

# The Establishment of Dominance Hierarchies Over Concentrated Food Sources Among Eastern Chipmunks (*Tamias striatus*)

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## ABSTRACT

Among chipmunks, competition over concentrated food sources has often been observed. Aggressive behavior is commonly displayed within an individual's territory between and within species. However, though sex, size, age, and individual variation are speculated to be factors in establishing dominance over a concentrated food source, the bases for the establishment of dominance over concentrated food sources in *Tamias striatus* remains questionable. This study tested the hypothesis that: *When a concentrated food source is placed equidistant from two or more chipmunk burrows, dominance over the food source will be established based on one or more of the following: first individual to encounter the food source, sex, and/or size (weight)*. After testing 6 sets of interactions with 6 chipmunks each, it was found that although aggression varied significantly with weight difference between winner and loser ( $p < .05$ ), a linear relationship did not exist. As interactors got closer in weight, intensity of aggression did not increase. Because only one chipmunk of the 6 was male, any correlation between sex and dominance could not be examined. In addition, because the sample size was so limited, any correlation between first individual to encounter the food source could not be examined. Overall, much aggressive behavior might be attributable to individual variation. Future studies might increase sample size and would further contribute to our knowledge of the bases for dominance in chipmunks.

## INTRODUCTION

Among squirrels (Rodentia: Sciuridae), competition over feeding stations has often been observed (Allen, 1938; Bergstrom, 1992; Wishner, 1982). Further, among chipmunks (*Tamias*) in particular, many accounts of single individuals driving others from concentrated food sources have been reported, including violent reactions by solitary, caged chipmunks to intruder chipmunks (Allen, 1938). In addition, both Bergstrom (1992) and Brown (1971) have found degrees of aggression to vary between species. Individuals ranking higher in established dominance hierarchies both defend and chase subordinate individuals away from feeding stations (Brown, 1971).

Establishment of intraspecific dominance hierarchies has also been well-documented among the eastern chipmunk (*Tamias striatus*) (Allen, 1938). This central-

place foraging omnivore inhabits most of the eastern United States and southeastern Canada (Kieffer, 1990), and exploits an array of food sources, including seeds, flowers, fruits, insects, and bird eggs (McFarland, 1987). *T. striatus* is most active during the early morning and late afternoon (Baker, 1983). Further, aggressive behavior in *T. striatus* has been well-described and categorized by Yahner (1978):

- **vocalization:** noises emitted by chipmunk (chip, chip-trilling, or chipping)
- **chase:** one chipmunk running after another at high speed
- **withdraw:** chipmunk leaving an area due to being chased or the presence of a dominant individual
- **fight:** two chipmunks locked together and rolling around while biting
- **freeze:** chipmunk ceases motion in response to the presence of another chipmunk or predator.

Such aggressive behavior is often displayed within an individual's territory, defined as the area it defends against conspecifics (while home range is the area to which an individual confines her activity). Competition over food resources is costly particularly to subordinate individuals, who must expend energy in avoiding, and who are prevented from feeding or caching as much as, dominant individuals (Giraldeau et al., 1994; Trombulak, 1985). However, except for the apparent habitat-induced difference in aggressive behavior displayed by two different *Tamias* species in Nevada (Brown, 1971), the bases for the establishment of ranking in chipmunk dominance hierarchies is not well understood. In general, females seem to be more aggressive than males, perhaps because they exclusively raise young and therefore need a larger food supply (Wishner, 1982). However, though relative size, age, and inherent aggressiveness are important, they do not become exclusive determinants within dominance hierarchies unless all members of the group are more than a hundred feet from home (Wishner, 1982). Thus, I tested the following hypothesis to determine how dominance in *T. striatus* is established: *When a concentrated food source is placed equidistant from two or more chipmunk burrows, dominance over the food source*

*will be established based on one or more of the following: first individual to encounter the food source, sex, and/or size (weight).* It was expected that as weight difference decreased (as the interactors got closer in weight), intensity of aggression would increase.

## MATERIALS AND METHODS

This study was conducted at the University of Michigan Biological Station in Pellston, Michigan between July 28 and August 9, 1995. Three sites (located at Creaser, Lower Blanchard, and Lakeside Labs), each having an approximate radius of 100 feet and 2 to 3 chipmunks, were utilized. One wooden feeder containing sunflower seed was placed arbitrarily within each site. Feeders, square-foot platforms approximately 7 inches high with raised edges, were observed to determine the number of chipmunks utilizing each. Chipmunks were then followed back to their burrows, which were marked with colored flags. A point approximately equidistant between burrows was marked, and the feeder was relocated there in an attempt to control for territoriality, with a flag placed laterally on both sides of each feeder at a distance of 1.5 meters. Chipmunks were trapped with steel Sherman live traps, marked with magic marker or by fur-clipping, sexed, and weighed. Identifying mark, weight, sex, and location of burrow were recorded.

