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Nicholas C. Nydegger
University of Idaho, Moscow

Donald R. Johnson
University of Idaho, Moscow

SIZE AND OVERLAP OF TOWNSEND GROUND SQUIRREL HOME RANGES

Nicholas C. Nydegger[1] and Donald R. Johnson[1]

ABSTRACT.—We evaluated movement distance (an index of home range size) based on capture histories of 32 postbreeding Townsend ground squirrels (*Spermophilus townsendii*) on a 15 × 15 trap grid in southwestern Idaho. Capture frequencies and movement distances of adult males were significantly greater than those of other sex/age groups. Members of the same sex/age group were rarely captured at the same grid location, evidence of mutual avoidance within sex/age groups. These results are compared with those for other species of ground squirrels.

Ground squirrels offer favorable opportunities to investigate space use because of their abundance, relative ease of capture, and diel pattern of activity. Conversely, some populations demonstrate temporal differences in movement patterns related to sexual activity, food availability, density, dispersal, and interspecific competition. Thus, comparisons between congeners or even intraspecific populations require caution. In this study we evaluate indices of home range size of Townsend ground squirrels in the Birds of Prey Area in southwestern Idaho during the postbreeding season when home ranges were assumed to be stabilized.

METHODS

In 1983 we established a 280 × 280-m grid of 225 Pymatuning live traps (Tryon and Snyder 1973) with 20-m spacing in a stand of big sagebrush (*Artemisia tridentata*) and winterfat (*Cerratoides lanata*). The grid incorporated Site 5 of Smith and Johnson (1985). Traps were baited with apple and opened during daylight hours 1–3 days per week between 15 February and 30 April, a total of 19 days.

Captured animals were toe-clipped, weighed, and immediately released. Because trapping had been conducted at this site annually since 1975, the ages of residents first marked as juveniles were known. We classified unmarked squirrels when first captured as juveniles, yearlings, adults, or unknown (at least one year of age) using the criteria of Smith and Johnson (1985). Capture records of juveniles (young of the year) and those in which > 50% of the captures occurred on the grid edge were eliminated from the analysis. We also eliminated capture histories that did not contain at least four grid locations, assuming that these inadequately sampled space use. Five movements (involving three animals) > 200 m were thought to be exploratory and were ignored in our calculations.

Analysis of movement distances assumes independence of capture locations (Swihart and Slade 1985). Serial dependence results in biased estimates of movement distance depending upon the pattern of captures. We used the microversion of the HOMERANGE computer program (Samuel et al. 1985) to calculate T2/R2, a test for independence in capture locations. Because 21 of 32 capture histories lacked independence in locations, we evaluated capture data of sex/age groups rather than individuals to minimize the effects of autocorrelation. There was no significant difference ($P < .13$) in successive movement distances recorded during the same day and those separated by more than 24 hrs. Thus, serial dependence was due to the pattern of spacial use rather than insufficient time between successive captures (Swihart and Slade 1987).

We calculated (1) DS, the mean distance between successive captures, as d_i/m_i where d_i is the cumulative linear distance between successive capture locations and m_i is the number of movements for squirrels of sex/age group *i*, and, (2) AD (Koeppl et al. 1977), the mean distance between all capture locations as $d_i/[\Sigma\, n_i\,(n_i - 1)/2]$ where d_i is the cumulative linear distance between all capture locations

[1]Department of Biological Sciences, University of Idaho, Moscow, Idaho 83843.

TABLE 1. Mean capture frequency and movement distance (± SE) in m of Townsend ground squirrels: DS, mean distance between successive captures, and AD, mean distance between all capture locations. Sample size in parentheses. * = significant difference ($P < .05$) from other sex/age groups. ** = significant difference between sexes.

