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THE INFLUENCE OF FOREST SIZE ON TRANSIENT AND RESIDENT BIRD SPECIES OCCUPYING MARITIME HAMMOCKS OF NORTHEASTERN FLORIDA

JAMES COX

Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program, 620 South Meridian Street, Tallahassee, Florida 32399-1600

Abstract.—Nineteen point counts were established in both large and small tracts of maritime hammocks (a total of 38 counts) in northeastern Florida. The occurrence of migratory, resident, and over-wintering species at census stations was analyzed to detect differences in the use of large or small hammocks during April 1987. Species richness was greater in large hammocks, and several species showed a preference of either large or small hammocks. Species favoring large areas were Black-and-white Warbler (*Mniotilta varia*), Ovenbird (*Seiurus aurocapillus*), Northern Parula (*Parula americana*), and Summer Tanager (*Piranga rubra*). Species favoring small areas were Mourning Dove (*Zenaida macroura*), Fish Crow (*Corvus ossifragus*), and Brown-headed Cowbird (*Molothrus ater*). Several species that prefer large forested areas during the breeding season also appear to prefer large forested areas during migration. In particular, large patches of maritime hammocks appear to be important to several species of migratory warblers that do not breed in Florida.

Forest size has been shown to influence characteristics of avian communities during the breeding season in a number of situations (Formann et al. 1976, Gates and Gysel 1978, Whitcomb et al. 1981, Kroodsma 1984, Harris and Wallace 1984, Lynch and Whigham 1984). Studies of the influence that forest size exerts on avian communities during other portions of avian life cycles also have reported that significant changes in species composition occur (Willson and Carothers 1979, Martin 1980, Terborgh 1980), but considerably less research of this type has been conducted. Considering that some birds spend as little as 25% of their annual life cycles occupying breeding habitats (Hussel 1981), the influence of forest size on other portions of avian life cycles may be particularly important to avian population dynamics and general conservation planning.

In this paper I report the results of an inventory of resident and transient birds found in patches of maritime hammocks of differing size

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in northeastern Florida. Maritime hammocks represent a narrowly distributed plant association (Laessle and Monk 1961) that often contains a diverse assemblage of migratory species (Lane 1981, Hillestad et al. 1975), but maritime hammocks may contain fewer breeding species than comparable habitats farther removed from the coast (Kale and Webber 1969a,b). It is not well known how the number of transient or resident breeding species may change in response to changes in the amount of area covered by this plant association.

Large tracts of hammock are being fragmented and transformed by urbanization at a rapid rate in northeastern Florida, and a concern has developed that this process may have a deleterious effect on transient and resident bird species (M. Allen, pers. comm.). This study was initiated primarily to determine whether this concern is valid and to help identify species that might be influenced by habitat alterations. This study was not designed to address questions concerning species-area relationships or minimum reserve size for maritime hammocks. Much more elaborate research is needed to provide answers to these questions.

On a few of the larger urban developments that have occurred in recent years, small, remnant tracts of maritime hammock have been protected. Small, vacant woodlots also contain characteristic hammock vegetation in residential areas that were developed many years ago. Several large tracts of hammock also have been protected through public and private conservation efforts. These differing sized parcels provide an opportunity to assess the influence that increasing deforestation might have on transient and resident bird species of the area.

Methods

Sampling was conducted during a period of generally heavy migration (Lane 1981) from 10 to 27 April 1987. Point counts (Blondel et al. 1981) were established in 19 small and 4 large tracts (19 counts in each type) of maritime hammocks on Amelia, Big and Little Talbot, and Ft. George Islands in Nassau and Duval counties. Hammocks were classified as "small" if they were <5 ha and were surrounded by urban development. Large hammocks were >20 ha and located on state-owned properties or as yet undeveloped private properties.

During the sampling period, many migratory species that breed in the area have not established territories or initiated nesting, while many over-wintering species also are present (Sprunt 1954). Species were classified as "year-round residents," "winter residents," "transients," and "migratory breeders" to distinguish among different levels of permanence (Table 1).

