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# DIET OF THE HOUSE MOUSE *(MUS MUSCULUS* L.) IN TWO PINE AND A KAURI FOREST

**Summary:** The diet of the house mouse *(Mus musculus* L.) was studied in an exotic pine *(Pinus radiata* D. Don) and an indigenous kauri *(Agathis australis* Salisb.) forest near Auckland from 1976-1977. Stomach contents of 594 and 117 mice collected by snap trapping in the Woodhill and Hunua Forest respectively revealed an omnivorous diet consisting largely of adult arthropods, lepidopteran larvae and seeds. In the Woodhill pine forest adult arthropods and lepidopteran larvae were the main foods throughout the year, while seed generally became important between spring and autumn. In the Hunua kauri forest, adult arthropods and seed were important foods all year round. Kauri seed largely prevailed in the stomach contents during April and May. Predation by mice on birds' nests was not evident.

**Keywords**: House mouse, Mus musculus, stomach contents, pine forest, kauri forest, Woodhill State Forest, Hunua Ranges.

## Introduction

*Mus musculus* L. is widely distributed throughout New Zealand (Wodzicki, 1950) but there are no published reports on their diet. Long term studies on *M. musculus* in New Zealand beech forests have shown a high association of mouse numbers and seed fall (Fitzgerald, 1978; King, 1982) but no dietary analyses have been published.

This paper reports on the diet of mice in two exotic plantations of *Pinus radiata* D. Don in the Woodhill State Forest and an indigenous kauri *(Agathis australis* Salisb.) forest in the Hunua Ranges.

## Study Areas

Woodhill State Forest is approximately 42 km north-west of Auckland (36∞41'S, 174∞23'E) and forms a narrow coastal strip about 40 km long and 2-3 km wide between 0-120 m a.s.l. (Fig. 1). The forest was planted with *P. radiata* originally to stabilise encroaching sand-dunes and is now managed for production (Restall, 1964).

Sampling was confined to Compartments 90, 99 and 100. Compartments 90 and 100, planted in 1938 and 1940 respectively, formed mature stands. The trees were pruned up to 5.5 m in 1957-58 and thinned to a stem density of 220 trees/ha in 1958-59. Ground vegetation was mainly patches of yellow lupin *(Lupinus arboreus* Sims) or toe-toe *(Cortaderia splendens* Connor).

Compartment 99 was a young *P. radiata* stand planted in 1975 and was covered by lupin and inkweed *(Phytolacca octandra* L.). 'Release cuttings' around the young pines were undertaken in January-February 1976 and 1977, and September 1977.

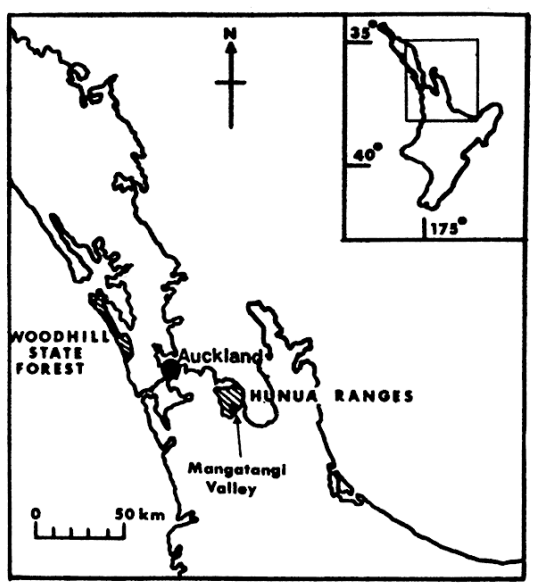


Figure 1: *Location of study areas.*

The Hunua Forest is in the lower Mangatangi Valley on the south side of the Hunua Ranges, 40 km south-east of Auckland (37∞08'S, 175∞13'E) (Fig. 1). The Hunua Ranges are approximately 24,800 ha in area, ranging in elevation from 0-680 m a.s.l. The forest type in the lower Mangatangi Valley is basically hard beech *(Nothofagus truncata* Col.) and kauri. Hard beech favoured the cooler south-facing ridges, while kauri predominated on the drier ridge tops and

north facing slopes. Detailed descriptions of the vegetation in the Hunua Ranges have been given by Barton (1972).

