SHORT COMMUNICATION

Habitat use by mice during winter on subantarctic Auckland Island

Grant A. Harper*

Department of Conservation, PO Box 743, Invercargill, New Zealand
* Present address: Department of Conservation, Rotoiti Nature Recovery Project, PO Box 55, St Arnaud 7053, New Zealand
(Email: gharper@doc.govt.nz)

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Abstract: Introduced mice were trapped in the three main vegetation types on subantarctic Auckland Island, New Zealand, over three trapping sessions, in winter 2007. Fifty mice were trapped over 675 trap-nights. Mice were caught most often in upland tussock grassland and more often in rātā forest than in shrubland but there were no significant differences among the catch rates in these habitats. Upland tussock grassland appeared to have been a better vegetation type for mice, as adult females were trapped only there and mean weight of adult males was heavier there than of adult males from the other vegetation types.

Keywords: *Mus musculus*, trap success

Introduction

Mice *Mus musculus* have been introduced to most subantarctic islands worldwide, which support many endemic species of plants, invertebrates and birds. Owing to their small size, it was thought that mice were relatively benign on these islands but, increasingly, it has been shown that mice are likely to extirpate invertebrate species (Marris 2000), alter ecosystem functioning (Le Roux et al. 2002; Jones et al. 2003; Smith 2008), and even prey on large seabirds (Cuthbert & Hilton 2004). Most published research on mice in the subantarctic thus far has focused on population dynamics and diet (Gleeson & van Rensburg 1982; Pye 1993; Smith et al. 2002; van Aarde & Jackson 2007). However, information on their habitat use is becoming increasingly useful as eradication of mice becomes increasingly feasible (Torr 2002) and because they often form the principal prey of other introduced mammals like cats (Bloomer & Bester 1990), which in turn are being eradicated from large subantarctic islands (Bester et al. 2002).

Mice were among the first introduced mammals to become established on Auckland Island, about 1820 – the same time as cats *Felis catus* and slightly later than pigs *Sus scrofa* (Taylor 1968). Research on the habitat use by mice was undertaken as part of a larger investigation into the possible eradication of cats and pigs from Auckland Island. As mice were likely to form a substantial proportion of cat prey, in turn influencing cat habitat selection, estimates of mice abundance in the main vegetation types was required. In June and July 2007 a small expedition spent 4 weeks undertaking the fieldwork at Port Ross on the northern end of the island.

Methods

Details of the history, climate and vegetation of the study site are outlined in DeLisle (1965), Godley (1965), Challies (1975) and Taylor (1975). Mice were trapped in the three main vegetation types: rātā (*Metrosideros umbellata*) forest, shrubland (dominated by rātā, *Myrsine divaricata* and *Dracophyllum longifolium*), and upland tussock grassland. Trap lines comprising 25 Victor™ mice traps at approximately 25-m intervals were established in rātā forest, shrubland, and upland tussock and run concurrently in the three vegetation types for 3 nights. Each line was at least 500 m from the nearest line in the adjacent habitat. Traps were baited with a mixture of rolled oats and peanut butter. At the end of each trapping session the trap lines were shifted at least 200 m to another site within each vegetation type. This trapping protocol was run three times to assess variation of mice abundance within habitats and to reduce the effect of weather on trapping success within one trapping period. Trapping was carried out from 18 June to 3 July but was suspended between 24 and 30 June due to snow.

Captures were recorded to estimate mouse abundance. The rate of capture was defined as the number of mice caught per 100 trap-nights (TN). This total was corrected (C) for all sprung traps and the final total notated as mice/100CTN (Nelson & Clark 1973). Mice were processed on the day of capture. Details of sex, approximate age (judged by perforate or imperforate vagina for females and the presence or absence of visible tubules within the cauda epididymides for males), weight, and reproductive condition were recorded (following Cunningham & Moors 1996).

A repeated-measure analysis of variance (ANOVA) was used to test whether overall relative abundance of mice differed between vegetation types for each trapping session. A single-factor ANOVA tested whether weights of adults differed among all habitats. The ratio of males to females, juveniles to adults, and adult males to adult females between habitats were tested using chi-square analyses. Results are presented as means ± one standard deviation.