Point samples were taken from 06:00 to 10:00 hr and from 17:00 to 20:30 hr, and evening and morning sampling times were distributed equally between large and small tracts. Only species obviously making use of the available habitat were counted. Sample points were separated by a minimum of 1.2 km from nearby points to generate a certain level of independence (similar to the distance separating sample points in breeding bird surveys [Bystrak 1979]). A 10-minute sampling period was made at each point count, and the

recorded song of a screech owl (*Otus asio*) was played for the duration of each sampling using a tape recorder set at an invariant volume. The recording helped to attract secretive species.

A *t*-test (Brown and Hollander 1977) of the number of species recorded at sample stations was used to compare species richness on small versus large tracts. The abundance of bird species detected at stations was not used in my analyses because of difficulties in accurately estimating this parameter using these techniques. I attempted initially to estimate abundance, but there were several instances where I felt I was counting a single individual more than once.

Differences in the frequency of occurrence at point counts in small versus large tracts also were computed for each species as a coarse index of the species' relative sensitivity to forest size. For example, if a species was detected at five census points in large hammocks and only three census points in small hammocks, the difference in frequency would be two for that species. The mean difference in the frequency of occurrence at point counts for all species was 0.45 with a standard deviation of ± 2.67. Thus, most species (approximately 68%) recorded in both large and small tracts showed differences in the range of from –2.22 to +3.02. Species with a difference ≥4 in absolute value were considered to show a preference for the size of hammock patches.

The general habitat preferences of many of the species observed here were presented by Whitcomb et al. (1981) using a coarse forest-interior to forest-edge gradient. The categorizations developed by Whitcomb et al. (1981) were "interior" species (those requiring large, unfragmented forests), "interior-edge" species (those common along forest edges and in smaller forest fragments), and "field-edge" species (those common along edges or in unforested areas). I did not categorize species not studied by Whitcomb et al. (1981). A cross-tabulation of the status (year-round resident, winter resident, etc.) of different species in maritime hammocks by habitat preference along this interior-to-edge gradient was compiled to detect patterns among species with similar life-history traits.

RESULTS

A total of 65 species was observed at all stops, but 11 of these were not considered to be using the habitat (e.g., Laughing Gull, *Larus atricilla*) (Table 1). The mean number of species detected at stops in large hammocks was 11.6 species (s.d.=2.67) per station, whereas the mean number detected in small hammocks was 8.8 species (s.d.=2.73) per station. This difference is significant (t=3.12, $P \leq 0.05$) and indicates that larger areas support more species than smaller areas.

Thirteen species were detected only in large hammocks (Table 1), while eight species were detected only in small areas. Most of the species detected in one or the other habitat types were seen too infrequently to allow interpretation, but a few species showed a preference for either large or small hammock patches using the index described above (Table 1). Species exhibiting a preference for large hammocks were Northern Parula (*Parula americana*), Black-and-white Warbler (*Mniotilta varia*), Ovenbird (*Seiurus aurocapillus*), and Summer Tanager (*Piranga rubra*). Species exhibiting a preference for small areas were Mourning Dove

Table 1. Frequency of occurrence of different species found in maritime hammocks of northeastern Florida.

Species	Large areas	Small areas	Interior/edge preference[1]	Status[2]
Wood Duck *Aix sponsa*	0	1	N	R
Red-shouldered Hawk *Buteo lineatus*	1	0	N	R
Red-tailed Hawk *Buteo jamaicensis*	0	1	N	R
Mourning Dove[3] *Zenaida macroura*	1	5	FE	R
Common Ground Dove *Columbia passerina*	0	1	N	R
Yellow-billed Cuckoo *Coccyzus americanus*	4	2	IE	MB
Eastern Screech Owl *Otus asio*	2	1	N	R
Common Nighthawk *Chordeiles minor*	1	1	N	MB
Chimney Swift *Chaetura pelagica*	2	2	N	MB
Ruby-throated Hummingbird *Archilochus colubris*	1	0	IE	MB
Red-bellied Woodpecker *Melanerpes carolinus*	10	8	IE	R
Downy Woodpecker *Picoides pubescens*	3	0	IE	R
Pileated Woodpecker *Dryocopus pileatus*	5	2	I	R
Great Crested Flycatcher *Myiarchus crinitus*	6	7	IE	MB
Eastern Kingbird *Tyrannus tyrannus*	1	2	FE	MB
Blue Jay *Cyanocitta cristata*	4	5	IE	R
Fish Crow *Corvus ossifragus*	0	6	N	R
Carolina Chickadee *Parus carolinensis*	6	4	IE	R
Tufted Titmouse *Parus bicolor*	7	4	IE	R

Table 1 (continued).

