Habitat Segregation of Sciurids in Upper Michigan

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Abstract

Sciurids, including eastern chipmunks, red squirrels, and northern flying squirrels, may exhibit habitat segregation at a fine scale, which can be examined through trapping data. Their behavior and physical characteristics may affect trapping success, something that should be taken into account when conducting analyses. For this study, two trapping grids of 25 stations and 2 traps at each station were constructed. Mark-recapture population estimates were made using Program Mark. Density estimates, capture, and recapture probabilities were calculated and compared across sites and species. Basic habitat segregation was exhibited by these sciurids between upland and lowland habitat types, with sphagnum moss being the indicator for lowlands. Capture and recapture probabilities provided further knowledge about potential behavioral competition of sciurids.

Introduction

The family Sciuridae consists of several species of rodents including ground and tree squirrels, chipmunks, marmots, and flying squirrels (Feldmahmer et al. 2007). Signature characteristics of sciurids include large eyes and bushy tails. They exhibit typical rodent tooth structure with large incisors for gnawing. These animals are primarily herbivorous, feeding on a variety of seeds and nuts, but some are known to eat insects and small invertebrates. Their broad range of resource usage allows them to exist in many different habitats across the globe.

Several sciurid species inhabit upland and lowland areas of the University of Notre Dame Environmental Research Center (UNDERC) property near Land O' Lakes, Wisconsin, including eastern chipmunks (*Tamius striatus*), Northern flying squirrels (*Glaucomys sabrinus*), and red squirrels (*Tamiasciurus hudsonicus*). Despite belonging to the same family, these sciurids have unique characteristics that differentiate them from one other. Eastern chipmunks are a ground dwelling sciurid, while red squirrels inhabits trees. Both of these species are diurnal, which contrasts with flying squirrels' nocturnal activity. Eastern chipmunks tend to inhabit hardwoods areas (Sonenshine and Levy 1981, Snyder 1982), while northern flying squirrels and red squirrels prefer coniferous areas (Obbard 1987, Gerrow 1996).

The details of resource partitioning by these species on a finer scale are not well known. Little research has been done to examine the interactions of all these species in specific habitats. Robitaille and Linley (2006) studied the use of forest patches by small mammals, including sciurids. They examined small scale factors, such as shrub cover and tree basal area, that may affect habitat use by small mammals with a particular focus on future forest management. Cote and Ferron (2001) also studied northern flying squirrels, red squirrels, and eastern chipmunks in harvested systems to investigate relationships between habitat and species population dynamics. Fine scale differences in habitat may limit sciurid populations for different reasons. Availability of den sites such as cavities may limit population growth of arboreal squirrels (Carey 1991). Food sources and territory sizes may place population constraints on other species such as red squirrels (Smith 1968a).

Unlike these previous studies, the UNDERC property is not actively harvested, allowing for analysis without the confounding factor of habitat disturbance. Sciurid species of interest are known to coexist in the same areas at UNDERC, but potential habitat segregation structure is unknown. These sciurids may exist in several habitats, but preferences for certain types such as uplands or lowlands are not clear. These factors would impact trapping success, further influencing ecological estimates such as density or home range. Therefore, it is pertinent to study sciurids' habitat interactions.

Capture and recapture probabilities also affect trapping success. Variation within these probabilities is accounted for by behavioral responses, time effects, and heterogeneity among individuals (Otis et al. 1978). Species may exhibit different behaviors after entering traps, initially causing different recapture success rates, a phenomenon known as trap happiness. An animal's age, sex, or activity level may also cause differences in capture probability, creating heterogeneity among individuals (Smith 1968b).

This study attempted to examine differences in the use of lowland and upland areas by sciurids in Upper Michigan and to use basic population models to determine densities and capture probabilities of these species. Due to differences in food preferences and general ecology, we expected to find eastern chipmunks in upland areas containing northern hardwoods. Red squirrels and northern flying squirrels were expected to be found in lowland, coniferous areas. We also expected that capture and recapture probabilities would be the same across sites but different between species.

