USE OF TREE SPECIES BY SUMMER BIRDS IN OZARK UPLAND OAK-HICKORY FOREST

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Abstract—Impacts of oak-boring beetles in the Ozark region could produce major changes in forest communities of northwestern Arkansas resulting in loss of oaks replaced by other tree species. Because the extensive Ozark forests are a major source of surplus birds, alterations of forest structure producing changes in foraging opportunities for birds could have serious consequences. This study compared tree species usage while foraging in summer by year-round resident and summer resident migratory forest bird species. Extent of usage was compared to relative abundance of different tree species at each of six study sites. The results show that oak species were used by forest birds in greater proportion than their abundance at the sites.

INTRODUCTION

When European settlers arrived, much of northwestern Arkansas was in oak-hickory forest, and many regions are still heavily wooded in this manner (James and Neal 1985). These extensive forests of the Ozarks in northwestern Arkansas are believed to be population sources for several species of birds (Robinson and others 1995). There is much concern in recent decades about population declines in forest breeding intercontinental migratory birds in many regions of eastern North America (Martin and Finch 1995, Sauer and Droege 1992, Sauer and others 1999). Due to these declines population sources are important in helping to maintain population numbers elsewhere (Pulliam 1988). In recent years the red oak borer, *Enaphalodes rufulus* (Haldane), has had considerable impact on oak trees, devastating large areas (Spencer 2001). The loss of these trees may have a negative impact on populations of bird species, some of which are already stressed by other factors.

The present study was designed to investigate the importance of oaks in summer foraging by species of both year-round resident and summer resident migratory bird species in closed canopy oak-hickory forests that were not infested with the oak borer. Relative abundance of different tree species was used to determine whether oaks are used in greater or lesser proportion than their abundance by various bird species and in what proportion are other tree species used compared to their abundance and compared to oaks.

SITES

Six sites, all in northwestern Arkansas, were used in this study. All were closed canopy oak-hickory forests in different stages of development with varying amounts of undergrowth. Tree composition differed between sites. The following sites were located in Washington County: (1) Mount Sequoyah in Fayetteville, Section 15, Township 16N, Range 29W; (2) Lake Fayetteville area, Section 19, Township 17N, Range 29W; (3) Wilson Lake area, southeast of Fayetteville, Section 2, Township 15N, Range 30W; and (4) Devil's Den, near West Fork, Section 26, Township 13N, Range 31W. The remaining sites are Hobbs State Management Area at Beaver Lake near War Eagle in Benton County, Section 36, Township 19N, Range 29W; and Withrow Springs near Forum in Madison County, Section 10, Township 17N, Range 26W.

METHODS

During the months of May, June, and July 2002 foraging behavior was studied in birds occupying oak-hickory forests in areas appearing unaffected by the oak borer. Two investigators walking together found foraging birds as they were encountered. One identified the birds and the tree species they occupied, the other recorded the information. A bird was considered to use a tree if it was either seen or heard in the tree. Data was recorded sequentially (Robinson and Holmes 1982). No more than three sequential observations of the same bird in the same tree were made. Both year-round resident and intercontinental migratory species were investigated. The number of bird observations per study area were approximately the same, but did differ somewhat.

Relative abundance of different species of trees in the study areas was determined by establishing two perpendicular transects transversing each of the study areas. There were two investigators. One identified the species of each tree having a diameter at breast height (d.b.h.) greater than 7.5 cm that occurred within a meter each side of the transect line, the other recorded this information.

RESULTS AND DISCUSSION

Tree Species Composition

To summarize forest composition, oak species (*Quercus*) made up about 25 percent or more of the trees at Wilson Lake, the Hobbs State Management Area, and Withrow Springs, nearly 20 percent at Mount Sequoyah and Lake Fayetteville, and slightly more than 10 percent at Devil's Den. Hickory species (*Carya*) made up approximately 20 percent of the trees at Wilson Lake and the Hobbs State Management Area, somewhat less at Mount Sequoyah, between 5 and 10 percent at Lake Fayetteville and less than 5 percent at Devil's Den and Withrow Springs. Elm species (*Ulmus*) made up over 30 percent of the trees at

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Mount Sequoyah, over 20 percent at Wilson Lake, between 5 and 10 percent at Lake Fayetteville, Devil's Den and the Hobbs State Management Area, and < 2 percent at Withrow Springs. The proportion of black gum, *Nyssa sylvatica* Marsh, was around 20 percent at Withrow Springs, somewhat less at Devil's Den, around 5 percent at the Hobbs State Management Area, and low or not found at the three other sites. The proportion of flowering dogwood, *Cornus floridana* Linnaeus, was > 25 percent of the trees at Devil's Den, nearly 20 percent at Lake Fayetteville and Withrow Springs, over 10 percent at the Hobbs State Management Area, and < 5 percent at Mount Sequoyah and Wilson Lake. Snags made up >10 percent but <20 percent of trees at all sites. Other tree species were present in smaller numbers.