The study area was essentially a dense kauri pole stand with some rimu *(Dacrydium cupressinum* Lamb), tanekaha *(Phyllocladus trichomanoides* D. Don), and occasional beech forming the forest canopy. Mature kauri were removed from the study area during selective logging between 1969-71. Ground vegetation was dominated by kauri grass *(Astelia trinerva* Kirk), mingimingi *(Cyathodes jasiculata* Forst. f. and C. *jumipera* J.R. et G. Forst), cutty grass *(Gahnia xanthocarpa* Hook. f.) and ground fern *(Blechnum capense* L.).

## Methods

Mice were caught using snap-traps baited with peanut butter and flour. Trapping at Woodhill was conducted for 2-3 successive nights each month, from May 1976 to November 1977 in the mature pine plantation and from December 1976 to November 1977 in the young pine plantation. In the Hunua forest mice were collected over three successive nights at regular intervals throughout 1977.

Stomachs from trapped mice were preserved in 70% ethanol prior to analysis. Stomach contents were examined under binocular microscope and the frequency of occurrence (Daniel, 1973) of various food items calculated. Food items were divided into five categories of animal matter (adult arthropods, lepidopteran pupae, lepidopteran larvae, arthropod eggs, Annelida (earthworms» and three categories of plant matter (seed, leaf material, fungal spores). From stomach contents of the Woodhill samples the frequency of occurrence of the more commonly eaten species of lepidopteran larvae and seed was calculated. Kauri seed was recorded in the Hunua samples. All stomachs contained some unidentifiable material or trap bait which was excluded from frequency of occurrence calculations.

## Results

A total of 260 and 334 mice from the young and mature pine plantations at Woodhill and 117 mice from the Hunuas were trapped and stomach contents analysed.

*Woodhill Forest - young pine plantation*

Main food items were adult arthropods, lepidopteran larvae and seed (Table 1). Adult arthropods and lepidopteran larvae occurred in most stomachs each month. In March lepidopteran pupae became common. The Variable-Bell moth larvae *(Pyrogotis semiferana* Walker) was the predominant lepidopteran species eaten but Kowhai moth larvae *(Uresiphita polygonalis maorialis* Felder) became important during February and March (Fig. 2a).

Seed was present in most stomachs throughout. the year except in December (Table I). Inkweed was the main seed eaten during February and from August to October, while smooth fleabane *(Erigeron pusillus* Nutt.) was common during May and June (Fig. 3).

Table 1: *Percentage frequency of occurrence of food items in the stomachs of* M. musculus *from the young* P. radiata *plantation, Woodhill Forest. Empty stomachs are excluded.*

| | | | % Freguency of occurrence | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Date | Total no. examined | Adult arthropods | Lepidopteran pupae | Lepidopteran larvae | Arthropod eggs | Annelida | Seed | Leaf | Fungal spores |
| 1976 | Dec | 12 | 75 | 8 | 83 | 0 | 0 | 8 | 25 | 0 |
| 1977 | Jan | 3 | 100 | 67 | 100 | 0 | 0 | 67 | 33 | 0 |
| | Feb | 13 | 85 | 15 | 100 | 0 | 8 | 85 | 23 | 0 |
| | Mar | 25 | 40 | 84 | 100 | 0 | 8 | 24 | 16 | 0 |
| | Apr | 37 | 73 | 57 | 81 | 14 | 3 | 59 | 27 | 5 |
| | May | 46 | 85 | 20 | 91 | 2 | 9 | 76 | 11 | 20 |
| | June | 35 | 60 | 9 | 83 | 6 | 0 | 77 | 6 | 9 |
| | July | 15 | 87 | 0 | 93 | 0 | 0 | 47 | 20 | 0 |
| | Aug | 15 | 93 | 13 | 93 | 0 | 0 | 93 | 27 | 0 |
| | Sept | 19 | 100 | 0 | 100 | 0 | 0 | 90 | 37 | 5 |
| | Oct | 25 | 72 | 4 | 88 | 0 | 0 | 84 | 28 | 4 |
| | Nov | 15 | 87 | 7 | 80 | 0 | 0 | 47 | 13 | 7 |
| | Total | 260 | Mean 80 | 24 | 91 | 2 | 4 | 63 | 22 | 4 |

*Woodhill Forest - mature pine plantation*

Main food items were similar to those on the young pine plantation (Table 2). Adult arthropods occurred most frequently in the diet between May and November while lepidopteran larvae remained a staple food throughout most of the year. The seasonal frequency of occurence of lepidopteran species eaten was also similar to that found in the young pine plantation, particularly in summer when nearly all mice fed on Kowhai moth larvae (Fig. 2b). Lepidopteran pupae became important in March (Table 2).

