determine whether red deer use of the area is increasing, in response to an apparent decline in intensity of commercial venison recovery.

Seventeen lines were measured in Oroua catchment, which is closed to aerial recovery. All were measured in 1983, and ten were also measured in 2000. Five lines were measured in the Tukituki, which is open to aerial recovery. All had been measured in 1983.

Pellet frequencies were 10% in the Oroua catchment, significantly higher than that recorded in 1983. Pellet frequency was 8.5% in the Tukituki. Raw data from earlier surveys is not available, but comparison with results given in Forest Service reports shows that current densities are higher than those of the 1980s although still lower than those recorded in the early 1970s. These results are similar to those found in Pohangina and Pourangaki in 2006, and confirm the impression that deer numbers in the Ruahines are increasing.

Remeasurement of these lines will provide better information about how deer numbers are changing. This should be supplemented by monitoring pellet densities on established lines in other catchments, measurement of vegetation condition and communication with other stakeholders.

Acknowledgements

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Contents

Introduction

Aim

To determine whether red deer density in two catchments of the Ruahine Forest Park is increasing.

Background

This report provides information about densities of feral deer in the Ruahine range. For the past thirty years densities have been controlled by aerial hunting. 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.

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 (Elder 1965).

This pattern has been modified by introduced animals and localised fire and logging. Most striking was the collapse of kamahi (and some beech) forest in the southern part of the range and its replacement 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).

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).

Ungulate control began in 1938 and deer numbers decreased, 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). Helicopter hunting was restricted from the Pourangaki, Mangawhakariki and Oroua catchments in 1981 (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).

Animal abundance has been measured using pellet counts along transects. Surveys took place in 1969 (southern Ruahines), 1974 (Tukituki catchment; Kawekas and Ngaruroro catchment), 1975 (southern Ruahines), 1978 (northwest Ruahines), 1981 (northeast Ruahines) and 1983 (entire range). Since 2000, small subsets of the 1983 pellet transects have been measured annually. Results are summarised in Table 2.

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.

Eleven on the western side of the range have been re-measured since 1997 using the method described in (Allen 1993). The twelfth is derelict. On the eastern side, one of those inspected in 1983 was measured in the late 1990s along with the Ngaruruoro exclosure, and three others (constructed in 1983). Results have not been reported. The current status of the seven Tukituki exclosures and the remaining two visited in 1983 (in the Tamaki catchment) is not known.

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 cover a very small part of the range and results varied greatly from plot to plot.

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. Clare Veltman and Geoff Rogers (RD&I) are currently coordinating a project to review this and the exclosure plot data.

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

Pellet counts are a common indicator of deer use. Data collection using this method allowed direct comparison with earlier measurements in the area.

Sample design

Data collection was restricted to two catchments to reduce cost. The Oroua and Tukituki catchments were selected because they represented areas on both sides of the Range that are open and closed to commercial hunting.

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).

In 1983, 31 lines were measured in the Oroua catchment and 9 were measured in the Tukituki. In 2000, 9 lines were measured in the Oroua. The East Coast Hawkes Bay and Wanganui Conservancies contributed resources for the 2007 measurement and 16 lines were measured in the Oroua and five in the Tukituki.

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 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, in Febuary 2000, and in January and March 2007. In 2007 data was collected by Backcountry Contracting Ltd for a contract of $9800.

Analysis

Two kinds of data were collected: presence/absence (p/a) of deer pellets and point distance information about pellet spacing. Methods for analysis are described in (Bell 1973). Frequency – proportion of plots in which pellets were found - is used here. 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).

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 a mean frequency (percentage of plots containing pellets) and an estimate of error[1]. This analysis was made for measurements where the original data was available. Where the same lines had been measured in two years, the difference between the two measures was calculated line by line and a t-test was used to determine if the mean difference was greater than 0.

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].

James and Beaumont (1971) only surveyed the southern part of the range, including the Oroua but not the Tukituki. Cuddihy (1977) also included the Oroua but not Tukituki. However, the Tukituki was surveyed in 1961-2, 1974 and in 1981 (Jenkins 1981).

Oak's summaries are for aggregations of catchments, so results here apply to a wider area than the true catchment boundary (Table 1).

[1] no attempt was made to account for the different numbers of plots on each line.

