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HOME RANGES AND HABITAT USE OF THE GARDEN DORMOUSE (ELIOMYS QUERCINUS) IN A MOUNTAIN HABITAT IN SUMMER

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Radio-tracking was used to investigate home ranges, daily resting places and habitat use of the garden dormouse in Scots pine woodland in summer. Males used larger areas than females. Overlaps between ranges suggested a spatial organization during the breeding period in which males partially share their home ranges and overlap with those of females. Dormice nested above ground in holes between rocks and every animal used more than one nest during the radio-tracking period. Most of the active time was spent by animals on the ground, searching for food under hazel bushes and moving through areas with abundant rocky cover, probably for protection from predators.

Key words: resting places, space use, habitat selection, radio-tracking, Italy

INTRODUCTION

Despite a widespread distribution and its ecological flexibility, the garden dormouse (*Eliomys quercinus*) has been the object of few field studies. Previous investigations were conducted using capture, mark and recapture methods, and focused on population dynamics, weight changes, and animal survival (MANN 1976, VATERLAUS 1998, BERTOLINO *et al.* 2001, SCHAUB & VATERLAUS-SCHLEGEL 2001). The use of space and habitat selection of this species have been poorly investigated. Available data come mainly from trapping studies that showed only some aspects of habitat use (LE LOUARN & SPITZ 1974, MANN 1976). Little is known about home ranges, movement, nest site selection and the three-dimensional niche of this animal. The only study using radio-tracking was conducted in a deciduous woodland area (VATERLAUS-SCHLEGEL 1997). This research revealed that the garden dormouse moves mainly in trees, but that animals could spend a third of their time on the ground. This pattern of space use differs from that of other dormouse species (BRIGHT & MORRIS 1992, MORRIS & HOODLESS 1992).

During 2002 we began a radio-tracking study on the garden dormouse in an Alpine woodland area. The objective was to investigate the use of space by this species, particularly regarding home range size, nest site selection, and three-dimensional niche.

MATERIAL AND METHODS

The study was carried out in the Champdepraz Valley (Aosta, northwestern Alps, Italy). The study area was Scots pine (*Pinus sylvestris*) woodland at about 1300 m a.s.l. In the lower part of the woodland there was a group of hazels (*Corylus avellana*) planted in the past. Garden dormice were captured for radio-tracking in June 2002, using 100 Sherman live-traps placed in a grid (10 × 10) at 20 m intervals (area covered by the grid with a boundary strip of 20 m = 4.84 ha). Traps were baited with apple, cheese, and hazelnut cream at the entrance, and inspected in the morning and evening for 6 days. Animals caught were individually marked by ear tattooing numbers. Then they were weighed and the hind-foot length measured, and the sex and reproductive condition determined.

After capture, the garden dormice were fitted with radio transmitters (from Biotrack, Wareham, Dorset, England) that weighed 3.28 g (TW4, frequency 173 MHz). Only animals with body weight > 65 g were fitted with collars, so that the transmitter package was never more than 5% of their body mass. The garden dormice were released at the capture site within 1–2 hours; during this time they were kept in glass boxes and their behaviour was observed. The transmitters were bought in 2001 with a battery duration of three months. The road to the study area was closed for repair in spring and summer 2001, for this reason we postponed the study to 2002.

Trackers followed the garden dormice on foot using a TRX 1000S Ziboni (Bergamo, Italy) receiver and a hand-held 4-element Yagi antenna (Biotrack). For each fix, the animal was located within 5 m, using signal strength and direction as a guide. The position was gauged using a GPS (Global Position System) Garmin II Plus. Then we recorded time, presence on the ground or tree (tree species and height on the tree), and whether the animal was still or moving. Animals were tracked four nights a week, from 18,00 to 02,00 or from 24,00 to 06,00, and fixes were taken every 40 min. During the day we returned to the study area to locate the daytime nest sites.

