

## BRIEF NOTE

ACTIVITY LULL OF *TAMIAS STRIATUS* DURING THE SUMMER IN SOUTHEAST OHIO.<sup>1</sup>

A summer decline in activity of the eastern chipmunk (*Tamias striatus*) remains an unsolved aspect of chipmunk biology (Dunford 1972). The present study was designed to quantify trends in chipmunk activity during the period subsequent to the summer breeding season and prior to larder hoarding of food in autumn and to determine the adaptive nature of differences in population and individual activity.

Individual and population activity of chipmunks (N=13) occupying burrow systems within a 2 ha sector of a woodlot near Athens, Ohio, were studied for a 6 week period in the summer of 1975 (7 Aug to 17 Sept). Trapping and field observations were conducted for 37 days during this period (a minimum of 5 days per week and 4 hours per day) between the hours 0600 and 1800 (EDST). Since activity declined appreciably after 1800 hr, activity was not recorded after that time.

Sex, age, weekly weight, and reproductive condition were recorded for each chipmunk, and each was marked with ear tags and fur dye for individual identification. Two 13" x 13" x 36" live traps were placed within a 3 m radius of the entrances of each active burrow system. Traps were inspected at hourly intervals. The remaining portion of each hour was spent observing different areas of the 2 ha sector and sightings of uncaptured chipmunks supplemented capture data. Each area of the sector was observed for an

equal amount of time. Captures and sightings were used to calculate levels of individual and population activity and statistical significance (see Sokal and Rohlf 1969 for methods).

The seasonal activity of the population, measured as the mean number of chipmunks active per hourly interval per day, decreased from 7 to 27 Aug and then significantly increased in subsequent weeks from 28 Aug to 17 Sept (one-way anova;  $F=9.73$ ;  $df=5,32$ ;  $P<0.001$ ). No significant difference in activity occurred from 7 Aug to 3 Sept though activity from 4 to 10 Sept was greater than that of the previous four weeks ( $P<0.05$ ), and activity from 11 to 17 Sept was still greater than that in week 5 (Student-Newman-Keuls test;  $P<0.05$ ).

The daily activity of the population was determined by first calculating the proportion of total hourly intervals in which activity was recorded for each chipmunk in each time period (0600-1000, 1000-1400, and 1400-1800 hr) per week, and then pooling these values per chipmunk to get the population value. No diurnal peaks in population activity were found (one-way anova;  $F=0.37$ ;  $df=2,10$ ;  $P<0.50$ ). Seasonal activity varied between individuals in the same week (two-way anova;  $F=16.29$ ;  $df=12,60$ ;  $P<0.001$ ) and between the same individual in different weeks ( $F=10.28$ ;  $df=5,60$ ;  $P<0.001$ ) (table 1).

No difference was found in seasonal activity between males and females. Weekly activity of each individual (taken from table 1) regressed on weekly body weight was not significant in weeks 1, 2, 4, 5, and 6 ( $P>0.05$ ), but a significant inverse relationship was evident in week 3 ( $P<0.05$ ). Five (38%) chipmunks were least active in the morning (0600-1000 hr), while eight (62%) chipmunks reduced activity in late afternoon (1400-

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TABLE 1  
*Seasonal activity of resident chipmunks in the summer lull*

