Rata litterfall and canopy condition, Whirinaki Forest Park, New Zealand

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CONTENTS

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ABSTRACT

A preliminary study to examine the variability of rata (*Metrosideros robusta*) litterfall, as collected in funnel traps, both between and within individual crowns, was undertaken from December 2001 to June 2002 in Whirinaki Forest Park, North Island, New Zealand. Although a relationship between differences in crown size and crown health categories could not be demonstrated, sufficient foliage was collected in all sampling intervals to warrant further evaluation of leaf litterfall as a measure of change in crown condition over time. Because of high variability in litter catch at different points under any one crown, trap placement would have to remain the same throughout any study. A single sample period of two months is recommended, with samples being air-dried before sorting.

Keywords: rata, *Metrosideros robusta*, litterfall, tree crown health.

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1. Introduction

In an attempt to identify possum-damaged foliage as the basis of a possum density index, a major study was undertaken by Numata (unpubl. report 2001) of litterfall collected under northern rata (*Metrosideros robusta*) in Whirinaki Forest Park, situated approximately 50 km west of Taupo at 38° 45´S, 176° 40´E. The painstaking sorting of almost two years of monthly samples yeilded very small numbers of possum-damaged leaves. In hindsight, this was not surprising, given the possum's habit of completely removing twigs and foliage, leaving very few partially damaged leaves. However, the litter trap sampling method yielded good quantities of undamaged, or insect-chewed, rata leaves and showed the seasonal pattern of foliage loss.

In reviewing this work by Numata, it became evident that total rata leaf litterfall changes from year to year, and may be used as an indicator of change in crown health (Hosking & Numata unpubl. report 2001). The hypothesis was proposed that, irrespective of crown size, increasing litterfall would show recovery, and decreasing litterfall would show decline, in tree health.

1.1 OBJECTIVES

The primary objective of the present study was to examine the variability of rata foliage litterfall over a six-month sampling period, both between and within trees, prior to testing the above hypothesis. The sampling would also show whether the quantities of leaves collected would be great enough to be useful in a sampling programe.

Specifically the study aimed to:

- examine the variation between two traps collecting litterfall under the same tree;
- examine the variability in litterfall between trees relative to canopy size and health;
- determine the difference in leaf litter condition between a two-month and three-month sampling interval; and
- determine the time and resources needed to process litterfall samples.

2. Methods

2.1 TREE SELECTION

Trees were selected as representative of large emergent rata in the area, with some being those previously sampled by Numata (unpubl. report 2001). A range of trees was chosen to represent large and small crowns, and within these size classes, three health classes: healthy, intermediate, and unhealthy, as defined by Hosking & Hutcheson (1998). A total of 11 trees were sampled for the whole six-month period, from December 2001 to June 2002. Several other trees, which were sampled for only part of the period, are not included in the analysis.

2.2 LITTER COLLECTION

Litterfall was collected using methods based on those of Hosking & Hutcheson (1986) in their study of hard beech forest deterioration. Two funnel collecting traps, each with a collecting area of 0.283 m^2, were located under the most exposed crown of each sample tree. The litterfall from one trap was collected every 2 months (A series), and the other three monthly (B series), giving a total of 5 samples from each tree.

2.3 SAMPLE TREATMENT

All samples were sorted prior to oven-drying, those collected in February and April after two weeks air-drying, and those in June immediately after collection. Rata foliage was separated from all other foliage, woody debris, fruit and possum pellets, placed in a clean paper bag, and oven-dried in a laboratory drying cabinet at 35°C for at least 10 days. Other foliage and debris was separated from fines, and both were similarly dried. All components were weighed (in g, to an accuracy of two decimal places) before and after drying . All dried samples were archived.

2.4 DATA ANALYSIS

Data analysis was undertaken using non-parametric tests. Because the A series and B series samples were collected under the same sample trees, and were therefore related, data for different sampling periods have been analysed using the paired-sample *t*-test (Zar 1974). Data from the various crown size and health classes were examined using ANOVA, but any statistical conclusions have been rejected on the basis of very small number of samples, and/or very high within-group variance.

3. Results

3.1 SAMPLE PROCESSING TIME

The average time taken to sort litter in a single trap was 15 min for a two-month collection and 30 min for a three-month collection. Sorting of air-dried samples was much easier than directly after field collection, and two-month samples, where foliage and debris were less compacted, were easier to sort than three-month samples. Each weighing of samples took about 30 min. The total time taken to process the 11 samples was about 4 hours for the two-month collections, and 6.5 hours for the three-month collections. A monitoring programme of this size, carried out over the main six-month litterfall period, involves a time commitment of between 4.5 and 5.5 person days. This time excludes field collection, data analysis and reporting.