Total home range sizes were calculated using the minimum convex polygon method (MCP, including 100% of the point-fixes). We used the incremental area analysis to evaluate the number of fixes necessary to adequately describe home ranges. Home range overlap was expressed as the % of overlap of a dormouse‘s home range with the home range of all other dormice of each sex.

RESULTS

We caught a total of 15 garden dormice: 10 males and 5 females. This corresponds to a density on the trapping grid of 3.1 animals/ha. Eleven animals, 6 males and 5 females, were fitted with the collars (Table 1). Mean body mass of males (80.33±8.83 g) and females (75.00±10.61 g) did not differ (t-test, $t = 1.01$, d.f. = 9, $P = 0.34$). Two animals lost the collars a few days after their release and 2 radio-transmitters lasted only a few days before the battery ran out, so we collected data for only 7 animals. The other trasmitters lasted up to 6 weeks before the battery ran out and during this period we collected from 4 to 37 fixes per animal (Table 2). The incremental area (Minimum Convex Polygon method) analysis showed that 25–30 fixes were necessary to describe the home range of an animal (Fig. 1). This number of fixes was obtained for only 2 animals (Table 2): a male (M337) that had a home range of 7.45 ha, and a female (F750) with a home range of 3.32 ha.

Table 1. Characteristics of the garden dormice (*Eliomys quercinus*) fitted with radio-transmitters

N	Sex	Weight (g)	Foot length (mm)	Collar 173.xxx MHz
1	F	65	25	.770
2	F	75	26	.750
3	F	65	28	.810
4	F	90	27	.850
5	F	80	23	.285
6	M	70	26	.710
7	M	77	26	.830
8	M	85	27	.790
9	M	80	24	.306
10	M	90	26	.337
11	M	80	26	.730

The area of the home range of the other animals was probably underestimated due to the low number of fixes recorded. However, comparing animals with a similar number of fixes (M337–F750; M710–F850, Table 2) male home ranges were greater than that of females. Males showed home range overlap (mean = 33.6%, n = 4), which was not found in females (Fig. 2), although the few females radio-tracked and the few fixes collected for two of them must be considered.

We calculated the population density considering the effective trapping area, taking into account the possible movements of the garden dormice. A boundary strip for the trapping grid was evaluated considering the mean radius of the 4 largest home ranges taken as a circle. The value of 118 m obtained was added to the

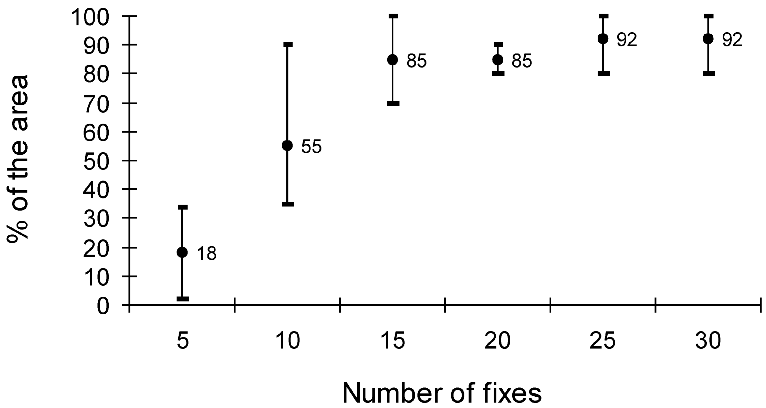

Fig. 1. Incremental area analysis (N = 6 animals). The size of the areas were estimated as 100% Minimum Convex Polygon (MCP). Bars correspond to 95% confidence intervals

Table 2. Number of fixes and home range sizes estimated as 100% Minimum Convex Polygon (MCP)

Id	Number of fixes	Type of home-range (% fixes)	MCP (ha)
M337	31	multinuclear (3n) (90%)	7.45
M710	17		3.57
M790	13		3.24
M730	9		1.75
F750	37	mononuclear (80%)	3.32
F770	4		0.82
F850	19	mononuclear (80%)	0.75

grid as a boundary strip in three directions, where the woodland was continuous. The effective trapping area was thus 12.4 ha and the density 1.21 animals/ha