Materials and Methods

Study site

The property encompasses approximately 7500 acres of mixed northern hardwoods and coniferous habitat. The dominant tree species of the property include sugar maple (*Acer saccharum*), trembling aspen (*Populus tremuloides*), and balsam fir (*Abies balsamea*). Species of the shrub and ground layer include beaked hazelnut (*Corylus cornuta*) and sphagnum moss (*Sphagnum spp.*) The property contains open water and both open and forested wetlands. (www.underc.nd.edu)

Sampling procedure

The main methods used for this study were live trapping and ear tagging from mid-June to mid-July. Two trapping grids were placed in order to trap and tag animals. The grid near Forest Service Bog, South grid, consisted of a 5 x 5 setup with 40 meter (effective trapping area of 5.76 hectares) spacing and 2 traps at each station, a Tomahawk 201 trap in the tree and a Sherman live trap on the ground. Traps were placed on trees large enough to support Tomahawk live traps approximately 1-2 meters off the ground. The other grid near Kickapoo Lake consisted of a 3 x 3 setup with 40 meter spacing and 2 traps at each station, but the grid was eventually reorganized into a 5 x 5 setup with 20 meter spacing (effective trapping area of 2.56 hectares). The sites were located in mixed hardwoods and conifer stands, containing both upland and lowland areas. Bait consisted of a seed mixture rolled in peanut butter and apples. Traps were checked at daybreak and in the afternoon on suitable days. Trapping did not occur overnight when the temperature dropped below 40°F or when there was a 40% or greater chance of precipitation.

Several pieces of information were collected for each sciurid captured. Each sciurid was identified to species, and sex, age (juvenile versus adult), and reproductive status (scrotal versus nonscrotal for males and open versus closed for females), were recorded. Weights were also taken using a pescola scale, and animals received one tag in each ear before being released. Recaptured animals were noted as well.

Analysis

Trapping data was run through Program Mark to determine densities of each species in upland, lowland, and overlap areas for each site. The simplest closed capture model was run for these estimates. Animals were separated by species into these categories based on capture site habitat type. Traps in areas that contained sphagnum moss were considered to be in lowlands, while those in areas without sphagnum moss were categorized as uplands. Animals caught in both areas were put in the overlap (both) category. Capture and recapture probabilities were also calculated and compared across sites and species. Graphical representations of the data with 95% confidence intervals were constructed for visual comparison and conclusions.

Results

Capture probability across sites was not significantly different, and species did not exhibit different capture probabilities (Figure 1). Recapture probabilities were similar across sites as well, but red squirrels were less likely to be recaptured than eastern chipmunks or northern flying squirrels on the South grid (Figure 2).

Total densities varied by species and site. Eastern chipmunks had the highest density with similar densities across sites. Red squirrels were present in a higher density than northern flying squirrels on the South grid but were less dense on the Kickapoo grid than northern flying squirrels (Figure 3).

Northern flying squirrels were denser in lowland areas on the South grid than at Kickapoo. They were equally dense in lowland and overlap areas at Kickapoo, but they had no density represented in upland areas (Figure 4). Red squirrels were denser in lowland areas on the South grid than at Kickapoo. They were denser in lowland than overlap areas on the South grid, but they were not found in upland areas (Figure 5).

Eastern chipmunk density did not differ between sites. Density did not differ between upland, lowland, and overlap areas at Kickapoo, while they were slightly denser in upland than overlap areas on the South grid. They had no density represented in lowland areas on the South grid (Figure 6).

Discussion

Capture probabilities across sites and between species were not significantly different (Figure 1). We would expect sites to have similar capture probabilities, particularly if we were intending to use these sites as replicates of each other. Therefore, the sites must have had similar habitat structures and underwent similar environmental stochasticity. Site to site variation was small, allowing us to compare these sites to each other in regard to animal densities. Our trapping efforts were successful in sampling a diversity of sciurids. We would assume that characteristics of the species themselves would affect capture probabilities (Hammond and Anthony 2006). Recapture probabilities were fairly similar, except for the lower rate for red squirrels (Figure 2). This is potentially related to the behavior, such as lower susceptibility to trap happiness or foraging activity, of this species. Personality and risk-taking behavior may play a role in this hypothesis as well (Boon et al. 2008).

Total densities between species and across sites showed some variation (Figure 3). The number of eastern chipmunks as well as northern flying squirrels was similar between sites. Kickapoo had a much lower density estimate for red squirrels. This is related to the fact that only one red squirrel was captured on this grid. This may not be an accurate representation of the population in the area, but more related to the smaller size of the trapping grid, which was due to space restraints. Since the grid was smaller in size, it did not accurately reflect the home range size of red squirrels, causing fewer captures.

