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Some spatial and behavioral features of the thirteen-lined ground squirrel

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SOME SPATIAL AND BEHAVIORAL FEATURES OF THE THIRTEEN-LINED GROUND SQUIRREL

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ABSTRACT.— Some relationships between home range, agonistic behavior, and reproductive patterns in thirteen-lined ground squirrels were investigated in Laramie Plains, Wyoming (August 1966–April 1969). Population size and densities fluctuated seasonally and annually. Adult male (N = 7) home ranges averaged 0.24 ha and were smaller than those of the female (N = 9), which averaged 0.35 ha. Agonistic interactions were more frequent during the natal period (late May–June) than during the breeding-gestation period (mid April–May). Most squirrels (86 percent) shared capture sites and had overlapping home ranges. However, a certain degree of spacing existed because of agonistic behavior.

This study investigated the relationship between home range, agonistic behavior, and reproductive patterns in a natural population of thirteen-lined ground squirrels.

METHODS

A 10 ha grid with Sherman traps at 20 m intervals was live-trapped from August 1966 to April 1969. Captured squirrels were marked by toe clipping and dye marking with Nyanzol black fur dye. A grid of colored stakes at 30 m intervals was superimposed over the trap grid to facilitate squirrel observations. Home ranges (Dice 1952) and "centers-of-activity" (Hayne 1949) were determined. To the polygon-shaped home range, a boundary strip of one-half the distance between traps was added. Observations were made from two elevated blinds (4 m tall) and vehicles.

Reproductive patterns were estimated by examining males for testis position and females for perforated vagina, swollen vulva, and recent evidence of parturition or lactation (Packard 1968).

Agonistic data were collected in 1968 by observing marked and unmarked squirrels behaviorally interacting in a 2 ha sample area. Ten 1-hr observation sessions (0900–1000) were made five days apart. Five fell within the "breeding-gestation" period (15 April–5 May) and five in the "birth-natal" period (1–31 June). Just prior and following each session, five scans were made of the study site to determine identifications of all active squirrels, their locations, and type of activities exhibited. Social interactions were classified as "agonistic" or "sexual" after Burns (1968). The "form" and "result" of all agonistic interactions was noted. The form was either "contact" (in which some physical contact occurred), "chase" (both squirrels moving at least 1 m in the same direction at same time), or both. Even though neither contact nor chase were involved, an interaction was still called agonistic if it contained "threat" postures (Grubitz 1966). Results were classified as "dominant," "stand-off," or "subordinant" (a squirrel spatially supplanted by a second squirrel).

STUDY AREA

Squirrels were studied on Hutton Lake National Wildlife Refuge, Albany County, Wyoming. This area is montane (elev 2400 m) and consists of native short grass prairie called "Transitional Life-Zone" by Cary (1917). Predominant plants included blue grama (*Bouteloua gracilis*), western wheatgrass (*Agropyron smithii*), june grass (*Koleria cristata*), needle grass (*Stipa* spp.) and prickly pear cactus (*Opuntia polycantha*) (Clark 1971).

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RESULTS

In all, 196 squirrels were captured: 18 in 1966, 79 in 1967, 87 in 1968, and 12 in 1969. Squirrels emerged from hibernation from late March to early April and disappeared from mid-August to early October each year. Two general peaks in captured rates occurred (Fig. 1), the first during the breeding season and early gestation in late April and May and the second in early July when young squirrels made their initial appearance above ground.

By 1968, a large number of squirrels had been marked, allowing identification of age structure. Therefore, the 1968 data is felt to be most representative and is given below. Density peaks in 1968 corresponded to population peaks, when 15.2 animals per ha were present during breeding and early gestation and 12.7 when young first appeared above ground. The mean density from 31 March to 17 August 1968, was 4.0 per ha.