During the radiotracking period the modal number of daytime nests used by the animals was 4 (range 2–5) (Table 3). The mean distance between nests used by the same animal was 102.2±14.4 m, which did not differ between males and females (t-test, $t = 0.49$, d.f. = 15, $P = 0.63$). Twenty two nests out of 23 were located above the ground, usually between rocks, and only one was inside a tree hollow. For 64 fixes we could evaluate the exact position of the animals in the space and the

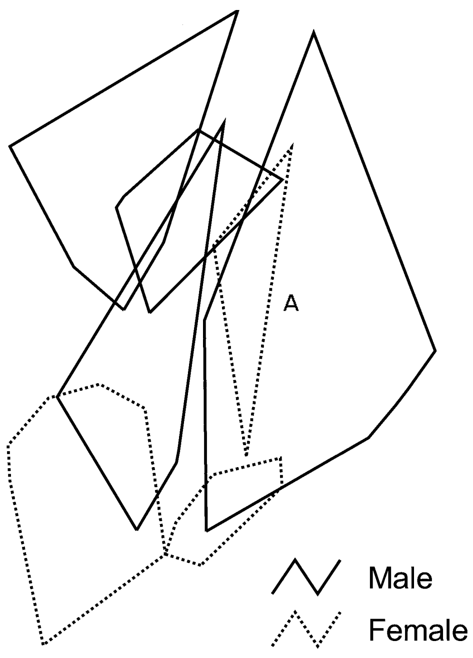

Fig. 2. Male and female home ranges; A = female F770 with only 4 fixes

Table 3. Mean distance between nests used by the same dormice during the radio-tracking period (June–July 2002)

Animals	Number of nests	Distance between nests (m)				Mean (m)	±SE
M710	5	218	122	140	63	135.8	32.0
M337	4	111	95	95		100.3	5.3
M730	4	142	40	63		81.7	30.9
M790	4	139	35	13		62.3	38.9
F750	4	136	64	215		138.3	43.6
F850	2	46				46.0	
Males	17					98.2	15.5
Females	6					115.3	38.5
Overall	23					102.2	14.4

substrata used during their activity periods. Most of the fixes were on the ground (83%) and only 17% of the locations were on trees (Fig. 3). While moving on the trees, garden dormice used mainly the part between 2 and 6 metres (range 0–8 m) above the ground. About half of the locations on the ground were in the area characterized by the presence of hazel shrubs (Fig. 4), 25% of the fixes on the ground were located in rocky areas and 5% in the grass. In 20% of the fixes on the ground we were not able to distinguish the substrata.

DISCUSSION

The loss of radio collars and the failure of some radio transmitters reduced the number of animals that were radio-tracked during the study. Furthermore, the

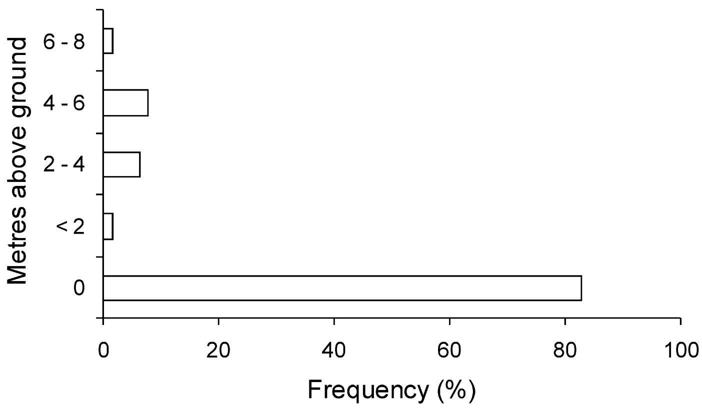

Fig. 3. Frequency of the radio-tracking locations in relation to height above ground (N = 64)

very difficult terrain of the study area allowed us to track only 1–2 individuals a night, and we could not collect enough fixes to describe the home range of all the animals. However, considering that the pattern of space use of the garden dormouse is so poorly known and that the published information available comes mainly from trapping studies (LE LOUARN & SPITZ 1974, MANN 1976, BERTOLINO *et al.* 2001, SCHAUB & VATERLAUS-SCHLEGEL 2001), we think that our data does constitute a small increase in the knowledge of this species.