3.2 LITTERFALL AND SAMPLING INTERVAL

Total litterfall for the six-month sampling period, by individual tree and sample interval, is shown in Fig. 1. The full data are presented in Appendix I. Clear differences are apparent between the weight of foliage collected in the three two-month samples, and the two three-month samples (significant at 1% level, t 1.42). Differences for four of the 11 sample trees were particularly marked (Fig. 1). The major influence is believed to be trap position, the A and B series traps being necessarily under different parts of the tree crown. The first sampling period in both series produced significantly more foliage than the last (Figs 2 and 3), with Series A being significant at the 0.005% level, and Series B at the 0.025% level. A consistent pattern of decreasing litterfall, from December to May, is evident in the two-month sampling series (Fig. 2). Over 52% of total rata foliage collected fell in December–January, and only 17% in April–May. The three-month sampling series (Fig. 3) collected 62% of foliage in December–February.

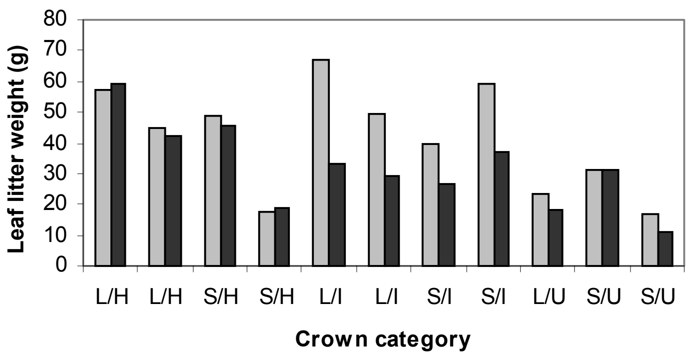

Figure 1. Total rata leaf litter in two-monthly (grey) and three-monthly (black) collections. Crown categories: L large; S small; H healthy; I intermediate; U unhealthy.

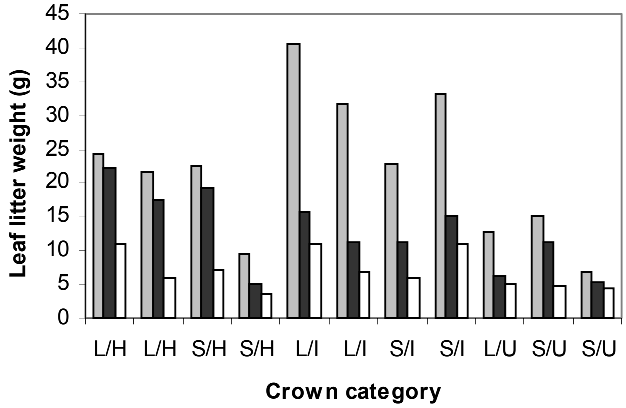

Figure 2. Rata leaf litter weight by sampling period, A series: grey, Dec–Jan; black, Feb–Mar; white, Apr–May. Crown categories: L large; S small; H healthy; I intermediate; U unhealthy.

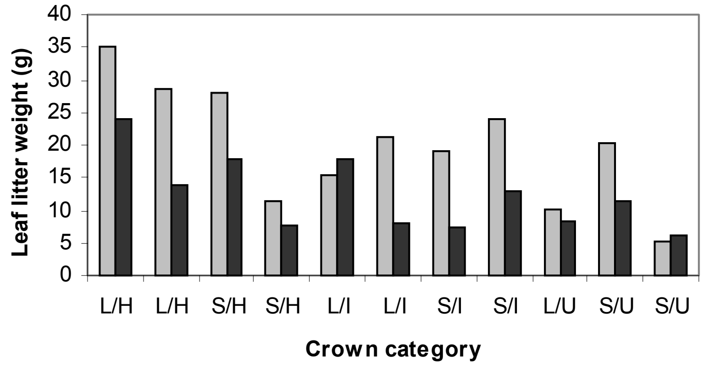

Figure 3. Rata leaf litter weight by sampling period, B series: grey, Dec–Feb; black, Mar–May. Crown categories: L large; S small; H healthy; I intermediate; U unhealthy.

