# Assessing Influences on Social Dominance in *Tamias striatus*

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**Abstract**

Social dominance at prime foraging sites in eastern chipmunks (*Tamias striatus*) is believed to be related to the need to conserve valuable energy as suggested by the Central Place Foraging Theory. In order to determine the factors which influence dominance, we investigated the effects of sex, weight and the distance from feeding stations to burrows on dominance in *T. striatus*. We observed behaviors of pairs of interacting chipmunks at a series of feeding stations and determined dominance relationships for those pairs which interacted at multiple stations. Sex and weight were not important factors determining dominance in *T. striatus*. However, dominance *is* inversely related to the distance between a chipmunk's burrow and a foraging site. In addition, dominance roles reversed when feeding stations were moved away from the dominant chipmunk's burrow.

**Introduction**

Due to their small size and thus large surface area to volume ratio, small mammals must consume many more calories per unit mass than larger mammals simply to meet their daily energy requirements. This may explain the intensely competitive foraging and semi-territorial habits of many small animals including the eastern chipmunk (*Tamias striatus*) (Kurta, 1995). Without this aggressive

competition, animals would not be ensured access to nearby foraging sites and would waste valuable energy traveling longer distances to acquire food (Giraldeau, 1994). Social dominance in chipmunks is a tactic which has evolved to guarantee an animal at least a large percentage of food near its burrow (Wittenberger, 1981).

Known as the Central Place Foraging Theory, this concept explains how the distance from an animal's burrow to a foraging site dictates how that animal will behave at the site. It should affect how often they return to a food site, how long they are willing to wait at a site, the size of the load they will carry back to their burrow and most importantly, how aggressively they defend the site from competing individuals of the same species (Lair, 1994). In populations of *T. striatus*, dominions are loosely determined and overlap, but are defended, nonetheless, by aggressive staring, vocalizations, chasing and fighting (Kurta, 1995).

It is clear that *T. striatus* are territorial animals, and that they aggressively vie for food at prime foraging sites by asserting their dominance over other competing individuals (Kurta, 1995). This has been observed in numerous studies (Giraldeau, 1994, Danford, 1970, Elliot, 1978). Yet what determines dominance? We tested the influences of three factors in determining dominance in *T. striatus*: weight, sex and the distance from foraging sites to burrows.

## Methods and Materials

Research was conducted at the University of Michigan Biological Field Station (located in southwestern Cheboygan Co. Michigan) between June 28 & July 11, 2000. Chipmunks were captured and marked, each with its own

number. This was done by 22 University of Michigan students who set an estimated 120 arbitrarily-dispersed *Havahart* live traps around the biological station camp, an area of roughly one sq. mi. These traps, baited with approximately 2 Tbsp. of sunflower seeds, were in operation on June 28 & 29 between the hours of 9 a.m. and 8 p.m. and were checked once every hour. Captured chipmunks were weighed (using a bag and a spring-scale), sexed, and numbered. Numbering was done using black Nyanzol-D dye applied with a Q-tip. All animals were sexually active adults. Twenty females and 21 males were captured. After they were marked, the animals were released at their site of capture.

During the following days, students and instructors made efforts to locate the home burrows of as many *T. striatus* as possible. The most effective methods for doing so involved establishing feeding stations on the ground (4 in. diameter piles of sunflower seeds on a 12 x 12 x .5 in. piece of plywood), waiting for an animal to fill its cheek pouches with seeds, and then following it on foot as it returned to its burrow. This process generally required at least two observers so that the animal was not lost en route to its burrow. Burrows were mapped and marked in the field by orange flags labeled with the individual's number.

Shortly thereafter, five feeding stations of similar size were established in locations around the central camp area known to be within easy access of a large number of chipmunks. These stations were monitored by students for the next 5 days. Observers watched for 1.5 hour shifts between 7:15 a.m. and 8:00 p.m. They recorded the behaviors of two or more interacting animals. They noted the numbers of the interacting subjects and which appeared to dominate during each interaction. The winner of an interaction was defined as the individual which,

by means of chasing, fighting, vocalizing, staring and general aggressive behavior, succeeded in denying another access to a feeding station. Seeds at each feeding station were replenished as needed.

After tallying the interactions from the first several days, we tested the effects of sex and weight in relation to dominance. In addition, we constructed dominance hierarchies for each station. The dominant individual of a specific interacting pair was defined as the chipmunk which won at least 75% of the interactions. Dominance was determined only in pairs with three or more interactions. A new set of five feeding stations were then established at different locations around the central camp area. Stations were moved away from the burrows of apparently dominant individuals in order to test the significance of distance between burrows and feeding stations in relation to dominance. The factors of sex and weight were determined to have no bearing on dominance (see Results) and were thus disregarded in deciding where to move the stations.