Species densities across particular habitats within sites were compared. Northern flying squirrels and red squirrels were denser in lowland areas, particularly in the South grid, than in overlap or upland areas (Figures 4 and 5, respectively). These species are known to prefer conifer areas, which predominantly occur in lowland areas in this region (Obbard 1987, Gerrow 1997). We expected to find them in higher densities in these areas, with potential overlap due to competition for resources.

Eastern chipmunks were found in approximately even densities across several habitat types, especially on the Kickapoo grid (Figure 6). The biology of the chipmunk explains this distribution, as they inhabit a variety of areas including edges and forested areas consisting of upland and lowland vegetation (Burt 1957). No chipmunks were estimated to be in lowland areas on the South grid, which could be a function of higher red squirrel densities in that area. These species are both diurnal and utilize similar food sources, so habitat partitioning on a fine scale may be exhibited here.

Our data shows that sciurids appear to select for particular habitats on a fine scale, meaning that they can be found in greater densities in small patches of preferred habitat. Competition may also be playing a role in habitat type selection. The trapping data compiled was rather small to determine any significant relationships involving species interactions between each other and with the habitat. More replicates and a longer trapping season are needed to draw more defendable conclusions about habitat segregation. Despite the small sample size, we did manage to show that capture probability was constant across sites, a critical variable that must be managed for when conducting trapping studies.

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UNDERC website: www.under.nd.edu

Figures

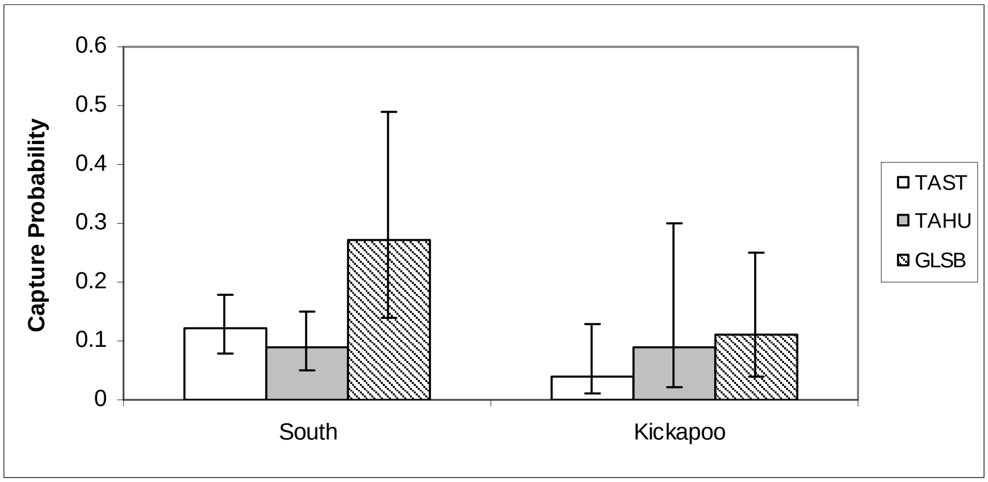

Figure 1. Capture probabilities of eastern chipmunks (TAST), red squirrels (TAHU), and northern flying squirrels (GLSB) on two different trapping grids. Error bars represent 95% confidence intervals as given by Program Mark. No significant differences between sites and species were found.

