Using Habitat Variables to Predict Eastern Chipmunk (*Tamias striatus*) Presence or Absence

BIOS 33502: Practicum in Environmental Field Biology

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Abstract

The variables that influence small mammal species' habitat selection are a subject of continued study. Habitat selection by the eastern chipmunk (*Tamias striatus)* was the focus of this project. At mixed deciduous and coniferous forest sites on UNDERC property, trapping and visual observations were used to confirm presence or absence of eastern chipmunks at each of the sites. Habitat variables were measured at each site, and tested as predictors of eastern chipmunk presence or absence. Soil moisture levels, percent canopy cover, vertical stratification, and relative herbaceous ground cover were quantified at each site. Only soil moisture was found to be statistically significant when compared between sites with chipmunks absent and present. Because four of the five habitat variables measured were not statistically significant when compared between sites with presence and absence of eastern chipmunks, it appears that eastern chipmunks on UNDERC property are a more generalist species in terms of habitat selection. Pearson pairwise correlation analysis of total captures of eastern chipmunks and red-backed voles (*Myodes gapperi*) at sites where eastern chipmunks were trapped suggests a similar idea, namely that eastern chipmunks occupy variable habitat types on UNDERC property.

Introduction

Habitat selection by small mammals in areas with multiple species present has been examined numerous times (Dueser and Shugart 1978, Silva et. al 2001, Silva 2003). Among small mammals species, there seems to be a variable number of habitats that different species can occupy. Some species, such as the red-backed vole (*Myodes gapperi*), appear to be specialists in terms of habitat selection, occupying a specific type of habitat, namely mesic areas within forests (Allen 1983). Other species, such as white-footed mice (*Peromyscus leucopus)*, have been found to a more occupy more numerous habitat types, such as coniferous and deciduous stands, and are deemed generalists (Drickamer 1976). Comparing the population densities of small mammal species to habitat variables, such as soil moisture, shrub cover, tree density, and understory vegetation, provides information about the characteristics of preferred habitats of small mammals. One species that has been part of many studies examining habitat selection is the eastern chipmunk (*Tamias striatus*; Dueser and Shugart 1978, Silva et al. 2001, Silva 2003).

The eastern chipmunk has been shown to inhabit certain habitats, most commonly deciduous forests. Eastern chipmunks, however, have also been observed to inhabit open bushy areas, mature forests, and residential areas (Synder 1982). Within these preferred habitats, certain variables have been shown to be important in terms of eastern chipmunk abundance. Silva et al. (2001) found a weak positive relationship between the soil humidity at the microhabitat level and the relative abundance of the eastern chipmunk, a condition believed to be common in relatively undisturbed habitats. Dueser and Shugart (1978) found that eastern chipmunks were captured primarily at sites with a largely deciduous canopy, high density of trees, and low density of shrubs. Silva (2003) also found a positive relationship between eastern chipmunk abundance and density of large trees (tree height > 1.5 m).

The relative abundances of other small mammal species, however, have been positively associated with the density and diversity of small shrubs and trees in the forest understory (Castleberry et al. 2002, Silva 2003). Castleberry et al. (2002) proposed that a diverse understory provides a wide variety of food items and minimizes foraging time for the Allegheny woodrat (*Neotoma magister*). In addition, Dueser and Shugart (1978) found white-footed mice (*Peromyscus leucopus*) primarily at sites with a high density of shrub-understory vegetation. While most studies of the eastern chipmunk have not focused on vertical stratification as a variable in habitat selection, the findings of the above studies could be indicative of more vertical stratification in the habitats of those species, and can be studied as a variable in eastern chipmunk habitats.

On the University of Notre Dame Environmental Research Center (UNDERC) property, I gathered information about which habitats eastern chipmunks prefer. I examined the relationship between eastern chipmunk presence or absence and soil humidity, percent canopy cover, degree of vertical stratification, and the relative amount of herbaceous ground cover. I expected to find presence of eastern chipmunks at sites with high soil moisture because some granivorous rodents find seed caches better in moist substrates than dry substrates (Vander Wall 1995). I also expected to find presence of eastern chipmunks in areas with high percent canopy cover, similar to Bowers (1995) who found that eastern chipmunks showed a preference for habitats with a closed canopy. I predicted that presence of eastern chipmunks also would be found in habitats with low relative herbaceous ground cover and low vertical stratification because it should allow for an increased use of sight by chipmunks to locate predators and conspecifics (Yahner 1978).