ID	Sex	Age (mo.)	Reproductive status*	Mean summer weight (g)	Activity/Week**					
					1	2	3	4	5	6
79	♀	12+	N	91	0.28†	0.15	0.12	0.11	0.28	0.39
81	♀	12+	M	106	0.00	0.00	0.00	0.00	0.10	0.29
128	♂	12+	—	95	0.00	0.00	0.00	0.16	0.13	0.29
137	♀	12+	N	91	0.11	0.00	0.00	0.00	0.13	0.24
171	♀	12+	N	102	0.22	0.22	0.00	0.29	0.46	0.68
175	♂	12+	—	88	0.00	0.00	0.00	0.00	0.05	0.14
179	♀	12+	N	96	0.31	0.15	0.12	0.43	0.59	0.85
258	♀	12+	N	89	0.00	0.11	0.00	0.05	0.08	0.42
431	♂	12+	—	90	0.14	0.00	0.00	0.08	0.00	0.24
463	♂	12+	—	84	0.36	0.17	0.29	0.30	0.46	0.49
484	♂	5-6	—	82	0.36	0.40	0.29	0.21	0.35	0.42
505	♀	5-6	X	76	0.28	0.15	0.18	0.19	0.33	0.35
526	♀	12+	M	78	0.28	0.11	0.18	0.11	0.18	0.51

\*Female reproductive status M, mated in summer breeding season but lost the litter; N, successfully weaned a summer litter; and X, did not mate in summer.

\*\*Activity is expressed as the proportion of total hourly intervals during which activity was recorded in each week from weeks 1 through 6.

†Two-way anova. The difference between weeks was significant,  $F=10.28$ ,  $P<0.001$ .

The difference between individuals in the same week was significant,  $F=16.29$ ,  $P<0.001$ .

1800 hr). No chipmunk displayed a bimodal pattern of activity but males tended to be more active in morning and less active in late afternoon than females.

Periods of estivation were proposed to explain the summer inactivity of chipmunk (Seton 1929; Allen 1938; Smith 1942; Panuska and Wade 1957), but summer torpor was not found by Wang and Hudson (1971). Thibault (1969) found no correlation of summer inactivity with meteorological factors. Food shortages and the termination of summer breeding have also been discounted as factors responsible for decreased summer activity (Dunford, 1972). I recently observed a lull in activity after spring mating which suggests that declines in the endogenous controls of reproductive behavior may contribute to a reduction in population activity after each mating season. Dunford (1972) suggested that the termination of the lull is correlated with the timing of juvenile dispersal and larder hoarding of mast in autumn. The significant increase in population activity observed from 11-17 Sept, however, preceded both of these events by nearly a month (Yahner 1975).

The occurrence of the lull is largely due to individual differences in activity, which varies with body weight, reproductive condition and, presumably, with metabolic requirements. During the 21-27 Aug, a significant inverse relationship was found with body weight and individual activity levels, and population activity was lowest at this time. Young animals were very active during the weeks of summer and never exceeded 85 g in weight. Adult chipmunks, which lost weight in summer (such as chipmunk 483 in weeks 2-3), increased activity when the weight loss occurred. Larger animals (greater than 85 g), in contrast, continued to show low activity during summer (table 1). McNab (1974) suggested that body size is the most important determinant of energy expenditure and that small animals have higher metabolic rates than those of larger animals. Therefore, it is suggested that high levels of activity of small animals are due to high energy requirements and the need to obtain adequate energy sources.

Population activity increased during the latter part of summer from 28 Aug to 17 Sept due to increased activity of

several lactating females of larger body size (such as chipmunks 79, 171, and 179; table 1). Increased energy expenditure associated with parental care may demand that more time be allocated to food-searching behavior. Increased food intake has been reported in mice (*Peromyscus*) in later stages of lactation (Millar 1975). Females which lost litters (such as chipmunk 81) and most adult males (for example, chipmunks 128 and 175) continued a reduced level of activity until the middle of September (table 1). These chipmunks presumably had lower energy requirements as compared to those of lactating females.

The summer lull occurs briefly between two important events in the circannual rhythm, mating and larder hoarding. Thus, a reduction of activity in summer may be the optimal strategy since small, forest-dwelling mammals tend to forage quietly in a small area to reduce predation risks (Eisenberg 1966). The best question to ask may very well not be: Why a summer lull?—rather, why is it adaptive for a small, diurnal rodent to, expend considerable energy, risk predation due to wide-ranging movements in the mating seasons and in the preparation of a winter food cache?

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