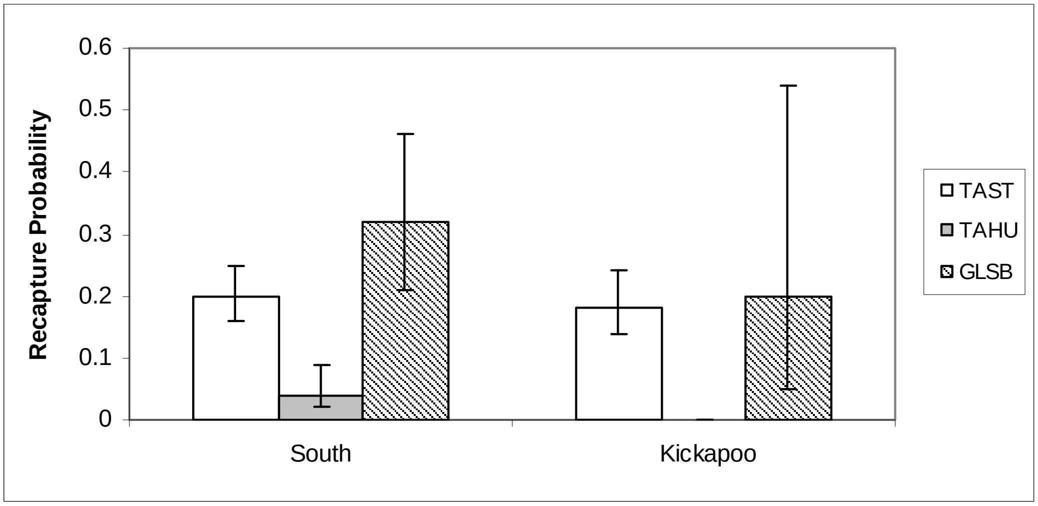

Figure 2. Recapture probabilities of eastern chipmunks (TAST), red squirrels (TAHU), and northern flying squirrels (GLSB) on two different trapping grids. Error bars represent 95% confidence intervals as given by Program Mark. No significant differences between sites and species were found. Red squirrels had a significantly less chance of recapture than the other species.

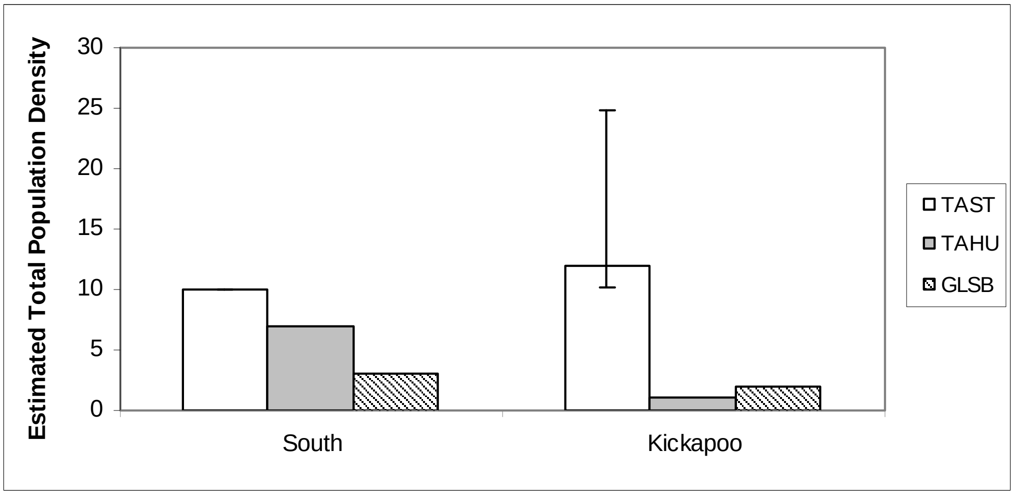

Figure 3. Estimated total population densities of eastern chipmunks (TAST), red squirrels (TAHU), and northern flying squirrels (GLSB) on two different trapping grids. Error bars represent 95% confidence intervals as given by Program Mark. Chipmunks were the most abundant species at both sites, with red squirrels and northern flying squirrels present at smaller densities.

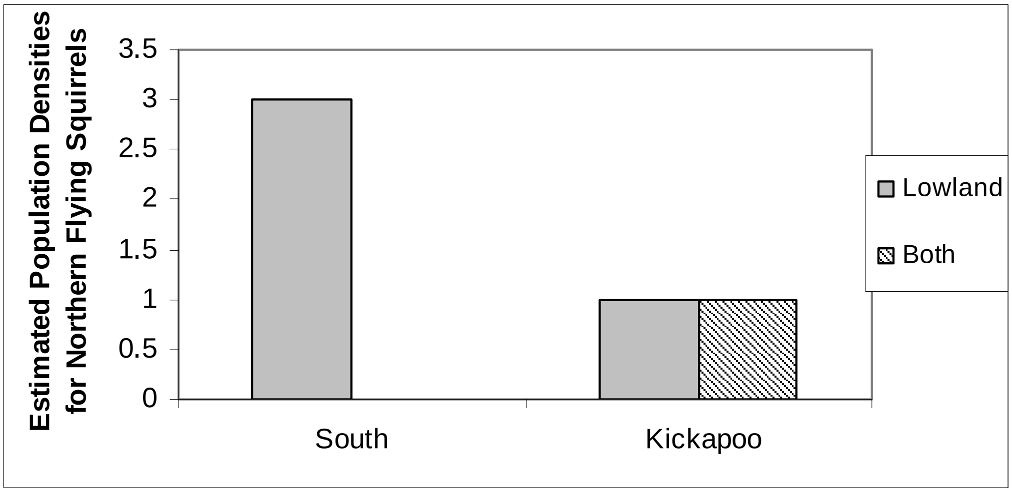

Figure 4. Estimated total population densities of northern flying squirrels on two different trapping grids. Error bars represent 95% confidence intervals as given by Program Mark. Northern flying squirrels were estimated to be in lowland areas only on the South grid, while they were present in similar densities in lowland and overlap habitat types at Kickapoo.