Materials and Methods

Eastern Chipmunk Trapping

To determine presence or absence of eastern chipmunks, eight 4500 m^2 (ca. 45 m X 100 m) plots on the UNDERC property served as trapping sites: Palmer, Kickapoo, Cranberry, Tenderfoot, Ed's Bog, Beaver Bog, and Long Lake (Wilson et al. 1996). Plots of this size should be adequate for studying eastern chipmunk, which display territorial behavior and average territories of 800 m^2 (Lacher Jr. and Mares 1982). Plots were initially selected based on tree composition, namely sites that were composed largely of conifers and sugar maple (*Acer saccharum*). At 15-m intervals within each plot (0, 15, 30, 45 m), 100-m transects were established. Each transect contained 10 Sherman traps at 10-m intervals, beginning at 0 m. In addition, three Tomahawk traps were spaced evenly along each transect. Due to property boundaries at one site (Palmer), two

180-m transects were established 25 meters apart. Traps were laid in the same manner and number, except that Sherman traps were placed every 9 meters. Trapping was conducted four weeks of the summer, five consecutive nights each week. Trapping was done at each site at least twice over the summer, with two sites trapped at three times (Northeast Gate and Ed's Bog). Traps were baited with rolled oats and peanut butter. At 0730-0930 CDT and1600-1800 CDT daily, traps were checked. All captured individuals were weighed and identified in terms of location, species, gender, and age. Each individual was also marked with a numbered metal ear tag (No. 1, National Band and Tag Co., Newport, KY). In addition, individuals visually observed at sites during field work were recorded in terms of date and location. Sites were determined to have eastern chipmunks present if either trapped or visually observed at the site.

Habitat Analysis

Soil moisture readings were taken at each of the eight sites three times over the course of the summer. A Kelway Soil Moisture Tester (Kel Instruments Co., Inc, Japan) was used to quantify soil moisture on a percentage scale. Readings were taken at 30 points within each site, determined using a random numbers table.

The relative amount of herbaceous ground cover at each site was estimated using a combination of two measures. Ten coordinates were picked from a random numbers table to determine the sample areas. First, the basal area of the nearest herbaceous individual believed to provide adequate cover for an eastern chipmunk was estimated by measuring width and length of the ground covered by the individual. The individual was then divided into four quadrants. From each quadrant, the distance from the edge of the individual to the edge of the nearest cover-providing herbaceous individual was also determined.

Percent canopy cover at each site was also calculated using a spherical densitometer (Forest Densiometers, Bartlseville, OK), a small convex mirror divided into 24 square grids. At 30 points selected from a random numbers table, a densitometer reading was taken. Held approximately 12 in. from the body at elbow height, each square was mentally divided in four and the number of squares that contained vegetation was recorded. This was done in each of the cardinal directions, with the readings being averaged and divided by 96 to get the percent canopy cover.

In order to determine vertical stratification within each of the sites, a random numbers table was first used to pick 30 points for study in each site. Measurement of the vertical density of plants at those points was done with the help of 4.5-m tall rangepole (Francl and Schnell 2002). At 0.5 m increments, any vegetation that touched the pole was recorded, up to a height of 6 meters above the ground. Using the recorded data, the degree of vertical plant density was estimated using the Levins diversity index (L; Levins, 1968):

$$L= \Sigma\ 1/(d_t)^2$$

in which d_t represented the number of vegetation hits recorded within each 0.5 m increment for each point "t".

Statistical Analysis

Mann-Whitney U-tests, a non-parametric test, were done to determine the relationship between eastern chipmunk presence or absence and soil moisture and percent canopy cover. A paired t-test was done to examine the difference between sites with presence and absence of eastern chipmunks and the Levins diversity index, the measure of vertical stratification. Also, the two measures for estimating relative amount of ground cover, average basal area of herbaceous individuals and average distance to nearest cover-providing herbaceous individual, were compared to presence or absence of eastern chipmunks using a paired t-test. In addition, Pearson pairwise correlation analysis of the total number of captures of eastern chipmunks and total number of captures of all other species at sites where eastern chipmunks were trapped was done. Total number of captures was used because trapping effort was the same across all sites where chipmunks were trapped at (520 trap nights; one trap night = one trap set for one night). All analysis of data was done using the program SYSTAT 11 (Systat Software, Inc., Point Richmond, California).