The new feeding stations were observed over the next four days in the same manner as the first set. Again dominance hierarchies were determined, and stations were moved to locations which would maximize the combinations of different interacting chipmunks at this final set of locations. Observations carried out for one day. Fourteen pairs of *T. striatus* which had had frequent interactions at multiple feeding stations were selected as the focus of the research. The distances between these animals' burrows and each of the feeding stations at which they appeared were measured.

## Results

Using four $X^2$ tests, the statistical significance of the following relationships were tested (See Tables 1-4 below): 1) The effect of sex on dominance, 2) The effect of body size on dominance, and 3) The effect of burrow proximity on dominance.

Sex was not a significant determinant of dominance in *T. striatus* ($X^2 = 1.58$, d.f. = 1, $p > .05$, Table 1).

| | Female | Male |
|---|---|---|
| # of winners | 19 | 12 |

*Table 1. Number of interaction winners according to sex.*

Weight also was not a significant factor in determining dominance in *T. striatus* ($X^2 = 1.10$, d.f. = 1, $p > .05$, Table 2).

| | Heavy | Light |
|---|---|---|
| # of winners | 33 | 25 |

*Table 2. Number of interaction winners separated according to whether they were the heavier or lighter of the interacting pair.*

We also tested for an interaction between sex and weight in determining dominance. The combined effect still did not influence dominance ($X^2 = .446$, d.f. = 1, $p > .05$, Table 3).

| | Heavy | Light |
|---|---|---|
| Male winners | 6 | 3 |
| Female winners | 9 | 8 |

*Table 3. Number of male and female interaction winners according whether they were the heavier or of the interacting pair.*

Table 4 shows the number of cases in which *T. striatus* were dominant at feeders when the distance to their burrows were either closer or farther away than the burrows of the other individual involved in the interaction. Individuals were more likely to be dominant closer to their burrows than far away ($X^2 = 8.05$, $.001 < p < .01$, d.f. = 1, Table 4).

| | Dominant near | Dominant far |
|---|---|---|
| # of cases | 17 | 4 |

*Table 4. Number of cases in which the more dominant chipmunk's burrow was located near and far from the feeding station.*

The average distance from a feeding station to a dominant individual's burrow was 22.2 m compared to 43.0 m to a subordinate's burrow. Excluding one individual who visited stations at extreme distances from its burrow, the average subordinate-distance was 35.6 m.

Out of six pairs of *T. striatus* in which multiple interactions occurred at more than one feeding station, five pairs demonstrated a reversal in dominance roles when feeding stations were moved closer to the burrow of the subordinate individual.

## Discussion

The results showed that dominance is inversely related to feeder-to-burrow distance while not to sex and weight. These are consistent with a similar study performed by Willis in 1973. These data also support the Central Place Foraging Theory and can be explained in part by the need to conserve energy. That is, it is much more energy-efficient for *Tamias striatus* to dominate the area nearest its burrow than it is to travel longer distances into another territory where it will expend even more energy to fight as a subordinate (Giraldeau, 1994). This also explains why many subordinate individuals wait patiently at feeders far from their burrows. Having already expended energy in traveling, they can ill afford to waste additional energy in a prolonged chase or fight with a more dominant individual. They accept their position and wait until the more dominant animal has left so that they are allowed to forage without an unnecessary expenditure of energy (Orians 1979). At some point however, the energy consumed en route to, or during a confrontation at a distant foraging site may become too great to be metabolically beneficial. *Tamias striatus* will most likely abandon these efforts in search of closer and less contested foraging sites (Lair, 1994).

In some instances, however, two or more individuals were observed sharing the feeding station in relative peace and tolerance. In addition, many pairs alternated their visits to the feeder so that both were never present at the feeder at the same time. These behaviors would appear to be the most efficient for both animals, as neither one is required to expend energy in a confrontation. However, these occurrences seem to be relatively uncommon. The preceding three situations (waiting, abandonment, tolerance and staggering of visits) were

all observed, but further study is necessary to determine the extent and significance of these behaviors. From this research alone, it is indeed possible to conclude that dominance in *Tamias striatus* is determined not by sex or weight, but rather, by the relative distance between an animal's burrow and a foraging site.

Research was occasionally interrupted by humans passing by and other animals invading the feeding stations. In addition, several chipmunks at the stations were without numbers and thus could not be included in the data analysis. These isolated incidents may have altered slightly, the behavior of chipmunks at the feeders. Also, several chipmunks could not be included in the data analysis because their burrows could not be located. In the future, a more targeted study of specific pairs of chipmunks (more than 6) could provide more accurate results, especially in terms of dominance role reversals.

**Works Cited**

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