Sex/age	No. captures	DS	AD
Ad males	19.1 ± 2.0 (191)*	28.6 ± 1.3 (181)*	38.7 ± 2.9 (327)*
Yr males	8.1 ± 1.0 (58)	26.9 ± 4.4 (51)	31.4 ± 3.4 (54)
Ad females	9.5 ± 2.7 (66)	23.0 ± 2.4 (58)	35.4 ± 2.7 (57)
Yr females	11.0 ± 1.9 (76)	25.3 ± 2.0 (70)	35.5 ± 3.2 (96)
All males	14.6 ± 1.8 (249)**	28.2 ± 1.4 (232)	37.7 ± 0.9 (381)**
All females	10.3 ± 1.7 (142)	24.3 ± 1.5 (128)	35.4 ± 1.5 (153)
All animals	12.2 ± 1.2 (391)	26.8 ± 3.8 (360)	37.0 ± 3.0 (534)

TABLE 2. Overlap (%) of capture locations among sex/age groups. * = significant difference ($P < .03$) from cells involving unlike sex/age groups.

Traps capturing	Also capturing			
	Ad males	Yr males	Ad females	Yr females
Ad males	8*	23	17	22
Yr males	50	3*	13	20
Ad females	45	16	6*	26
Yr females	57	17	23	11*

and n_i is the number of locations of squirrels within a sex/age group *i*.

RESULTS

Of the 146 squirrels captured, the capture histories of 32 animals one or more years of age (17 males and 15 females) met the criteria established for spacial use analysis.

The mean capture frequency of adult males was significantly greater ($F = 2.6$; $P < .05$) than that of other sex/age groups (Table 1). Both measures of movement distance were significantly greater for adult males than other sex/age groups (DS: $F = 3.59$, $P < .02$; AD: $F = 5.83$, $P < .001$). Of these three variables, capture frequency and AD were significantly different ($F = 5.4$, $P < .03$ and $F = 6.2$, $P < .02$, respectively) between the sexes (Table 1).

The mean distance between centers of activity of 11 adults (7 males, 4 females) in successive years (1982 and 1983) was 52 ± 11 m (range 12 to 131 m), similar to that of adult Columbian ground squirrels (*Spermophilus columbianus*) (Murie and Harris 1984).

Home range overlap was measured as the percentage of capture stations at which members of the same or different sex/age groups were also taken. Overlap was significantly less frequent among members of the same sex/age group than among different groups ($F = 6.7$, $P < .03$, Table 2). Differences in the mean and total number of capture locations among sex/age groups produced asymmetries in home range overlaps. For example, yearling males occurred at 23% of the stations at which adult males were captured, but adult males occurred at 50% of the stations at which yearling males were captured (Table 2).

DISCUSSION

Home range sizes of postbreeding ground squirrels may or may not differ between the sexes (Owings et al. 1977, Michener 1979). In our study home ranges of adult males were significantly larger than those of other sex/age groups (Table 1). Postbreeding males were also more mobile and prone to capture. It is likely that the difference in home range size between the sexes is increased during the breeding season when adult males search for females in estrus (Murie and Harris 1978, Michener 1979).

Spacing in ground squirrel populations reflects social status and in some cases kinship (Michener 1979). In our study overlap in space use by members of the same sex/age group was rare in comparison with that by members of different groups (Table 2). Squirrels clearly avoided trap locations used by individuals of the same sex and age. Using direct observation, Michener (1979) found

that adult Richardson ground squirrels (*Spermophilus richardsoni*) of the same sex maintained greater distances when simultaneously active aboveground than distances between their centers of activity, another example of mutual avoidance. However, there was extensive overlap in the home ranges of both adult females and adult males. We found that overlap in space use by yearling and adult females was no more frequent than that of other sex/age combinations (Table 2). Thus, we are uncertain if female offspring are likely to take up residency near their mothers as observed in Richardson ground squirrels (Michener 1979).

In summary, the home range characteristics of postbreeding Townsend ground squirrels are similar to those of certain other species of the genus *Spermophilus*. Adult males occupy larger home ranges than those of other sex/age groups. There is significantly less overlap in space use by members of the same sex/age group than those of different groups.

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