[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)

Table 1 Aggregate blocks for which data is presented in Oaks (1983)

Name	Catchments included
Ikawetea	Ikawetea and Makirikiri
Ngaruroro	Ngaruroro
Tukituki	Makaroro, Gold Creek, Waipawa, Tukituki and Makaretu
Whakarekau/Mangatera	Whakarekau and Mangatera
Maropea/Waikamaka	Maropea and Waikamaka
Kawhatau/Pourangaki	Kawhatau, Hikurangi, Pourangaki and Mangawharariki
Oroua	Oroua
Pohangina	Upper and Lower Pohangina
Southwest Ruahine	Makawakawa, Opawe and Ross
Southeast Ruahine	Mangaatua, Raparaparawai, Kumeti, Rokaiwhana, Tamaki and Manawatu

Results

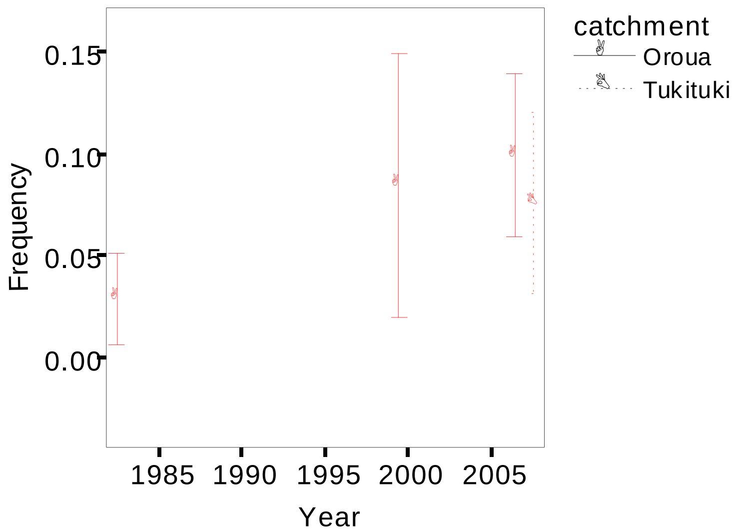

Figure 1 Frequency of deer pellets in the Oroua Catchment and Tukituki catchments

The proportion of the plots that contain pellets in the Oroua catchment increased from about 3% in 1983 to 2000, when mean frequency was about 8%, although variance was large. In 2007, mean frequency was higher still (10%). Analysis of the difference on the 16 lines measured in 1983 and in 2007 found that the mean increase was significant (t statistic 3.929, p = 0.001).

Mean pellet frequency in the Tukituki was approximately 7.5% in 2007. Table 2 summarises frequency of pellets derived from all previous measurements for which data is available. It indicates that current frequency is slightly higher than in the 1980s, but lower than in the 1970s.

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
2006	Pourangaki	13.0 ± 6.7	12.8
	Pohangina	7.3 ± 4.1	6.1
2005	Kawhatau (tussock)	0.4 ± 0.8	0.3
	Oroua (tussock)	0.7 ± 1.6	0
2003	Makawakawa	6.3 ± 5.1	11.9
	Ross	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
	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 both catchments have increased since 1983, but are still not as high as those recorded in the early 1970s. The deer population in the central part of the Range had declined throughout the 1960s so even the 1970s densities are probably well below peak. There was a further drop in pellet frequency from the mid 1970s to the early 1980s, attributed to aerial venison recovery which began in 1976.

It was thought that the catchments which were closed to aerial venison recovery in 1981 might act as indicators for the changes that might be expected over the entire range if venison recovery ceases. The increase in Oroua catchment, which is closed to aerial venison recovery, is slightly larger, but without the original data from the Tukituki, and larger samples from other catchments that are ‘open’ and ‘closed’, this cannot be attributed to the different management. It may also be that the management zones are too close together; deer move readily from one catchment to another and so differences in the rate of harvest do not affect animal density.

Since 2003, remeasurement of the 1983 pellet lines has shown small, statistically insignificant increases for the six catchments monitored (excluding the tussock lines established in 2005). The highly significant result reported here for the Oroua may reflect the larger number of lines sampled. Power analysis using 2006 data indicated that 15 lines should be measured to identify a 10% change, and 30 lines to measure a 5% change, in pellet density (Hawcroft 2006). It may also indicate that the difference has grown since the earlier measurements.

Care should be taken in placing too much emphasis on a single measurement. The increase apparent in 2007 may be due to unusual conditions in this particular year. For instance, a change in weather could mean that pellets decayed less rapidly than in previous summers. Repeated measurement of the same catchments in following years may provide more reliable information, but this must be balanced against the need to evaluate deer numbers in other parts of the range.

