Comparison of Small Mammal Abundance and Distribution in a Transitional Oak Stand, Jack Pine Barren, and Northern Hardwood Forest Stand

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Abstract

Small mammal abundance and distribution were compared in a transitional oak stand, Jack pine barren, and Northern hardwood forest stand. Twenty-five Sherman live traps were set in each, the Northern hardwood forest and Jack pine barren, and 10 traps in the transitional oak stand. There were 32% more captures in the hardwood stand than in the Jack pine barren, and 81% more in the hardwood than in the transitional oak. All stands were dominated by *Blarina brevicauda* and *Peromyscus* spp., suggesting that these species are habitat generalists. As species diversity increased across the transitional oak, Jack pine, and Northern hardwood stand, evenness marginally declined. The masked shrew (*Sorex cinereus*) and red-backed vole (*Clethrionomys gapperi*) were found to frequent sites with higher moisture content. The woodland jumping mouse (*Napaeozapus insignis)* frequented the deciduous environment due to its available resources, including succulent plant parts. The Northern flying squirrel (*Glaucomys sabrinus*) and the Eastern chipmunk (*Tamias striatus*) both selected the hardwood stand not only for its composition, but also for its structure. This study established habitat preferences of small mammals in three diverse sites and provides baseline information for further research of small mammal populations on a flat rock pine barren.

Descriptors: Small mammals | Northern Hardwood | Jack pine | habitat preference

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Introduction

Small mammals play several important roles within a forest ecosystem, including functioning as seed and insect predators, seed dispersers, and as prey for raptors and other predatory species (Zegers & Ha 1981, Terilliger & Pastor 1999, Clarke 1983). Terilliger and Pastor (1999) found that *C. grapperi* is a significant vector for ectomycorrhizal fungi infection for conifers, which in turn controls their potential invasion into beaver (*Castor canadensis*) meadows. In the absence of symbiotic fungi, Jack pine (*Pinus banksiana*) cannot germinate in these wet sedge meadows. Ahlgren (1966) observed that *Peromyscus* spp. subsist largely on conifer seeds and that mice populations increase considerably following the burning of Jack pine stands, which increases pine distribution via serotinous seed dispersal.

The resources small mammals utilize largely depend on the habitat in which they are living. A Northern hardwood forest, dominated mainly by Sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), and Birch (*Betula pendula*, *Betula alleghaniensis*), has considerably different habitat characteristics as compared to a Jack pine stand. While the Northern hardwood stand is comprised of deciduous vegetation, a Jack pine barren is a xeric, exposed, and fire- and drought-prone habitat (McCabe 2004). Barnum et al. (1992) found mice to select specific pathways in the understory to buffer against noise and provide cover. Mice showed strong preference for downed logs over dry leaf litter so as to avoid the noise the leaves would make while traversing the forest floor. However, these same researchers also found that mice take seasonal changes into account when dealing with moisture and leaf litter density. The Jack pine barren was

abundant with mosses and lichens, soft substances that mice utilize to avoid predator attraction due to noise.

The fire-prone habitat of a Jack pine barren draws insectivorous species such as shrews and mice due to the abundance of insects in the area that follows a burn (Ahlgren 1966). Ahlgren found deer mice to invade Jack pine barrens immediately following a burn, not only for broadcasted seeds, but also for insects. The years post-fire displayed a gradual decline in seeds and insect abundance, and consequentially, mice.

Small mammals are found to respond to particular undergrowth structure (Healy & Brooks 1988), as well as other conditions, such as soil moisture and substrate (Bowman et al. 2000). This study sought to compare the abundance and distribution of small mammal assemblages in relation to forest structure and composition between a transitional oak stand, Northern hardwood stand, and mid-successional Jack pine barren to identify habitat preferences. We hypothesize that the Northern hardwood stand will exhibit higher over- and understory biodiversity and thus higher small mammal richness, diversity, and abundance.

