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BIRD DIVERSITY AND ABUNDANCE IN THREE PLANT COMMUNITIES IN PUTNAM COUNTY, FLORIDA

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Geographically isolated communities exhibit distinct differences in the composition and diversity of breeding bird species (Abbot 1980). Species composition and diversity can be used to characterize the structure of avian communities (Curtis 1978), including correlates of the successional state of a given area. On a local scale, such community parameters are useful in demonstrating small-scale variation within an ecosystem and the niches that are available to resident birds. The purpose of this study was to differentiate bird populations for three distinct habitat types in the Welaka Center for Education and Research, through the determination of species composition, diversity, and feeding guilds.

METHODS

The Welaka Reserve is located on the east bank of the St. Johns River in southeastern Putnam County, Florida. Birds were censused on 16-17 May 1980 in three plant communities on the 918 ha Reserve. A variation of Emlen's (1977) transect method was used to determine bird density. Within each

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TABLE 1. Bird species found in three habitats and their guild membership.*

Flatwoods Habitat	Guild	Sandhill Habitat	Guild	Hammock Habitat	Guild
Ground Dove (*Columbina passerina*)	3,2,3	Red-headed Woodpecker (*Melanerpes erythrocephalus*)	2,1,1	Osprey (*Pandion haliaetus*)	—
Red-bellied Woodpecker (*Centurus carolinus*)	2,1,1	Red-bellied Woodpecker	2,1,1	Pileated Woodpecker (*Dryocopus pileatus*)	2,1,1
Fish Crow (*Corvus ossifragus*)	3,2,3	Great Crested Flycatcher (*Myiarchus crinitus*)	2,5,5	Red-bellied Woodpecker	2,5,5
Carolina Wren (*Thryothorus ludovicianus*)	2,3,4	Blue Jay (*Cyanocitta cristata*)	3,3,4	Great Crested Flycatcher	2,5,5
Cardinal (*Cardinalis cardinalis*)	3,3,4	Tufted Titmouse (*Parus bicolor*)	2,4,2	Tufted Titmouse	2,4,2
Rufous-sided Towhee (*Pipilo erythropthalmus*)	3,2,3	Brown Thrasher (*Toxostoma rufum*)	3,2,3	Parula Warbler (*Parula americana*)	2,4,5
		Pine Warbler (*Dendroica pinus*)	2,4,4	Unidentified Warbler	2,5,4

*Guilds were characterized following Willson (1974) as: A: primary food habits (1) seedeater, (2) insectivore, or (3) omnivore; B: stratum most commonly used for foraging (1) bark, (2) ground, (3) low, (4) middle, or (5) high canopy; C: usual foraging behavior (1) bark drill, (2) bark glean, (3) ground glean, (4) foliage glean, (5) sally. Each species was labeled with a 3-digit number representing its guild; thus a Great Crested Flycatcher is in guild 2,5,5—meaning that it was considered to be an insectivore, a user of the high canopy level, and a sallyer.

community two 300 m by 40 m transects were run before noon each day. All bird identifications were made by the same observer and recorded by a second observer. In addition, all birds that could be identified outside the transects were identified to species and their frequency of occurrence tallied. Only birds within the transect were used for density determination, while all birds were used in calculating diversity (H′), evenness (J′), and relative abundance. The Shannon-Wiener diversity index and evenness component were used as described by Tramer (1969) using the natural log base. Birds were categorized according to feeding habits using Willson's (1974) feeding guild format.

Transects were located in a longleaf pine—turkey oak sandhill, a longleaf pine flatwoods, and an oak—cabbage palm hammock. Sandhill vegetation consisted primarily of longleaf pine (*Pinus palustris*), turkey oak (*Quercus laevis*), and wire grass (*Aristida stricta*). Dominant plant species in the flatwoods were saw palmetto (*Serenoa repens*) and gallberry (*Ilex glabra*). Laurel oak (*Q. laurifolia*), live oak (*Q. virginiana*), and water oak (*Q. nigra*) were co-dominants with cabbage palm (*Sabal palmetto*) in the hammock. These habitats were described in detail by Laessle (1942), Veno (1976), and Schultz (1979). Scientific names of birds mentioned are given in Table 1.

Results

Fifteen species of birds (Table 1) were identified in the three habitats. Number of species per habitat was about the same (Table 1). Density was highest in the sandhill and least in the flatwoods (Table 2). Diversity was greatest in the hammock followed by the Sandhill and flatwoods.

Table 2. Comparison of bird community variables.

Community Variable	Sandhill	Flatwoods	Hammock
Density (number/ha)	6.70	1.25	4.15
Diversity (H′)*	2.59	2.20	2.64
Evenness (J′)**	0.92	0.95	0.88
Number of Species (s)	7	6	7

$*H' = -\sum_{i=1}^{s} P_i \log P_i$, where P = proportion of total.

$**J' = H'/H_{max}$

DISCUSSION

MacArthur and MacArthur (1961) demonstrated that increasing bird species diversity can be positively correlated with increasing foliage height diversity. It should be emphasized that diversity estimates were calculated for each community using on- and off-transect data. This was done in an effort to maximize the utility of all observations while recognizing that unavoidable biases may be introduced. The bias most affecting this analysis was declining detectability with increasing distance from the transect for some species. Preliminary tests indicated that 40m was an adequate transect width for all habitats. Outside of this width, however, detectability appeared to drop off more quickly in the hammock than in the sandhill or flatwoods. Therefore, estimates of hammock diversity may be much more conservative than the other communities. Despite this, our value of hammock bird diversity was the highest of the habitats studied.

We speculate that our measure of diversity was related to stratification of vegetation throughout the vertical profile as formalized by MacArthur and MacArthur (1961). Based on our qualitative assessment of foliage height diversity that was supported by descriptions in Veno (1976), bird species diversity appeared to parallel foliage height diversity in the three communities studied. Densities did not follow the same pattern. The highest density occurred in the sandhill. Cavity nesters dominated the species present in the sandhill (four of seven) and hammock (four of seven). Their presence may help to explain higher densities there. Since more cavity-prone hardwood plant species occurred in these areas, cavity nesters would be more abundant there. We observed several cavities in cabbage palm, turkey oak, laurel oak, and southern magnolia *(Magnolia grandiflora)*, species not found in the flatwoods.

Guild grouping indicated distinct differences in feeding habits among birds in the three communities (Table 1). All bird species (except the Osprey, which should not be considered a true community member) occurring in the hammock were insectivores; five out of seven were insectivores in the sandhill (two were omnivores); and two of six species in the flatwoods were insectivores (four were omnivores). Possibly, containing more deciduous trees and hence a more palatable plant biomass, the hammock supported a larger insect community. Omnivory would be an advantage in a resource limited environment such as the flatwoods or sandhill communities, where most green plant biomass occurs as evergreen leaves or needles, which may be more resistant to insect herbivory.

Nelson (1952) determined the species composition for the various habitats of the Welaka Reserve. Our lists were similar to Nelson's but were lacking in a few characteristic species. We feel that the short duration of the study prevented a complete censusing of the areas studied but allowed collection of enough data to reflect true differences among the communities studied. This paper should not be viewed as a conclusive study but one that attempts to explain certain community differences, recognizing the possible effects of inherent biases, based on a minimum of data.

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