Feeders were then observed in approximately 90 minute bouts (sets of interactions), and identities of feeding chipmunks, including first individual to feed per bout, were recorded. A total of 6 bouts involving 6 chipmunks were recorded. Interactions between two or more chipmunks at a feeder were recorded and ranked according to the following **Intensity of Aggression Scale**, in which the chipmunk on the feeder following the interaction was considered the “dominant”/winning chipmunk, and the individual deterred from the feeder was considered the “subordinate”/losing chipmunk (the greater the number, the smaller the distance between the interacting individuals) :

- **1** = Loser always  $> 1.5$  m away from Winner, no chase
- **2** = L  $<$  or  $= 1.5$  m away from W, but not on feeder, no chase

- 3 = W chases L, no physical contact
- 4 = W chases L, physical contact.

Data were then statistically analyzed using an ANOVA (analysis of variance) test ( $\alpha=.05$ ) to determine if intensity of aggression was correlated with weight difference of winner and loser. First individuals to feed per bout and sex of interactors were also analyzed to determine if trends between these criteria and dominance occurred.

## RESULTS AND DISCUSSION

Aggression was significantly related to weight difference between winner and loser ( $p<.05$ ,  $n=101$ ). Heavier individuals were sometimes dominant over lighter individuals (Fig. 1). A relationship between sex and dominance could not be determined because not enough variation among sex occurred. As the interactors got closer in weight, intensity of aggression did not necessarily increase (Fig. 2). For example, chases with contact occurred most when the dominant individual weighed 13 grams less than the subordinate individual; chases without contact occurred most when the dominant individual's weight exceeded the subordinate individual's weight maximally. Among the four diadic interactions, first individual to encounter the food source was also the dominant individual three times.

Although aggression varied significantly with weight difference between winner and loser, a linear relationship did not exist. Further, as interactors got closer in weight, intensity of aggression did not increase as expected. Because only one chipmunk of the six was male, any correlation between sex and dominance could not be examined. In severe environments, females showing dominance over males is sometimes attributed to sexual dimorphism, since females tend to be larger in such environments (Levenson, 1990). In addition, because the sample size was so limited, any correlation between first individual to encounter the food source and dominance could not be examined.

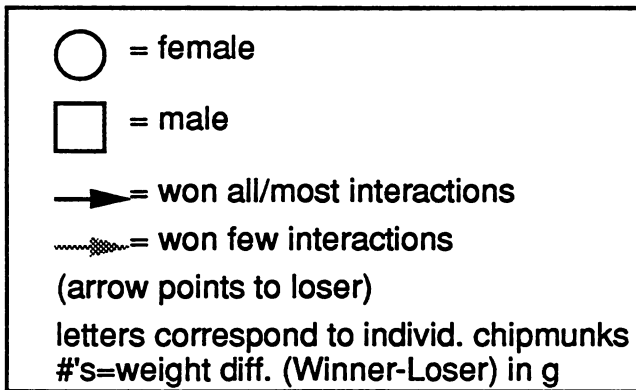
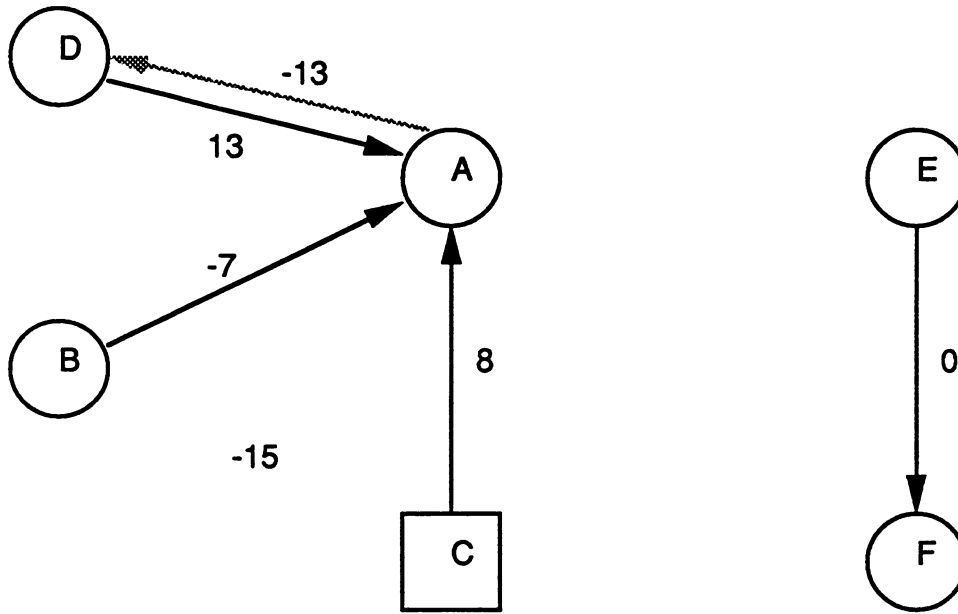
Overall, much aggressive behavior might be attributable to individual variation or inherent aggressiveness. Further studies might lessen the chances of biases introduced by territorial behavior by placing feeders at more than one equidistant point (if possible) from burrows within a site. Because chipmunk territories are fairly “loose” (Allen, 1938), territoriality will then be lessened as a possible factor in determining dominance. In future studies, sample size might be increased (number of interacting chipmunks and number of recorded sets of interactions). Further, chipmunks less accustomed to human behavior might be utilized for comparison. Overall, future studies on the bases for dominance in chipmunks will contribute to our limited knowledge of the subject.