Males and females that were radio tracked had similar body weights, but males seemed to use larger areas than females. A similar result was found by VATERLAUS-SCHLEGEL (1997) in the garden dormouse and by BRIGHT and MORRIS (1991) for the common dormouse (*Muscardinus avellanarius*). A pattern of large home ranges for males during the breeding season, and smaller ranges outside the breeding season, has been reported for the wood mouse (*Apodemus sylvaticus*) by TATTERSALL *et al.* (2001) and hypothesized by VATERLAUS-SCHLEGEL (1997) for the garden dormouse, but our data were inadequate to verify seasonal differences. Overlaps between ranges suggested a spatial organization in which males partially share their home ranges, and overlap with those of females. In the Alps, June corresponds to the mating period (BAUDOIN *et al.* 1986, BERTOLINO *et al.* 2001), and it was confirmed that males and females were close to each other in this month.

In our study area, garden dormice nested and moved mainly on the ground. During daytime, radio tagged dormice usually nested above the ground in holes between the rocks. Every animal used more than one nest, shifting from one to the next without returning to the old one.

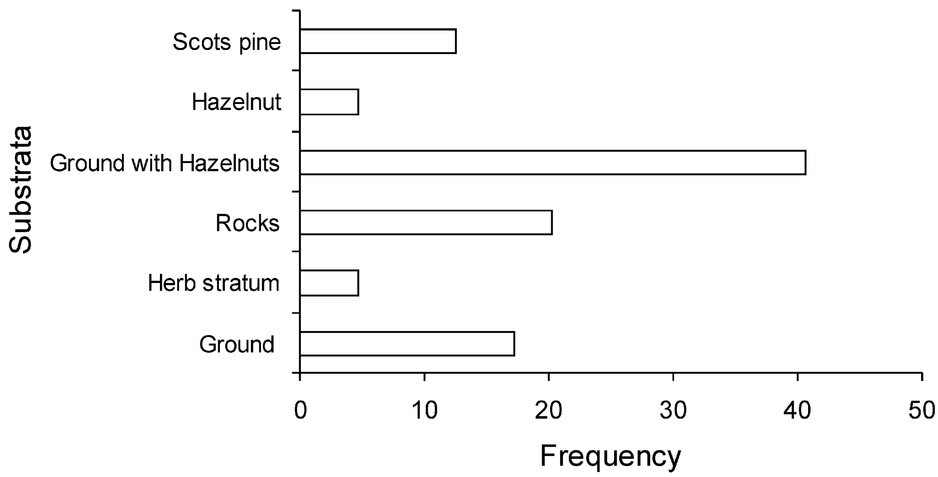

Fig. 4. Frequency of the radio-tracking locations on different substrates (N = 64)

Garden dormice spent most of their active time on the ground, mainly under the hazels and in areas with an abundant rocky cover. Movements in areas with hazel were probably related to the presence of nuts, a highly energy-rich food resource (GRODZIŃSKI & SAWICKA-KAPUSTA 1970). The use of rocky areas may be an adaptation to avoid predation. SKAR *et al.* (1971) observed that in Norwegian mountain areas, shelter among stones and rocks provided bank voles (*Clethrionomys glareolus*) with good substitutes for trees and shrubs as protection from predators and adverse weather conditions. In general, the possibility for small mammals to move through their home range using ground cover, holes and other refuges is recognised as an important means of avoiding avian predators (SOUTHERN & LOWE 1968, KING 1985).

Our preliminary data describe some ecological characteristics of the garden dormouse that differ from other dormice species. However, more extensive studies are necessary to better understand the space use and habitat selection of *Eliomys quercinus*.

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