

FACTORS INFLUENCING AVIAN HABITAT SELECTION BETWEEN OAK-HICKORY AND MESIC FORESTS IN SOUTHERN ILLINOIS

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ABSTRACT

Introduction

Oak (*Quercus* spp.) regeneration has declined drastically over the past century in eastern deciduous forests predominantly because of decreased disturbance (i.e., fire). Many forests are undergoing mesophication, a positive feedback system that occurs within closed-canopy systems wherein shade-tolerant, late successional, mesic species such as maples (*Acer* spp.) and American beech (*Fagus grandifolia*) outcompete fire-adapted oak. The Central Hardwood region is predicted to be the first major system to convert to climax succession. Numerous neotropical migrant populations have declined in this region. Oaks are a keystone species and provide many resources for forest birds; the ability of mesic species to provide similar resources is untested. To determine whether patches of distinct oak forest and mesic forest provide similar resources, we examined two nonexclusive habitat-selection hypotheses about avian abundance and distribution: (1) habitat heterogeneity and (2) availability and distribution of food resources. We predicted oak-dominated patches would provide greater heterogeneity and more food resources than mesic patches.

Methods

We conducted spring-migration bird surveys April 15-May 15, 2013 and breeding bird surveys May 20-July 15, 2013 in distinct oak-dominated ($n=10$) and mesic-dominated ($n=9$) sites located in the Shawnee National Forest (SNF) in southern Illinois. Sites were ≥ 10 ha in area within upland deciduous habitat ranging in elevation from 130 to 230 m. Sites represented a gradient of relative percentages of oak and hickory (*Carya* spp.) basal area (BA) and mesic tree species BA. When applicable, a mesic site was paired with a proximate (i.e., <500 m away) oak site. We used distance sampling for both point-count transects ($n=3-6$ points/site) and line transects ($n=2$ transects/site). Points were located >250 m apart for independence and >75 m from site boundaries. Surveys were conducted one to two times during spring migration and four times throughout the breeding season. At each point, we collected microhabitat data (e.g., leaf litter depth, stem density, and vertical obstruction) and measured diameter at breast height of all tree species within a 10-factor prism sample to characterize tree composition.

We calculated avian community metrics between site types with the BiodiversityR package. Our measure of abundance was detection rate, which we calculated as the total number of each species detected at a site divided by the total survey time at the site. We included solely individuals detected <75 m from the observer and excluded edge species from our analysis. We examined relationships between individual species abundance rates and explanatory variables during the breeding season with the BiodiversityR package. We calculated density by using the “unmarked” R package and modeled species response with site covariates. We used repeated-measures analysis of variance in PROC.

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MIXED SAS 9.3 (SAS Institute Inc., Cary, NC) to examine differences between abundance and main effects of year and district, and year only, from a 9-year breeding bird survey data set in the SNF.

Results and Discussion

During migration, only species richness was higher in oak sites, whereas Shannon diversity and Jaccard's evenness were slightly higher in mesic sites. Richness, diversity, and evenness were slightly lower in oak than mesic sites during the breeding season. We identified higher mean abundance of all neotropical migrants in oak sites. Transient migrants (e.g., Nashville warbler; see table for scientific names) were present in greater numbers in oak sites. Only the Kentucky warbler displayed a positive relationship with relative percentage of mesic tree species BA, whereas the red-eyed vireo and worm-eating warbler exhibited negative relationships. The worm-eating warbler showed a significant positive relationship with relative percentage of oak-hickory tree species BA. The wood thrush displayed slight selection toward oak sites. We found higher densities (i.e., >20-percent difference) of the red-eyed vireo and Acadian flycatcher in oak sites and higher density of the tufted titmouse in mesic sites. We identified significant 9-year declines for five forest-breeding migrants in the SNF: hooded warbler, Kentucky warbler, Louisiana waterthrush, scarlet tanager, and worm-eating warbler. The cerulean warbler and many common species also declined.

Conclusions

Multiple migratory songbirds of the Central Hardwood region are experiencing rapid decline. Oak-hickory forests may offer additional resources for avifauna. The worm-eating warbler requires dense leaf litter for nest concealment, and leaf litter is deeper in oak stands than in maple stands. Furthermore, oak and hickory species yield high densities of Lepidoptera whereas maples and American beech contain low densities. Likewise, foraging efficiency of migrant birds is higher in oaks than in maples. Our preliminary results are consistent with these findings. We will sample for Lepidoptera in spring 2014 to examine our food availability hypothesis and will continue our surveys to increase statistical power. It is vital to understand factors influencing avian habitat selection between oak and mesic forests to guide management towards the conservation of many bird species.

Appendix A.—Scientific names of forest-breeding birds mentioned in text

Common name	Scientific name
Acadian flycatcher	<i>Empidonax vireescens</i>
Cerulean warbler	<i>Dendroica cerulea</i>
Hooded warbler	<i>Wilsonia citrina</i>
Kentucky warbler	<i>Oporornis formosus</i>
Louisiana waterthrush	<i>Parkesia motacilla</i>
Nashville warbler	<i>Vermivora ruficapilla</i>
Red-eyed vireo	<i>Vireo olivaceus</i>
Scarlet tanager	<i>Piranga olivacea</i>
Tufted titmouse	<i>Baeolophus bicolor</i>
Wood thrush	<i>Hylocichla mustelina</i>
Worm-eating warbler	<i>Helminthos vermivorus</i>

The content of this paper reflects the views of the authors(s), who are responsible for the facts and accuracy of the information presented herein.