Birds Found

To provide a summary of bird species involved, Tufted Titmice, *Baeolophus bicolor* (Linnaeus), were observed relatively frequently at all sites, with the most observations at Mount Sequoyah and Withrow Springs. Carolina Chickadees, *Poecile carolinensis* (Audubon), were observed frequently at Mount Sequoyah and Lake Fayetteville, less at Wilson Lake and Withrow Springs, and least often at Devil's Den and Hobbs State Management Area. White-breasted Nuthatches, *Sitta carolinensis* Latham, were observed with moderately high frequency at Withrow Springs and moderately low frequency at the other sites. Downy Woodpeckers, *Picoides pubescens* (Linnaeus), were observed with moderately high frequency at Mount Sequoyah and moderately low frequency at the other sites. The Red-bellied Woodpecker, *Melanerpes carolinus* (Linnaeus), was observed at moderate frequency at Hobbs State Management Area and at low frequency elsewhere. Blue Jays, *Cyanocitta cristata* (Linnaeus), were observed at moderate frequency at Devil's Den and at low frequency elsewhere. Of the summer resident migratory birds, Red-eyed Vireos, *Vireo olivaceus* (Linnaeus), were observed often at Wilson Lake and Hobbs State Management Area, somewhat less at Withrow Springs, less at Devil's Den, and at moderately low frequency at Mount Sequoyah and Lake Fayetteville. Blue-gray Gnatcatchers, *Polioptila caerulea* (Linnaeus), were observed very often at Wilson Lake, moderately often at Hobbs State Management Area and Devil's Den, less often at Lake Fayetteville and infrequently at Mount Sequoyah. Black-and-white Warblers, *Mniotilta varia* (Linnaeus), were observed rather often at Devil's Den, less at Lake Fayetteville, and rather infrequently at other sites. Twelve other species of birds were not abundant at the study sites but were included as part of the foraging data.

Trees used by birds

The focus of this study was use of tree species by foraging birds, not foraging differences between bird species, so all birds were combined in evaluation of bird use of various tree species, especially oak species compared to non-oaks. Bird observations were to some extent dependent. This problem was overcome by combining all bird species into a single data set totaling more than one thousand observations. At every site oaks were used in greater proportion than their abundance at the site and other tree species were used less than their abundance.

Table 1—Usage of oaks by birds compared to other tree species, whether used more or less frequently than tree species abundances in the forest

Taxa	Species events	Number used more	Number used less
Combined data less low frequencies			
Oaks	6	5	1
Non-oaks	24	5	19
Accumulated data less low frequencies			
Oaks	20	18	2
Non-oaks	59	23	36
Accumulated data including low frequencies			
Oaks	28	23	5
Non-oaks	110	35	75

The findings can be analyzed in three different ways (table 1). Firstly, data from all six study areas can be combined omitting the very low tree and usage frequencies. This produces the results in the top part of table 1. To elaborate, there were six species of oaks of which five were used by birds more frequently than their forest abundances, only one oak used less. There were 24 species of non-oaks and 19 were used less than their abundance in the forest, 5 were used more than their frequency. Chi-square analysis of this pattern (two-by-two contingency table) showed that the oaks were frequented by birds significantly more often than non-oaks relative to their respective frequencies in the forest (Chi-square = 8.44, 1 d.f., $p<0.01$, 2-tailed test).

Rather than combining across all study sites, the separate information of each site can be used and accumulated across all sites. Thus the information on relative tree species usage by birds can be inspected at one site, and the same usage of the same tree species at other sites can be added to that data, repeating and accumulating with the same tree species at each site. If the low frequencies of tree abundance and avian foraging usage are omitted, this produces the data in the middle of table 1. Thus, repeat species of oaks across all study sites totaled 20 species events, of which 18 were used more than expected, only 2 less than their frequency in the forest. The same information for non-oaks shows 59 species events of which 36 were used less than their proportion in the forest, 23 used by birds more than expected. Chi-square analysis of this pattern (two-by-two contingency table) showed that birds used oaks significantly more than their abundance in the forest, non-oaks significantly less (Chi-square = 17.15, 1 d.f., $p<0.001$, two-tailed test).

The same approach using information from each site accumulated across each site separately can include the low frequencies of tree presence and bird usage. These results are in the bottom part of table 1. Chi-square analysis of

these columns support the previous results (Chi-square = 20.41, 1 d.f. $p<0.001$, 2-tailed test).

The study will be continued in upcoming years to confirm these preliminary findings and to obtain enough data to determine which birds rely most on oaks and to see which other tree species might also be preferred. This study raises serious cause for concern that indeed at least some of these forest birds will be negatively affected if oak species are devastated as predicted. It would also be valuable to study foraging behavior in forests already impacted by the oak borer to see which bird species are present and whether or not their foraging behavior has been modified in the presence of oak loss.

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