Methods

Site description:

A total of 60 traps were set in three habitats: a Northern hardwood stand (n = 25), a transitional oak stand (n = 10), and a mid-successional Jack pine (*Pinus banksiana*) barren (n = 25). A pitfall trap (150ml plastic cup) was also dug at each trap site for additional shrew and insect capture. All sites were located on Miner Institute land in West Chazy, Northeastern New York. The Northern hardwood stand was dominated by Sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), and Birch (*Betula pendula, B. alleghaniensis*); the transitional oak stand was dominated by Red oak (*Quercus rubra*), American beech, and Striped maple (*Acer pensylvanicum*). Both hardwood sites were located on cobblestone hills. The Jack pine stand was established on sandstone bedrock, with a thin layer of soil and understory of blueberry (*Vaccinium* spp.) and honeysuckle (*Lonicera canadensis*) bushes, and sheep laurel (*Kalmia angustifolia*). The pine barren also had several kinds of mosses and lichens, including reindeer lichen (*Cladina rangiterina*), *Cladonia uncialis*, and *Polytrichum* spp. moss.

Trapping took place during mid-September to late October 2008. Sherman traps were placed twenty paces apart in all stands, in addition to being set away from the road to reduce edge effect. Transect trap lines were placed in an E-W direction in the hardwood stand, W-E in the transitional oak stand, and parallel to the road in the Jack pine stand. Global Positioning System (GPS) coordinates of all traps were taken and used to create Geographic Information System (GIS) maps for orientation (ESRI, ArcGIS). All Sherman traps were pre-baited with a mixture of rolled oats and shelled sunflower seeds for two days prior to trapping. Cotton balls were placed in traps to serve as bedding material in inclement weather. Traps were baited at dusk and were checked the following morning at dawn, approximately 2-3 times per week.

Individuals captured were identified to species, weighed, body and tail lengths measured, and sex determined. Tentative *Peromyscus* spp. identification was attempted in the field by tail delineation specifically, a definitive line between darker dorsal versus lighter ventral tail pelage and was indicative of deer mice, whereas blended dorso-ventral

tail pelage was considered indicative of white-footed mice (Choate 1973). Tail tissue and saliva samples were obtained from *Peromyscus* spp. for future DNA and salivary amylase gel electrophoresis for species verification. Deceased *Sorex cinereus* were later identified under a dissecting microscope by the number and size of unicuspid teeth (Whitaker & Hamilton 1998). The pelages of all other species except for Peromyscus spp. were marked with White-Out for short term mark-recapture. All captured animals were released at their point of capture.

Results were analyzed using Shannon-Weiner diversity indices to establish species diversity and evenness:

$$H_s = -\Sigma\ (P_i)(\ln P_i)$$

Where:
P_i = Proportion of species (# species/total)
$\ln P_i$ = natural log of proportion of species

And

$$E_H = H/(\ln S)$$

Where:
E_H = Evenness
S = Species richness

These diversity indices were compared among sites to assess patterns in small mammal distribution among forest types.

Results

Over a total of 445 trap nights, 32% more animals were caught in the hardwood stand than in the Jack pine barren (Figure 1). The hardwood site also yielded 81% more captures than the transitional oak stand. Of the 6 species captured in the hardwood stand, 37% and 41% were *Blarina brevicauda* and *Peromyscus* spp., respectively. Similarly, the mid-aged Jack pine stand was dominated by *B. brevicauda* and *Peromyscus* spp. as well. However, mice were three times as abundant as Northern short-tailed shrews (Figure 2). The transitional oak stand yielded only two species, which were also the most common in the Northern hardwood and Jack pine stands (Figure 3).

Species diversity was highest in the hardwood and lowest in the transitional oak stand (Figure 4). Community evenness declines with increasing diversity.