There is a need for ongoing monitoring of the deer population and the vegetation in the Ruahines. The exclosure plots have provided some information about the state of the forest, and this will be further explored in current RD&I research including data from plots on the eastern side of the range and from unfenced forest plots measured in 1961 and 1983-4. However, there is little information about the present state of the vegetation. Currently low pellet frequencies suggest vegetation is likely to be in good condition, but some habitat types may be at risk, especially if deer densities rise. For instance, high altitude broadleaf-pahautea forest may be particularly susceptible (James and Beaumont 1971, Cuddihy 1977). It is to be hoped that current RD&I work in this area will provide recommendations for ongoing monitoring of the state of the forest.

The immediate need is a record of the vegetation on the open tussock tops, which will be most at risk from increased deer use if aerial hunting is reduced and/or deer numbers increase. A pilot study of the feasibility of relocating and measuring grassland vegetation transects was conducted in January 2007. Results will be presented in another report, but there is potential for relocating and comparing plots on the Whanahuia Range (closed) with those at the head of the Kawhatau and on the Hikurangi Range (open).

Pellet counts can also be used as a crude index of possum density (Baddeley 1985). It is unfortunate that this year the contract did not clearly state that possum pellet presence should be recorded. This should be included in future contracts as there is high interest in possum density in the Ruahines, particularly in the Southern part (B. Fleury pers. comm.)

Conclusion

Deer pellet frequency, an indicator of deer use, has increased in the Tukituki and Oroua catchments since 1983, when deer numbers were very low. Frequencies are still not as high as those recorded in the 1970s.

Recommendations

- Continue to monitor deer use of the Ruahines by periodic remeasurement of pellet lines. Increasing the number of lines remeasured and decreasing the time between measurements will provide better information.

- Supplement this index of deer use by measurement of vegetation condition in the tussock grassland.

- The work that RD&I are producing should be used to evaluate the potential for remeasurement of unfenced permanent forest plots.

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

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Appendix 1 Technical specifications provided to field workers

Equipment

A map of the lines and copies of the 1982–3 line location notes will be given to each team. Teams will also need:

- Data recording sheets (waterproof paper)
- GPS
- Compass
- General Map
- Measuring tape
- Permolat
- Hammer and nails for marking lines on trees
- Aluminium pegs for marking lines in the tussock
- Pencils

All other equipment needed to meet the Area Office's health and safety requirements. Area Staff will conduct a safety briefing.

Measuring existing pellet lines

There are 16 (of 34 existing) lines to be remeasured in Oroua and eight in Tukituki. Replicate as closely as possible the method followed in the 1981/82 animal survey (Bell, 1973 referred to in Oaks 1983) and in 2001.

- Navigate to the line start (should be marked with permolat).
- Complete a new line location form if conditions have changed since the 1980s.
- The first plot will be virtually at the line start and the others should be 20m apart along the bearing on the line location sheet (each plot should be marked with permolat).
- Complete a pellet survey sheet for each line. Label each sheet with the observer's full names, the date and the sheet number (e.g. 2/4 if it is the second sheet out of four used on that line).

On each sheet record:

- Area (= Ruahines).
- Catchment.
- Line = line number as shown on map and lists provided.

- Plot = plot number, 1 is the plot nearest the line start.
- Slope = measure the average slope of the plot with a clinometer.
- Altitude = to the nearest 10m either estimate from map or use GPS.
- Aspect = measure with a compass at right angles to the general lie of the plot, to 5 degrees.
- Habitat = the 3 digit code that best describes the vegetation in and around the plot (teams will get a laminated sheet with the codes and vegetation types).
- Physiography = describe as a **R**idge (including spurs), **F**ace, **G**ully or **T**errace.

Search the plot systematically and thoroughly. Growing vegetation should be pushed aside and large woody debris can be cleared away.

- Record the presence of intact deer, possum, goat, pig, hare or sheep pellets in a radius of 114cm from the plot centre with a 1 in the P/A cell. If they are not present record a –.
- Record the horizontal distance in cm:

  from the plot centre to the nearest pellet group (rp)

  from the centre of that group to the next nearest (rn); If there is no group within 3m record a –.

- 'INTACT' pellets means: WHOLE, with a COMPLETE OUTER COATING: no disintegration, no flaking or wearing away of the outer surface, no cracks (except fine, from rapid drying), no holes (eg from invertebrates), not under water or moved by water/wind from its original place of deposition.
- INTACT PELLET GROUP means: six or more pellets are intact and at least one pellet is visible without moving leaf litter. It is important to find all the pellets in a group, so it is ok to move the litter once you have seen one.
- THE PELLET GROUP CENTRE. For a heap, this is easy. For a string, it is in the middle of the long axis of the string, weighted towards the biggest cluster.