3.3 LITTERFALL AND SIZE AND CONDITION OF CROWN

Although total leaf fall from all large-crowned trees exceeded that of small-crowned ones, no clear relationship existed on the basis of individual trees (Fig. 4). Differences between the weight of foliage collected under unhealthy and healthy crowns were inconsistent, and there were no differences between healthy and intermediate crowns (Fig. 5). No statistically valid conclusions can be drawn from the data on the influence of crown size, or crown health, on litterfall over the sample period.

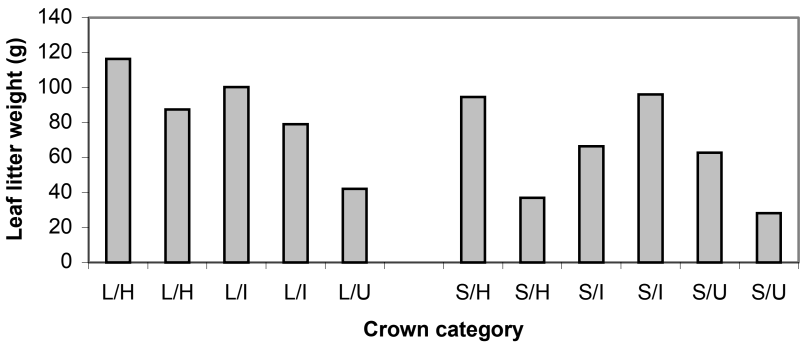

Figure 4. Total leaf litter weight (A plus B series) by crown size.
Crown categories: L large; S small; H healthy; I intermediate; U unhealthy.

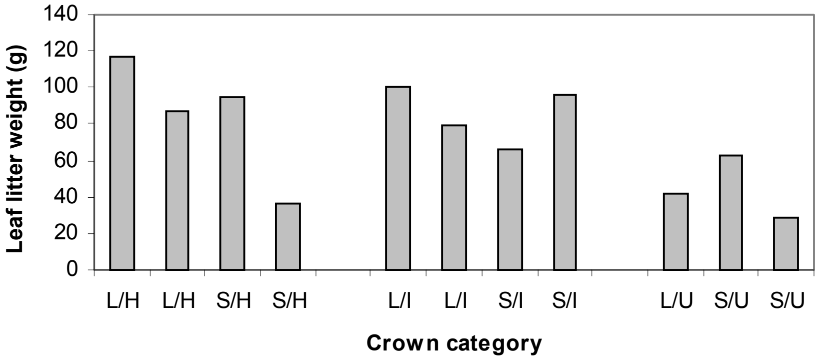

Figure 5. Total leaf litter weight (A plus B series) by crown health.
Crown categories: L large; S small; H healthy; I intermediate; U unhealthy.

4. Discussion

The amount of rata foliage intercepted is strongly influenced by trap placement. The rata crowns sampled, typical of northern rata, were emergent above a lower canopy. At the Whirinaki site there was a well defined second canopy tier dominated by tawa. Litter collection was further complicated by the lack of uniformity of the rata crowns themselves. Eight of the 11 sample trees showed a high degree of agreement between two-monthly and three-monthly collections. The other three trees showed much greater foliage weights for two-monthly as opposed to three-monthly collections. It is likely that individual trap placement, relative to the distribution of the crown being sampled, is responsible for this variability. Although such variability is undesirable, it may not be of great importance if sampling is aimed at measuring crown recovery, provided that the traps are maintained in the same location from one sampling season to the next.

The consistent pattern of greatest litter collection in the early part of the sampling period for both series of traps suggests the sampling period of any future trial might be shortened. Based on the A series data (Fig. 2), a sampling period of two months from the beginning of December to the end of January might be considered.

All of the 11 trees sampled over the full six-month period provided useful weights of rata foliage. Such quantities should be sufficient to show changes in crown condition from one season to another. A single gram of oven-dried rata foliage contains on average of 20 to 24 leaves.

5. Conclusions

It seems unlikely, based on the present study, that leaf litterfall, as collected in litter traps, can be used to classify tree crowns by condition class. However, providing sample traps are maintained in the same physical position from season to season, leaf litterfall may be a useful indicator of crown condition change over time. The study shows good quantities of leaf litter are collected over a 6 month period between December and May, and that this period might be shortened to two months in any future studies. Sample treatment is straight forward and not overly demanding on time or resources.

If the hypothesis advanced in the introduction to this report is to be tested, it is recommended 10 trees be selected and sampled using 2 traps per tree, with a single sample collected for the December to January period. Samples should be air dried before sorting and oven drying and all but rata foliage discarded. The ideal site would be one currently suffering possum damage, where possum control could be undertaken following collection of the first year's data.

