Ecology of Native and Exotic Urban Populations of Eastern Gray Squirrels

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INTRODUCTION

The eastern gray squirrel (*Sciurus carolinensis*) is one of the many species of tree squirrels found in North America. This species was introduced at 30 locations throughout Great Britain from 1876 to 1929. Resulting from urbanization, gray squirrels are abundant in urban areas in both North America (native) and Great Britain (exotic). Gliwicz et al., (1994) developed hypotheses on the effects of urbanization of wildlife species. Because of human activity, urban areas are highly susceptible to introductions of exotic fauna; however, there have been no investigations on the efficacy of these hypotheses on exotic species in urban areas. Therefore, six study sites will be established in metropolitan areas of Baltimore, Maryland and throughout the United Kingdom to compare population densities, intraspecific aggression, wariness, and activity patterns of native and exotic urban populations of gray squirrels. These populations will also be used to test Gliwicz et al.(1994), hypotheses on the effects of urbanization on wildlife species.

Similarities in synurbinization processes of the blackbird and striped field mouse, expressed as specific features of their urban populations in comparison to non-urban ones.

In Demography and Population Dynamics:
- Higher density and reduced territories
- Prolonged breeding season
- Higher survival in winter
- Reduced losses from predators

In Behavior:
- Shift in diet composition
- Nesting in/or man-made constructions
- Reduced migratory behavior
- Reduced fear of man

(Taken from Gliwicz et al. 1994)

RESEARCH QUESTIONS

Do exotic urban populations of eastern gray squirrel (*Sciurus carolinensis*) have different behavior and/or densities from native urban populations?

- Are there differences in the behavior of individuals in exotic and native populations? → Intraspecific aggression, wariness, and activity patterns
- Are there differences in population densities of exotic and native populations? → Population densities determined by time-area counts.

RESEARCH OBJECTIVES

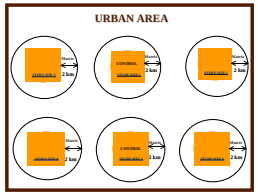
To distinguish differences in densities between exotic and native urban populations of eastern gray squirrel.

To distinguish behavioral differences between urban populations of exotic and native eastern gray squirrel.

To establish relationships between population density and habitat use of exotic and native urban populations of eastern gray squirrel.

STUDY SITES

Gray squirrel populations located in Baltimore, Maryland will be used as native populations and gray squirrel populations located in the UK will be used as exotic populations. Six study sites will be established throughout the metropolitan areas of Baltimore and the UK. Study sites will be 2 – 6ha (approximately 5 – 15 acres) have a canopy cover of 40 - 65%, and must be located within in a matrix that extends a minimum of 2km from the perimeter of the location.



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METHODOLOGY

Abundance
Each study site will be divided into equal quadrants. Time area counts conducted by quadrants will be used to estimate squirrel densities for each study site. The order of sites and quadrants to be counted will be determined by a random numbers generator. No quadrant within a study site will be counted consecutively during sampling periods. This will ensure the statistical independence of each count.

Intraspecific Aggression
Gray squirrel encounters that display an agonistic action that elicits an agonistic or submissive response will be documented as an aggressive act (Gustafson and VanDruff, 1990). Study site, time of occurrence, and weather conditions will be recorded for each act of aggression. Adults are dominant in the social system of the gray squirrel; therefore, only acts of aggression between adult squirrels will be recorded. Repeat encounters between the same two squirrels will be excluded as nonindependent observations, unless a role reversal occurs (Gustafson and VanDruff, 1990).

Wariness
Wariness will be quantified using a standardized threat stimulus approaching a gray squirrel on the ground directly and at constant speed (Gustafson and VanDruff, 1990). Threat stimulus will be observer walking toward the squirrel without vocalization or other deliberate auditory stimulus (Gustafson and VanDruff, 1990). Study site, time of occurrence, temperature and startle distance (the distance between the squirrel and the approaching threat stimulus at the instant the squirrel fled to cover) will be recorded for each squirrel.

Activity Patterns
Activity patterns will be assessed using similar techniques employed by Manski et al. (1980) to assess activity patterns of gray squirrel. Individual gray squirrels will be observed and video taped for 15 minute intervals between sunrise and sunset. Focal animal will be the third visible gray squirrel located in a quadrant determined by a random number generator. This approach will reduce the probability of studying only the most visible animals (Manski et al., 1980). Observed activities will be categorized and tabulated as: feed (process of consuming a food item); forage (behavior associated with searching for food); store (behavior associated with burying food); rest (sleeping and loafing); groom (scratching, licking, and biting oneself or another squirrel); chase (behavior associated with the pursuit and/or flight from another squirrel or squirrels); movement (other locomotion not used in the above categories); other (other behavior not described in the above categories). Resulting data will be pooled into two-hour periods from sunrise to sunset for analysis.

DATA ANALYSIS

Abundance
Squirrel abundance will be analyzed using a 95% confidence interval ($\alpha = 0.05$) with comparisons made by location (exotic versus native) and matrix type (TYPE I versus TYPE II). This approach will be (confidence interval) will be used because of the limited number of samples available for each comparison and will allow distinctions to be made between each population.

Intraspecific Aggression
Intraspecific aggression data will be collected at each study site three times throughout the calendar year (April/May, June-August, and October/November). A nonparametric t-test will be used to analyze comparisons among locations and among densities.

Wariness
Wariness data will be collected at each study site three times throughout the calendar year (April/May, June-August, and October/November). A nonparametric t-test will be used to analyze comparisons among locations and among densities.

Activity Pattern
Activity pattern data will be collected at each study site three times throughout the calendar year (April/May, June-August, and October/November). Data will be expressed as activity indices showing the percentage of squirrels engaged in each activity during each time period. Comparisons among locations and among densities will be made using chi squared. Similarities among locations will be determined using Principal Component Analysis (PCA). Matrices of correlations among characters will be computed, principle components will be extracted, and ordinations of projections will be prepared. A shortest minimally connected network will be computed and displayed in a three-dimensional plot displaying how similar or dissimilar each location is to the other.

		Variables	
Data	**Analysis**	**Independent**	**Dependent**
Abundance	95% Confidence Interval	location matrix type	number of animals number of animals
Intraspecific Aggression	nonparametric t-test	location density	number of aggressive acts number of aggressive acts
Wariness	nonparametric t-test	location density	mean distance mean distance
Activity Patterns	chi squared	location density	% of squirrels in activity % of squirrels in activity

REFERENCES

Gliwicz, J., J. Goszczynski, and M. Luniak. 1994. Characteristic features of animal populations under synurbization – the case of the Blackbird and of the Striped Field Mouse. Memorabilia Zoologica, 49:237-244.

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