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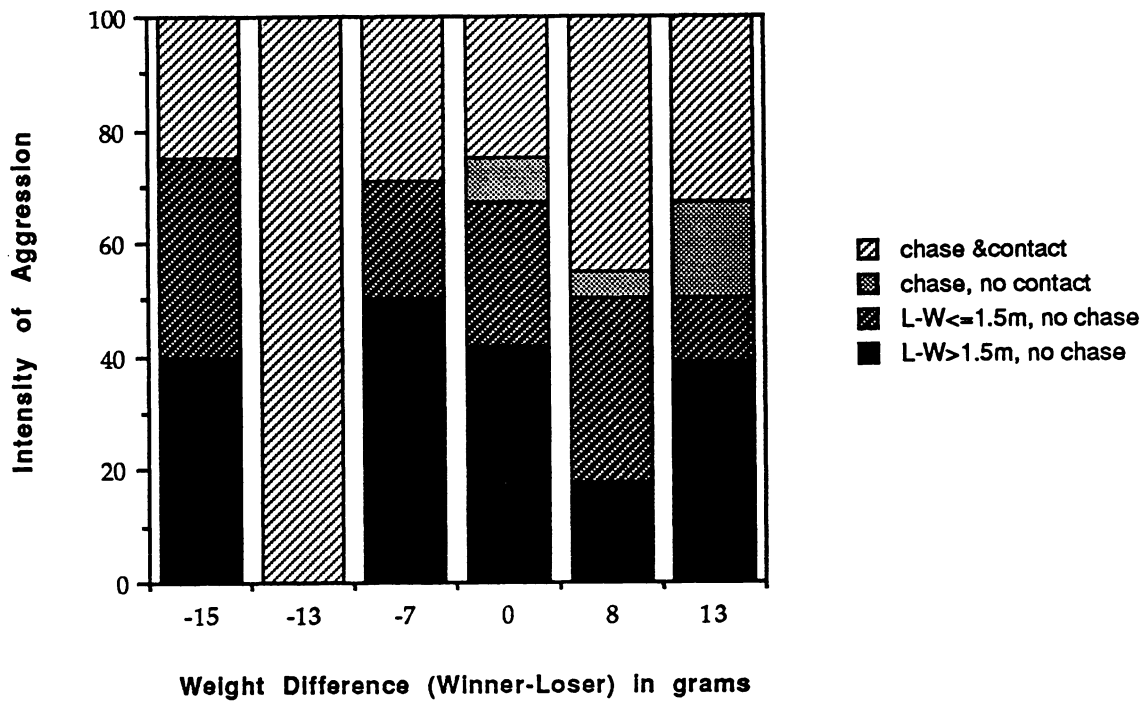
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**Fig. 1: Map of Interactions**

Being heavier was sometimes correlated with winning.  
 Not enough variance existed among sex for a  
 conclusion to be drawn regarding sex and dominance.



**Fig. 2: Weight Difference (Winner-Loser) vs. Intensity of Aggression**

The most chases with contact occurred when winner weighed 13 g less than loser.

The most chases without contact occurred when winner's weight exceeded loser's weight maximally.