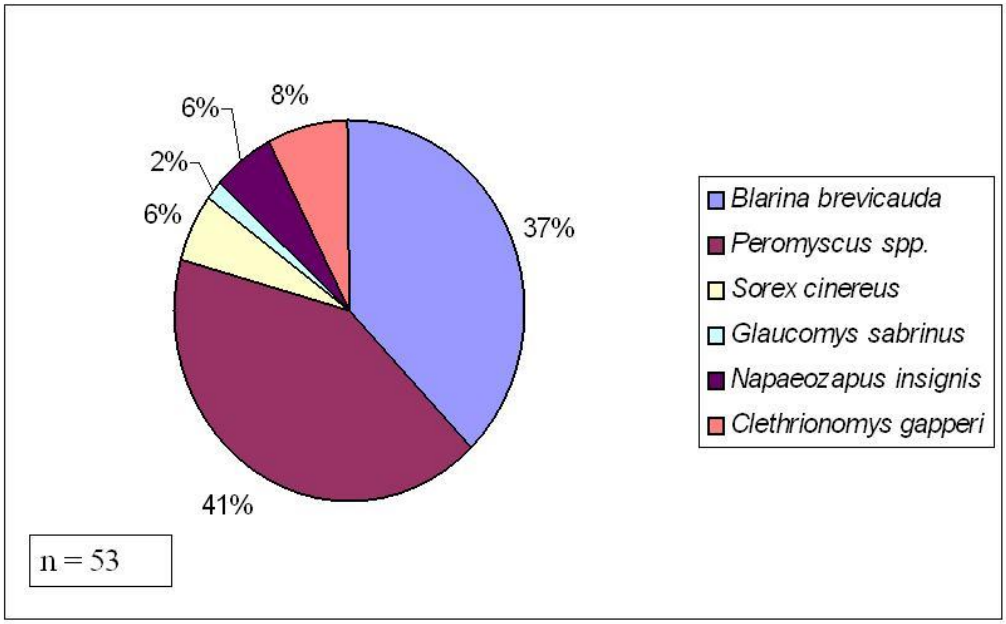

Figure 1. Abundance of small mammals in a Northern hardwood stand consisting of Sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), and Birch (*Betula pendula, Betula alleghaniensis*). Recaptured animals were not including in this graph.

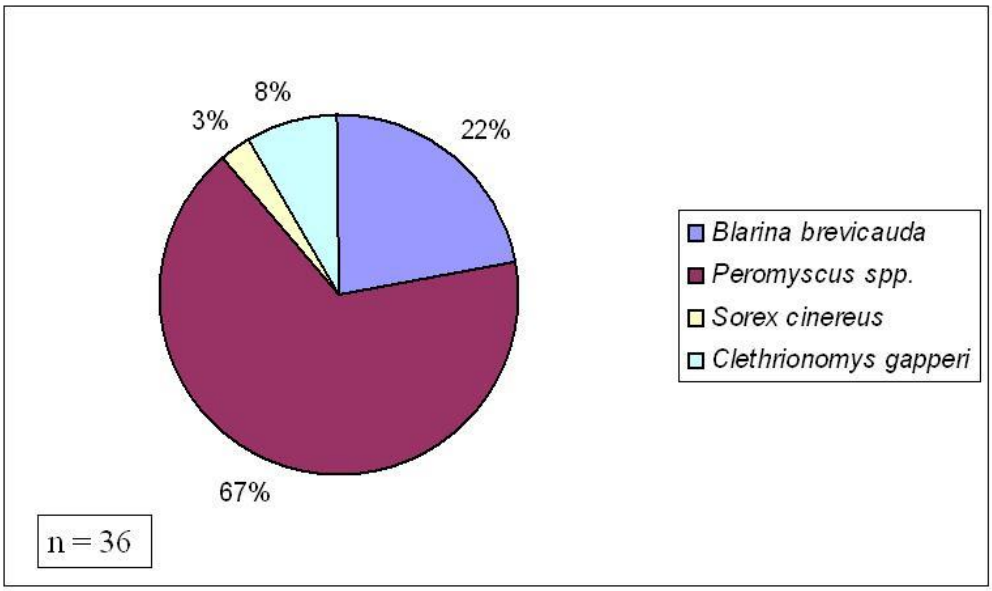

Figure 2. Small mammal abundance and composition in the mid-aged Jack pine (*Pinus banksiana*) stand. Recaptured animals were not included in this graph.