Age and sex structure varied seasonally. From late March to July, the population was comprised of 1+ yr olds. By mid-September the entire aboveground population consisted of young of the year. In August 1968, the population was 28.6 percent young of the year (14M:6F), 60.0 percent adults of unknown age (18M:4F), and 11.4 percent adults 2+ yrs old (4M:4F). The sex ratio was 1.0M:0.4F for young, 1.0M:1.3F for adults (age unknown), and 1.0M:1.0F for squirrels 2+ yrs old. There were nearly twice as many males as females in the young age class, but this changed in favor of females in the adult age class.

The 1968 mean trapping success per 100 trap days was 7.1 (range 1.6–20.1). Mean number of captures per squirrel was 4.0. About 36.1 percent of the squirrels captured were caught only once, 21 percent twice, 16 percent 3 or 4 times, 18 percent 5 to 10 times, and 8 percent 11 or more times.

Home range size varied between sexes. Adult females' home ranges averaged about 40 percent larger than adult males. The mean number of times each adult male (N = 7) was

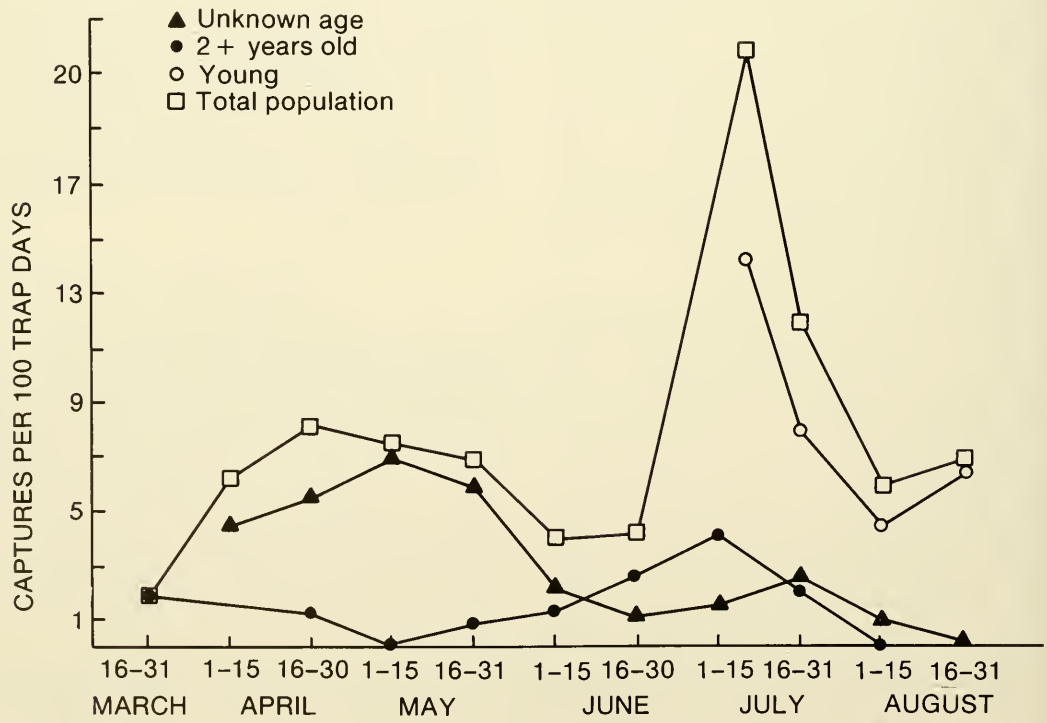

Fig. 1. Captures per 100 trap days expressed biweekly throughout the 1968 trapping period as an index of population activity.

captured or observed was 9.8 SD±2.1; for each adult female (N=9) it was 16.6±3.9. Mean home range for adult males was 0.24 SD±0.11 ha (range 0.11–0.39); for adult females it was 0.35 SD±0.19 (range 0.27–0.56).

Breeding occurred in April (Table 1), a fact determined by examining the sexual condition of 69 squirrels. Young squirrels first appeared above ground in early July. By first counting backwards, using known nest confinement and gestation periods (Asdell 1946), then observing breeding in the field, we estimated the duration of these life history stages.