Results

Eastern chipmunks were trapped at three of the eight sites (Palmer, Kickapoo and Cranberry), and visually observed at one additional site (Long

Lake). Because data for some of the habitat variables measured were unable to be normalized, a non-parametric test, Mann-Whitney U-test, was done to determine if there was a difference in habitat variables between sites where presence of eastern chipmunks was observed and those were no presence was observed. As can be seen in Figure 1, there was a statistically significant difference between sites where chipmunks were present and absent in terms of percent soil moisture ($U = 44227.000$, $p < 0.001$). Percent canopy cover was found to not be statistically significant when comparing sites with eastern chipmunk presence and absence ($U = 7483.500$, $p = 0.598$). In addition, a paired t-test showed that there was no statistically significant difference in terms of vertical stratification, based on the calculated Levins Diversity Index, between sites with eastern chipmunk presence or absence ($t = 0.573$, $df = 6$, $p = 0.587$). Both measures of estimating herbaceous ground cover were compared between sites with eastern chipmunk presence or absence using a paired t-test. No statistically significant result was found between average basal area of herbaceous cover individuals and presence or absence of eastern chipmunks ($t = 0.953$, $df = 6$, $p = 0.377$), or the average distance to nearest herbaceous cover individual ($t = -1.196$, $df = 6$, $p = 0.277$). In addition, a significant negative correlation was found between total captures of eastern chipmunks and total captures of red-backed voles (*Myodes gapperi*) at sites where eastern chipmunks were trapped ($r = -.997$, $p = 0.05$; Figure 2). No statistically significant correlation was found between total captures of eastern chipmunks and any of the other species trapped at those sites ($p > 0.05$).

Discussion

Many of the habitat variables tested were not statistically significant in predicting eastern chipmunk presence or absence (Table 1). Because of this inability of the habitat variables to predict the presence or absence of eastern chipmunks, it appears that eastern chipmunks on UNDERC property can be found in variable habitats. This may be supported by the significantly negative correlation between total number of eastern chipmunk captures and total red-backed vole (*Myodes gapperi)* captures at sites where eastern chipmunks were trapped. Morris (1996) found that the red-backed vole preferentially occupied mesic habitats, determining the species to be a specialist in terms of habitat selection. Thus, a high total number of captures may suggest a preferable habitat for red-backed voles. Even though chipmunks were captured in greater abundance at other sites, captures also occurred at sites with high total captures of red-backed voles. This suggests that even though eastern chipmunks may prefer another habitat type, habitation may still occur at sites different from the preferred type, even at low abundance.

Dueser and Shugart (1979), however, found the eastern chipmunk to be intermediate in comparison to white-footed mice (*Peromyscus leucopus)*, a generalist species, and a specialist species, golden mice (*Ochrotomys nuttali).*

This previous study, however, examined several variables, many of which were not measured in the present study, such as tree stump size and density and litter-soil compactability. Thus, my measures of habitat variables may not have been sufficient to accurately quantify habitat structure.

However, percent soil moisture was a good predictor for the eastern chipmunk presence. Specifically, it appears that eastern chipmunks selected for habitats with high soil moistures. This result is consistent with the idea that moist soil may allow for eastern chipmunks to better find seed caches. However, there may be other explanations. Even though seeds and nuts constitute the majority of the over-wintering food supply, insects and fungi are also important food sources, especially during the growing season when trapping was conducted (Synder 1982). Thus, one other explanation for my observed results may have to do with the relationship between soil moisture and the changes in slope of the terrain at each of the sites. If the site contains variable terrain, there may be areas for runoff to collect, allowing for moister soil. More variable terrain may further impact the presence or absence of eastern chipmunks as chipmunks select burrow sites in areas with steep slopes, which likely provides well-drained soil for burrow construction (Mahan and Yahner 1996). Future experiments should compare the degree and variability of slope change across the site terrain to eastern chipmunk presence.

Location of burrow sites was also not taken into account in this project, but should be examined more closely in future studies. Bowers (1995) found that microhabitat variables, such as closed canopy, were only preferentially selected for by eastern chipmunks at distances greater than 50 meters from the burrow. In other words, the distance from the burrow more accurately predicted habitat use then other habitat variables. Future experiments could locate burrows at sites prior to trapping, and examine the relationship between the distance from the burrow and number of individuals trapped.