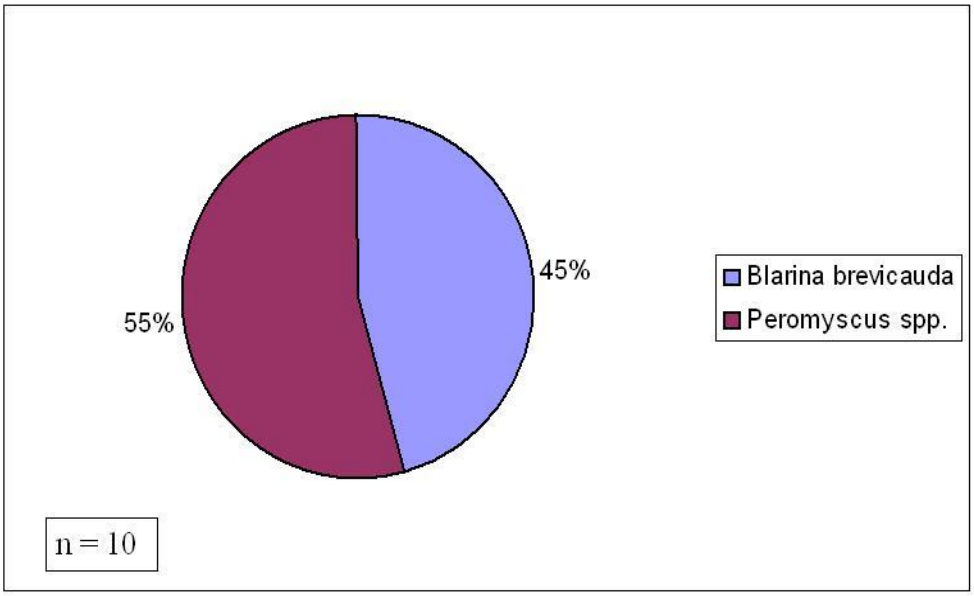

Figure 3. Small mammal abundance in a transitional oak (*Quercus rubra*) stand. Recaptured animals were not included in this graph.

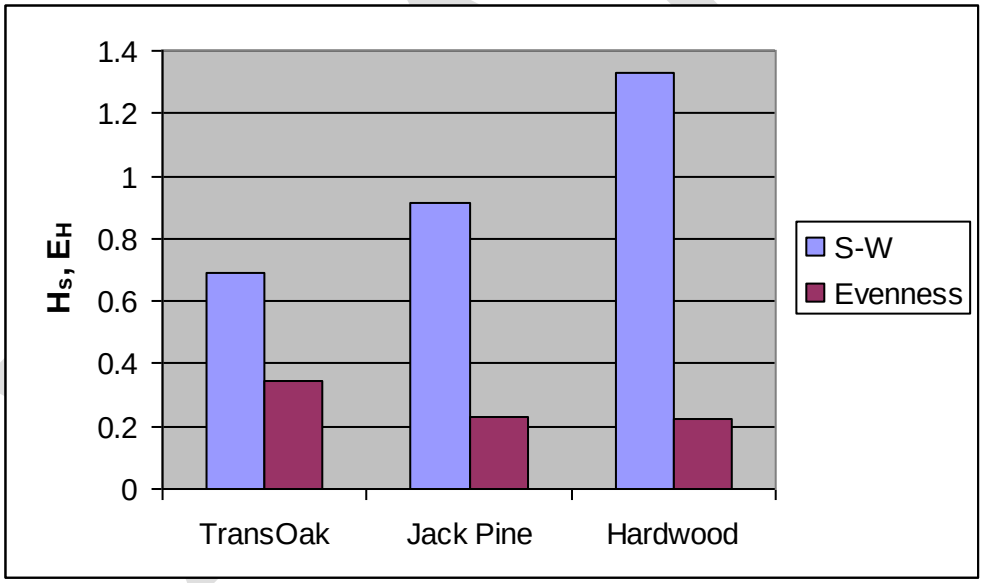

Figure 4. Species diversity (Shannon-Weiner) and evenness for the transitional oak stand, Jack pine stand, and Northern hardwood.

Discussion

To establish habitat use patterns of small mammal assemblages based on abundance and distribution patterns, small mammals were trapped in a Northern hardwood and transitional oak stand and a mid-aged Jack pine barren. *Peromyscus* spp. and Northern short-tailed shrews were the two most common species captured in all

habitat types (Figures 1, 2, 3). Much research suggests that both species are habitat generalists, which explains their predominance in this small mammal survey (Deuser and Shugart 1978, Kitchings and Levy 1981).

The region of a forest closest to the road is a transition area, where microclimate and vegetation change closer to the edge. While some species are ecotone specialists, many species avoid this zone. Although trapping transects began at least 20 m from the road, edge effect can influence small mammal capture at up to 50 m into the forest (Stevens and Husband 1998). In this experiment, because traps located closest to the road continually captured small mammals, it is unlikely that edge effect largely impacted small mammal habitat use.