Seed occurred most frequently during the spring, summer and autumn months. *P. radiata* seed was important in February and March, toe-toe in March and April, and inkweed in September (Fig. 3).

*Hunua Forest*

. Stomachs contained adult arthropods and seed throughout the year (Table 3). 111 contrast to populations at Woodhill, lepidopteran larvae made a smaller contribution to the diet while lepidopteran pupae and Annelids were absent. Kauri seed was present in the diet during April to June but was absent In the diet by August/ September. Fungal spores became a common food item in August/September.

## Discussion

In both Woodhill and Hunua forests mice were omnivorous and ate many arthropods. This confirms the results of overseas studies on *M. musculus,* particularly those in forest/scrub habitats (Kami, 1966; Watts and Braithwaite, 1978; Cockburn, 1980). Lepidopteran larvae formed a large proportion of the arthropod intake at Woodhill, which is similar to that found for *M. musculus* by Whitaker (1966), Berry (1968) and Houtcooper (1978). Seed has been found dominant in other studies on *M. musculus* diet especially those in grassland habitats (Tomich, Wilson and Lamoureaux, 1968; Berry and Peters, 1975; Borchert and Jain, 1978), cultivated fields (Whitaker, 1966; Houtcooper, 1978), and desert (Watts, 1970; Newsome and Corbett, 1975). *M. musculus* may eat birds' eggs and nestlings in New Zealand (Flack and Lloyd, 1978) but no bird remains were found in the stomach contents from Woodhill and Hunua.

Marked seasonal variations were evident in the

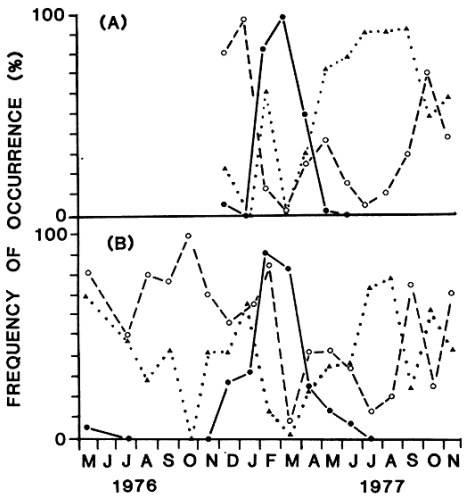


Figure 2: *Percentage frequency of occurrence of lepidopteran larva species in stomachs of* M. musculus *from the Woodhill Forest in (a) à young* P. radiata *plantation and (b) a mature* P. radiata *plantation. (●—●) Kowahi moth (○---○) Variable-Bell moth, ( .... ) other lepidopteran larvae species.*

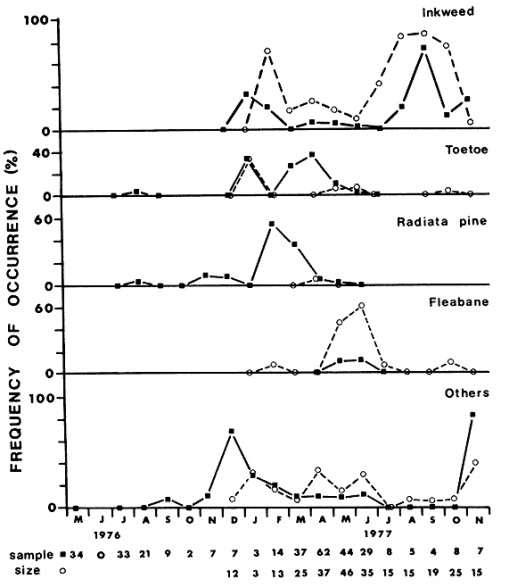


Figure 3: *Percentage frequency of occurrence of seed species in stomachs of* M. musculus *from the Woodhill Forest. (■—■) mature plantation, (○- - -○) young plantation.*