This project can serve as a potential starting point for future studies. For one, soil moisture levels can suggest where eastern chipmunks are likely present. In addition, the data preliminarily indicates the ability of the eastern chipmunk to act as a more generalist species and live in a wider variety of habitats. To further test this idea, however, future experiments should modify the methods of the present study. Trapping at additional habitat types should be done. Instead of trapping at solely mixed coniferous and deciduous sites, trapping should be done at predominantly deciduous and coniferous sites, as well as open habitats such as forest edges and fields. In addition, the number of trap nights should be raised so that a measure of species density at each of the sites can be accurately determined.

The presence of eastern chipmunks was found through trapping and visual observation at four sites on UNDERC property. Using presence or absence of eastern chipmunks as the means of comparison between sites, this study was able to show that soil moisture seems to be a good indicator of eastern chipmunk presence on UNDERC property. In addition, the results of the measured habitat variables, when compared between sites with eastern chipmunks present and absent, appear to show eastern chipmunks to be a generalist species in terms of habitat selection. Additional habitat variables to measure in future experiments have been offered, as well as modifications to the methods of the present study that may enhance the effectiveness of future studies.

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Table 1. The calculated p-value for each habitat variable when compared between sites where eastern chipmunks were present or absent. All results contained in the table were found to be not statistically significant, and thus could not be used as accurate predictors of eastern chipmunk presence or absence.

Habitat Variable	p-value
Percent canopy cover	0.598
Levins Diversity Index	0.587
Basal area of herbaceous cover	0.377
Distance to nearest herbaceous cover	0.277

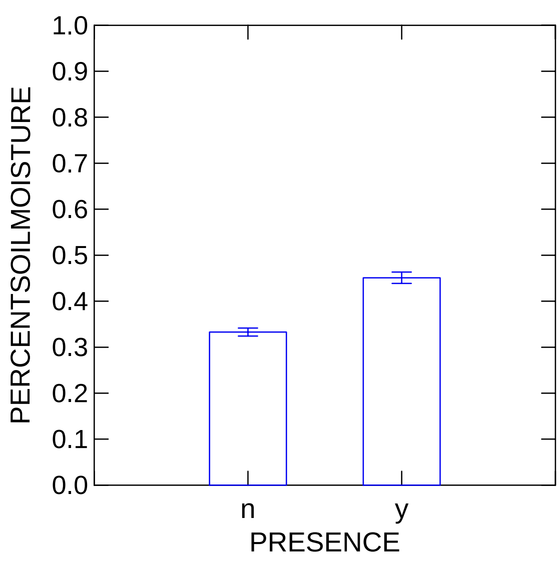

Figure 1. The percent soil moisture averaged across sites where chipmunks were absent (n) and present (y). A Mann-Whitney U-test was done, and presence and

absence were found to be statistically different (U statistic= 44227, $p < .001$). Eastern chipmunks appear to select sites for habitation in areas with moister soil. Error bars represent one standard error.

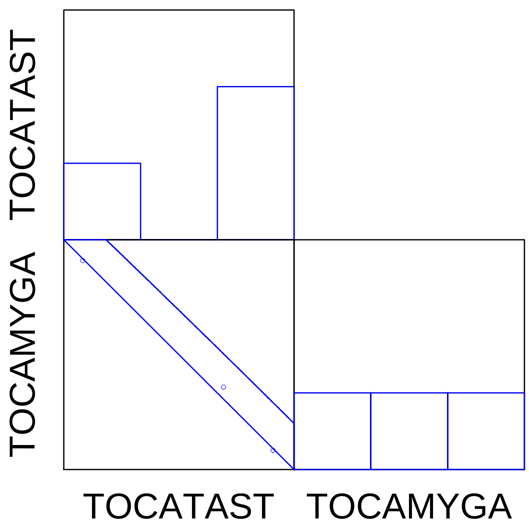

Figure 2. Pearson pairwise correlation analysis between total number of eastern chipmunk (TOCATAST) and red-backed voles (TOCAMYGA) captures at sites where eastern chipmunks were trapped. A statistically significant negative correlation (r= -0.997) was found using Bonferroni probabilities (p= 0.05).