Peromyscus spp. and *Blarina brevicauda* are both generalists and may experience seasonal competition for resources (Kitchings and Levy 1981). Although *Peromyscus* spp. and *Blarina brevicauda* share dietary overlap, competitive interactions may be alleviated by the arboreal habits of *Peromyscus* spp. (Zegers & Ha 1981, Deuser and Shugart 1978), as well as its herbivorous tendencies (Ahlgren 1966).

The number of captures in the transitional oak stand was substantially lower than in the other two habitat types. While species abundance has been shown to be directly linked to tree masting (Schnurr et al. 2002, Wolff 1996), it is more likely that the low trap effort (n=10) is accountable for the low number of captures.

The masked shrew, *Sorex cinereus*, and red-backed vole, *C. gapperi*, were both trapped in the Northern hardwood stand as well as in the Jack pine barren, although at much lesser frequency than *Peromyscus* spp. and *Blarina brevicauda* (Figures 1, 2). Innes et al. (1990) found a high frequency of *S. cinereus* capture in mid-aged Jack pine stands, as compared to young or old, possibly due to increased cover or insect availability. Further explanation for the presence of this species may be attributed to higher soil moisture content in both sites (Brannon 2002). Shrews commonly prefer sites with high moisture availability due to their high metabolic rate, which results in increased respiratory water loss (Brannon 2002). The red-backed vole characteristically has a high moisture requirement (Kirkland and Griffin 1974, Bowman et al. 2000, Schnurr et al. 2002) and has also shown a preference for coarse woody debris, which is directly associated with moisture retention (Pearce and Venier 2004, Bowman et al. 2000 & 2001). Healy and Brooks showed this species is present in several hardwood stand age classes, indicating its preference is not particular to structure, but for composition (higher moisture content). While Jack pine barrens are typically dry, a wetland adjacent to the site in our experiment may have compensated for the required moisture needs of the red-backed vole and masked shrew.

The woodland jumping mouse, *N. insignis*, was only trapped in the hardwood site. In addition to seeds, this species consumes succulent plant parts that are more common in hardwood sites with deciduous overstory (Ahlgren 1966). Healy and Brooks (1988) found this species in a number of deciduous stand age classes, leaving it preference for its composition, rather than the stands structure. Kirkland and Griffin (1974) found that *N. insignis* avoid coniferous zones, further suggesting preference for deciduous environments. The Eastern chipmunk (*Tamias striatus*) was observed inhabiting the Northern hardwood stand at every trapping period, although they were never captured. The preference for the hardwood stand over the Jack pine barren may be attributed to vegetative structure and complexity of the stand and its available resources, including

nuts (Deuser & Shugart 1978, Kitchings and Levy 1981, Healy & Brooks 1988). Similarly, the Northern flying squirrel, *Glaucomys sabrinis*, was also only captured in the Northern hardwood stand. Hackett and Pagels (2003) found that flying squirrels prefer nesting sites in yellow birch and American beech trees, common in hardwood stands. Flying squirrels were also found to prefer older aged stands. The Jack pine barren in this study was medium aged and the tree height was about 5-10 m, much smaller than the trees in the Northern hardwood stand, perhaps less appealing than the taller deciduous trees. The flying squirrel principally prefers the Northern hardwood stand for both its structure and composition.

The habitat use patterns of individual species is evident between the Northern hardwood stand and Jack pine barren. *Peromyscus* spp. and *Blarina brevicauda* are habitat generalists; they have a high tolerance for their surroundings and are common in a wide range of environments. Other small mammals have particular habitat requirements, from moisture, to nesting sites, and resource abundance. Although the scope of this study was limited, the data obtained is valuable baseline information in future studies of the sandstone pavement barren. Further examination of small mammal abundance and diversity among different habitats will lead to additional insight towards these species' habitat preferences. The sandstone pavement barren is a unique environment as one of only 6 in the world, with a rarity rank of S1 G2 given by the New York Natural Heritage Program. Silvicultural treatments are currently being practiced in the area. If we hope to maximize biodiversity, hardwood stands adjacent to the Jack pine barren should be preserved if possible.

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