6. Acknowledgements

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7. References

Hosking, G.P.; Hutcheson, J. 1986: Hard beech (*Nothofagus truncata*) decline on the Mamaku Plateau, North Island, New Zealand. *New Zealand Journal of Botany 24*: 263–269.

Hosking, G.P.; Hutcheson, J. 1998: Wind-caused disturbance of a red/silver beech forest: Ten years on. *New Zealand Journal of Forestry Science 28(3)*: 325–334.

Zar, J.H. 1974: Biostatistical Analysis. Prentice-Hall Inc., New Jersey.

Appendix 1

RATA LITTER SAMPLING TRIAL, 2001/02

A series			1 FEB 02				4 APR 02				3 JUN 02*	
TREE NO.	TREE ID	CROWN TYPE	Air-dried Sample	Air-dried Rata	Oven-dried Debris	Oven-dried Rata	Air-dried Sample	Air-dried Rata	Oven-dried Debris	Oven-dried Rata	Oven-dried Debris	Oven-dried Rata
4a,4b	**3**	Large/healthy	89.86	30.45	11.16	24.29	34.87	24.03	10.05	22.21	8.47	10.92
7a,7b	**17**	Large/healthy	38.01	22.4	12.3	21.59	53.73	32.38	12.54	17.4	5.85	5.89
6a,6b	**6**	Small/healthy	37.08	23.21	11.33	22.39	47.37	28.17	13.92	19.22	9.05	7.23
12a,12b	**14**	Small/healthy	33.07	9.86	20.13	9.39	22.66	5.15	16.63	4.89	10.62	3.46
10a,10b	**20**	Large/int	59.15	41.63	13.12	40.45	41.2	18.33	19.91	15.7	23.64	11.04
21a,21b	**21**	Large/int	70.85	45.28	15.65	31.69	37.92	16.07	16.75	11.16	5.29	6.86
1a,1b	**19**	Small/int	39.47	23.93	12.18	22.82	33.82	14.38	15.66	11.28	16.65	5.78
a,b	**Kai**	Small/int	85.02	52.69	16.59	33.11	41.41	16.25	23.3	15.14	24.47	10.99
23a,23b	**23**	Large/unhealthy	101.77	13.12	62.8	12.61	43.16	8.29	22.62	6.11	47.89	4.98
16a,16b	**16**	Small/unhealthy	34.12	16.86	11.07	15.22	41.65	20.95	13.01	11.24	12.5	4.74
22a,22b	**22**	Small/unhealthy	41.76	7.17	30.28	6.91	39.06	6.24	25.61	5.37	14.89	4.53
	Mar		39.51	16.56	19.88	15.96						
	17a						46.66	9.34	33.74	8.89	19.65	5.65
	33a						29.55	0.68	25.47	0.67	11.28	0.26
	Fines				39.48				19.89			

B series			28 FEB 02				3 JUN 02*	
TREE NO.	TREE ID	CROWN TYPE	Air-dried Sample	Air-dried Rata	Oven-dried Debris	Oven-dried Rata	Oven-dried Debris	Oven-dried Rata
4a,4b	**3**	Large/healthy	70.34	47.4	14.65	35.03	21.15	23.9
7a,7b	**17**	Large/healthy	63.4	36.58	15.02	28.61	7.54	13.91
6a,6b	**6**	Small/healthy	59.53	32.85	18.98	27.89	16.52	17.83
12a,12b	**14**	Small/healthy	58.13	12.54	37.42	11.48	28.52	7.67
10a,10b	**20**	Large/int	30.11	17	9.37	15.38	17.8	17.72
21a,21b	**21**	Large/int	74.6	28.89	29.04	21.29	32.95	7.94
1a,1b	**19**	Small/int	60.74	25.42	24.45	19.19	20.88	7.29
a,b	**Kai**	Small/int	71.19	28.3	30.79	23.89	17.23	12.94
23a,23b	**23**	Large/unhealthy	195.67	12.03	130.46	10.09	40.96	8.26
16a,16b	**16**	Small/unhealthy	62.11	27.77	23.12	20.22	18.68	11.27
22a,22b	**22**	Small/unhealthy	76.54	6.5	44.54	5.25	23.95	6.06
	17b						44.44	11.96
	33b						43.88	0.2
	Fines				37.56			

*Traps 1a and 1b were missed in the 3 Jun 02 collection and remained collecting for a further 15 days. The weight of foliage has been adjusted accordingly (A series by 0.8 times and B series by 0.86 times).