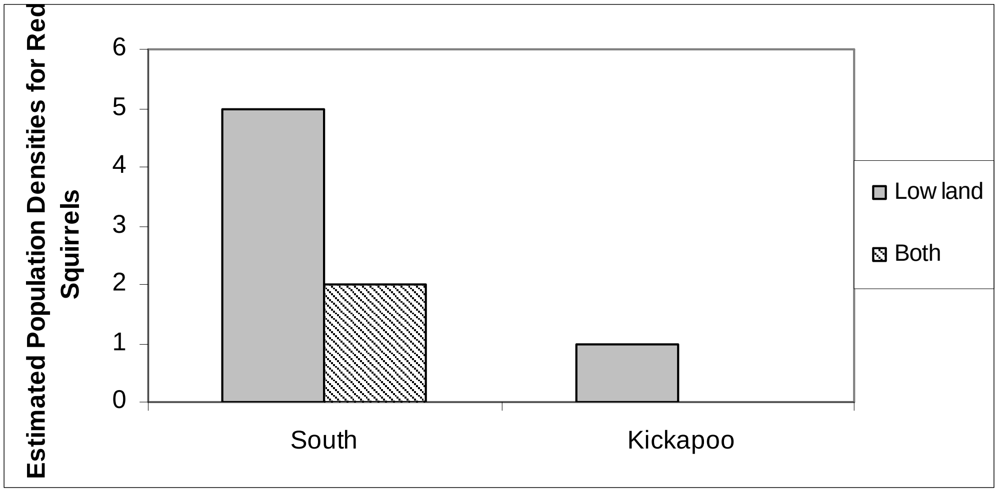

Figure 5. Estimated total population densities of red squirrels on two different trapping grids. Error bars represent 95% confidence intervals as given by Program Mark. Red squirrels were estimated to be in lowland and overlap areas on the South grid, while they were estimated to be present in only lowlands at Kickapoo.

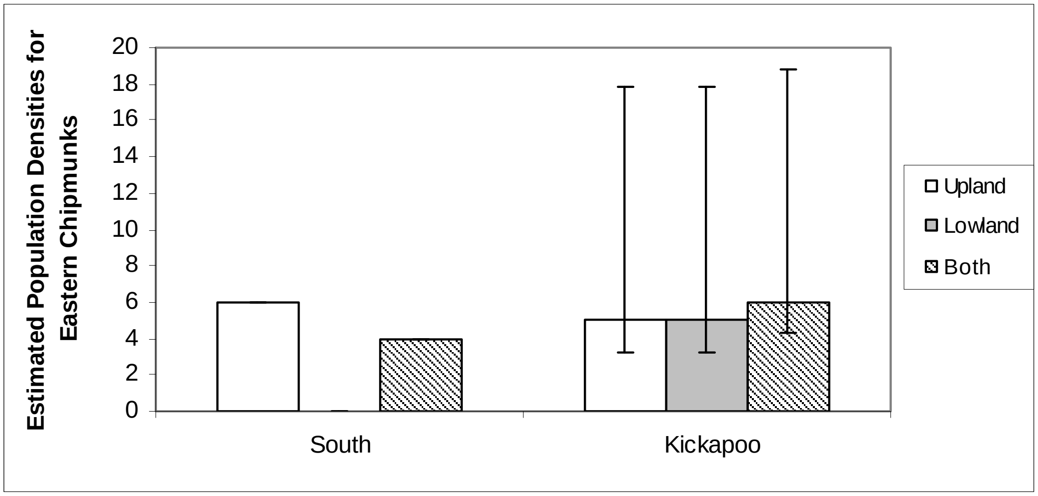

Figure 6. Estimated population densities of eastern chipmunks on two different trapping grids. Error bars represent 95% confidence intervals as given by Program Mark. Eastern chipmunks were estimated to be in upland and overlap areas only on the South grid, while they were estimated to be present in similar densities in all habitat types at Kickapoo.