Results

Fifty mice (21 females, 29 males, sex ratio 1:1.38) were trapped over 675 trap-nights in the three habitats combined (Table 1). One of these mice was trapped in a cat trap in rātā forest. Mice were trapped most often in upland tussock ($n = 21$), followed by rātā forest ($n = 17$), and shrubland ($n = 12$). There were substantial variations in abundance within habitats, which meant there was no significant difference in abundance between habitats ($F_{2,8} = 2.89$, $P = 0.17$). On the third trap line in the upland tussock, the last six traps were set in tussocks within an area where a sheet of water 3–5 cm deep ran across the surface. Two mice were trapped in this portion of the trap line.

The mean weight of adult male mice was 23.1 g (± 2.8) and varied between habitats (Table 1). Although there was no significant difference in the mean weights of males between habitats ($F_{2,16} = 3.31$, $P = 0.07$), sample sizes were small and males trapped in upland tussock were generally heavier than males from rātā forest and significantly heavier than males from shrubland (Table 1, Tukey $HSD_{.05} = 4.03$, $P = 0.05$). The mean head–body length of all trapped adult males was 92.9 mm (± 8.52), and for adult females was 90.3 mm (± 2.63). The mean weight of adult females was 22.5 g (± 1.5). There was no significant difference in the ratio of adults to juveniles between vegetation types ($\chi^2 = 0.79$, $P = 0.67$), or males to females between vegetation types ($\chi^2 = 0.33$, $P = 0.19$). There was a highly significant difference in the ratio of adult females and adult males caught between vegetation types (Exact contingency table, $P = 0.001$), as no adult females were trapped in rātā forest or shrubland (Table 1). All of the 10 adult females were caught in upland tussock. Seven had post-partum scars. Juveniles comprised 48% of the trapped mice.

Discussion

Although there was no statistically significant difference in the abundance of mice between the three vegetation types on Auckland Island, indicating that the differences in mean values may have been produced by chance, the combination of the abundance and body weight data suggests that upland tussock grassland was a more favourable habitat for mice. Overall, more mice were trapped in tussock grassland. Adult females were trapped only in this habitat. Slightly heavier males were trapped in tussock than in rātā forest but males were significantly heavier in tussock than in shrubland. These differences could be explained by differences in food and refuge availability (Matthewson et al. 1994). As mice develop runways to provide protection from adverse weather under low ground cover (Avenant & Smith 2003), it is likely that the generally dense ground cover in the upland tussock grassland provided equally favourable conditions for mice. In contrast, there were fewer patches of low ground cover in either rātā forest or shrubland (pers. obs.). The trapping of mice within a large sheet of flowing water in the upland tussock was unexpected as dispersal to these sites required the mice to either swim in very cold water or move across the tussock 'canopy' using stem tips.

The lack of adult females trapped in the two lower altitude sites is difficult to explain. Adult females would need to be present to maintain viable populations. They could be present here in very low numbers, which may at least partially explain the lower relative abundances recorded in these habitats. Seasonal dispersion of females into lower altitude sites could also occur. Sex-related differences in capture rates of mice are another explanation (Drickamer et al. 1999), but these are unlikely to be as extreme as recorded here.

It appears that breeding had recently finished as almost 50% of the population comprised juveniles and 70% of the adult females had bred. No pregnant female mice were trapped during the early winter. This mirrors results from other subantarctic islands, where pregnant or lactating mice were trapped only from late September to early May (Pye 1993; Matthewson et al. 1994; Jones et al. 2003; Avenant & Smith 2003).

The recorded weights and head–body lengths for mice trapped on Auckland Island were within the normal range for mice in New Zealand (Ruscoe & Murphy 2005). Similarly, the sex ratio reflected results from other wild populations, with more males than females being trapped.

The proposed eradication of cats is unlikely to result in large increases in mice numbers on the island. On subantarctic Marion Island mice were regulated by density-dependent factors and temperature (Ferreira et al. 2006; van Aarde & Jackson 2007). However, the eradication of mice populations on New Zealand subantarctic islands is desirable because of their substantial deleterious effects on invertebrate density and diversity, ecosystem functioning, and seabird populations on subantarctic islands (Angel et al. 2009).

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Table 1. Number and mean weights of mice caught in each habitat type on Auckland Island from 18 June to 3 July 2007. Results are presented ± 1 SD. CTN = corrected trap-nights.

Vegetation type	Rātā forest	Shrubland	Upland tussock
Mean relative abundance (no. mice / 100 CTN)	7.2 (± 4.1)	5.6 (± 2.4)	12.7 (± 8.7)
No. adult males	8 (+ 1: cat trap)	5	4
No. adult females	0	0	10
No. juveniles	8	7	7
Mean weight of adult males (g)	23.0 (± 2.6)	21.2 (± 2.6)	25.5 (± 1.5)

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