Table 2: *Percentage frequency of occurrence of food items in the stomachs of* M. musculus *from the mature* P. radiata *plantation, Woodhill Forest. Empty stomachs are excluded.*

| | Date | Total no. examined | Adult arthropods | % Frequency of occurrence Lepidopteran pupae | Lepidopteran larvae | Arthropod eggs | Annelida | Seed | Leaf | Fungal spores |
|---|---|---|---|---|---|---|---|---|---|---|
| 1976 | May | 34 | 47 | 15 | 97 | 0 | 0 | 0 | 44 | 0 |
| | June | — | | | | | | | | |
| | July | 33 | 82 | 0 | 82 | 6 | 6 | 0 | 18 | 15 |
| | Aug | 21 | 95 | 0 | 81 | 0 | 0 | 10 | 14 | 29 |
| | Sept | 9 | 78 | 0 | 89 | 0 | 0 | 11 | 0 | 33 |
| | Oct | 2 | 100 | 0 | 100 | 0 | 0 | 0 | 50 | 50 |
| | Nov | 7 | 100 | 14 | 86 | 0 | 14 | 29 | 57 | 14 |
| | Dec | 7 | 57 | 0 | 71 | 0 | 0 | 71 | 0 | 0 |
| | Jan | 3 | 100 | 33 | 67 | 0 | 0 | 100 | 33 | 33 |
| | Feb | 14 | 57 | 0 | 100 | 0 | 0 | 71 | 7 | 0 |
| | Mar | 37 | 60 | 73 | 60 | 3 | 0 | 46 | 14 | 0 |
| | Apr | 62 | 77 | 31 | 61 | 3 | 0 | 68 | 16 | 3 |
| | May | 44 | 98 | 16 | 80 | 7 | 2 | 43 | 2 | 7 |
| 1977 | June | 29 | 97 | 7 | 66 | 3 | 0 | 41 | 21 | 31 |
| | July | 8 | 100 | 0 | 75 | 0 | 0 | 0 | 0 | 0 |
| | Aug | 5 | 80 | 80 | 80 | 0 | 20 | 20 | 0 | 20 |
| | Sept | 4 | 100 | 0 | 75 | 0 | 0 | 75 | 0 | 0 |
| | Oct | 8 | 100 | 0 | 75 | 0 | 13 | 38 | 13 | 13 |
| | Nov | 7 | 58 | 0 | 71 | 0 | 0 | 86 | 0 | 43 |
| | Total | 334 | Mean 83 | 15 | 79 | 1 | 3 | 39 | 16 | 16 |

Table 3: *Percentage frequency of occurrence of food items in the stomachs of* M. musculus *from the Hunua Forest. Empty stomachs are excluded.*

| | Date | Total no. examined | Adult arthropods | % Frequency of occurrence Lepidopteran larvae | Arthropod eggs | Kauri seed | Other seed | Leaf | Fungal spores |
|---|---|---|---|---|---|---|---|---|---|
| | Feb | 2 | 100 | 0 | 50 | 0 | 100 | 0 | 0 |
| | Mar | 4 | 100 | 0 | 0 | 0 | 100 | 25 | 0 |
| | Apr | 18 | 78 | 22 | 0 | 83 | 17 | 11 | 0 |
| 1977 | May | 53 | 91 | 34 | 0 | 74 | 55 | 23 | 4 |
| | June | 18 | 89 | 39 | 0 | 28 | 50 | 22 | 17 |
| | Aug/Sept | 7 | 71 | 29 | 43 | 0 | 29 | 0 | 71 |
| | Oct/Nov | 11 | 91 | 64 | 27 | 0 | 9 | 18 | 9 |
| | Dec | 4 | 100 | 25 | 0 | 0 | 50 | 25 | 0 |
| | Total | 117 | Mean 90 | 27 | 15 | 23 | 51 | 16 | 13 |

mouse diet at Woodhill and Hunua. Kowhai moth was the predominant species of lepidopteran larvae eaten during summer at Woodhill. These occurred in high numbers on lupin in the forest during February and March (Mulvay, 1978). Subsequent pupation in March and April would explain the presence of pupae in the mouse diet over these months. Differences in the selection of seed species eaten by mice between the young and mature pine plantation at Woodhill reflected their availability in the habitat. In the Hunua

Forest, kauri was the main seed species eaten between April and June. Kauri seed became available to mice as trees shed their seed throughout March and April (I.L. Barton, pers.comm.). Mice have been reported feeding on kauri seed in a nursery (Ecroyd, 1982). That mice feed readily on kauri seed when available suggests that these rodents may be one factor affecting the natural regeneration of kauri stands.

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