Agonistic behavior observations were expressed for two periods: breeding-gestation (mid-April–May) and natal care (late May–June). From 28 April to 4 May 1968 there was a peak of activity. Four instances of "courtship" behavior were noted that followed descriptions given by McCarley (1966) and Wistrand (1974). No copulatory behavior was seen. During this week 14 squirrels were later recaptured in areas up to 300 m away from their original capture sites. Mean capture success for 15 April to 31 May (breeding) was 6.9 per 100 trap days, more than twice the 3.1 capture index for the natal period (1–31 June). However, differences were not significant

Of 29 agonistic interactions seen in 1968, 21 involved at least one female and 8 involved a male; the second animal in these interactions was not identified. Of agonistic interactions (N=17) observed during the natal period, 14 involved females. Table 2 gives the form of agonistic interactions seen. No significant differences existed in the form of the interactions between the two periods.

Parturition burrows (N=5) were located by observing adult females carry mouthfuls of nest materials into certain burrows. These sites were taken as centers-of-activity. In males, geometric centers of home ranges were considered as centers-of-activity in 9 cases. Analyses of location and outcome of 24 agonistic interactions for these squirrels indicated that an individual tended to be dominant in interactions occurring nearest its center-of-activity (Table 3).

DISCUSSION

According to Kummer (1971), social affinity and spatial proximity are so highly correlated that the distribution of individuals in space can be used as first reading of the social structure. A great proportion (86 percent) of all squirrels in the study shared capture sites. By itself, a large overlap in capture sites does not necessarily indicate a large overlap in home range. Existence of agonistic interactions suggests that a portion of each home range was defended against intrusion, although this may have indicated hierarchy independent of actual geography. Nevertheless, a certain degree of spacing did exist as a result of agonistic behavior.

TABLE 1. Sexual condition of adult thirteen-lined ground squirrels in the Laramie Plains, Wyoming.

	Breeding–gestation	Birth–natal
Sexual condition	1 April–31 May	1–31 June
Females:		
Vulvae normal	1	8
Vulvae swollen and/or open	29	1
Lactating	1	9
Nonlactating	29	0
Males:		
Testes abdominal	1	3
Testes scrotal	25	1

TABLE 2. "Form" of 29 agonistic interactions observed in thirteen-lined ground squirrels, Laramie Plains, Wyoming (1968).

	Breeding–gestation	Birth–natal
Form	1 April–31 May	1–31 June
Contact	2	4
Chase	4	3
Both	6	10
Totals	12	17

TABLE 3. Results of 24 agonistic interactions in relation to distance from "centers-of-activity" in thirteen-lined ground squirrels.

	Meters from center-of-activity		
Encounter results	0–8	9–15	16+
Dominant	12	4	2
Stand-off	4	2	0
Subordinate	0	0	0
Totals	16	6	2

In a population of ground squirrels organized into overlapping home ranges, it can be assumed that few novel encounters between adults will occur once the basic home range configuration has been well established. This may account for the relatively few agonistic interactions seen in this study (N = 29) and seen by Wistrand (1974), who saw only 19, compared to Grubitz (1966), who noted 767 in a closed area. Balph and Stokes (1963) suggested that, in Uinta ground squirrels, "territorial" behavior may be the result of an encroachment by one squirrel into the area of another squirrel's "individual distance" rather than a fixed site attachment. Wistrand (1974) considered that a similar pattern of agonistic behavior occurred in his thirteen-lined ground squirrel population.

Territorialism is suggested by squirrel's marked avoidance of certain burrows, especially during the natal period. In Richardson's ground squirrels, Yeaton (1972) noted that females possess a "territory" throughout the aboveground activity cycle. Wistrand (1974) noted that thirteen-lined ground squirrels defended burrows, but only at the time they occupied the burrow. He also noted that a burrow may be used by more than one squirrel, provided only one animal occupies it at a given time. A similar case may have existed in my study. Temporal-spatial mechanisms clearly need further elucidation before we understand thirteen-lined ground squirrel social organization.

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