Species	Large areas	Small areas	Interior/edge preference[1]	Status[2]
Carolina Wren *Thryothorus ludovicianus*	15	15	IE	R
House Wren *Triglodytes aedon*	0	1	FE	WR
Ruby-crowned Kinglet *Regulus calendula*	2	3	N	WR
Blue-gray Gnatcatcher *Polioptila caerulea*	12	11	IE	R
Wood Thrush *Hyocichla mustelina*	1	0	I	MB
Gray Catbird *Dumetella carolinensis*	1	2	IE	WR
Cedar Waxwing *Bombycilla cedrorum*	1	1	N	WR
White-eyed Vireo *Vireo griseus*	7	9	IE	R
Solitary Vireo *Vireo solitarius*	1	0	N	WR
Red-eyed Vireo *Vireo olivaceus*	12	11	IE	MB
Northern Parula[3] *Parula americana*	16	12	IE	MB
Cape May Warbler *Dendroica tigrina*	1	0	N	T
Black-throated Blue Warbler *Dendroica caerulescens*	3	0	N	T
Yellow-rumped Warbler *Dendroica coronata*	6	5	N	WR
Pine Warbler *Dendroica pinus*	1	0	I	R
Prairie Warbler *Dendroica discolor*	4	6	FE	MB
Palm Warbler *Dendroica palmarum*	0	1	N	WR
Black-and-white Warbler[3] *Mniotilta varia*	11	0	I	T
American Redstart *Setophaga ruticilla*	2	1	I	T

Table 1 (continued).

Species	Large areas	Small areas	Interior/edge preference[1]	Status[2]
Worm-eating Warbler *Helmitheros vermivorus*	3	0	I	T
Ovenbird[3] *Seiurus aurocapillus*	5	0	I	T
Kentucky Warbler *Oporonis formosus*	1	0	I	MB
Common Yellowthroat *Geothlypis trichas*	2	4	IE	R
Hooded Warbler *Wilsonia citrina*	1	1	I	MB
Summer Tanager[3] *Piranga rubra*	12	7	N	MB
Scarlet Tanager *Piranga olivacea*	0	1	I	T
Northern Cardinal *Cardinalis cardinalis*	18	17	IE	R
Indigo Bunting *Passerina cyanea*	3	3	FE	MB
Painted Bunting *Passerina ciris*	4	1	N	MB
Rufous-sided Towhee *Pipilo erythrophthalmus*	0	3	FE	R
Red-winged Blackbird *Agelaius phoeniceus*	2	0	N	R
Common Grackle *Quiscalus quiscula*	2	1	IE	R
Brown-headed Cowbird[3] *Molothrus ater*	2	6	FE	R
Orchard Oriole *Icterus spurius*	0	1	FE	MB
American Goldfinch *Carduelis tristis*	2	3	FE	WR

[1]Edge/interior preferences are: "N" none, "FE" field-edge, "IE" interior-edge, and "I" interior.

[2]Status is either "R" year-round resident, "MB" migratory breeder, "T" transient, or "WR" winter resident.

[3]Species with an absolute difference in detection frequency ≥ 4, which indicates a preference for one of the area conditions.

(*Zenaida macroura*), Fish Crow (*Corvus ossifragus*), and Brown-headed Cowbird (*Molothrus ater*) (Table 1).

A cross-tabulation of all species' preferences for edge-to-interior habitats by their relative permanence in hammocks (Table 2) revealed two patterns: (1) year-round resident species classified as field-edge species by Whitcomb et al. (1981) were more commonly detected in small hammocks; and (2) transient species classified as interior species by Whitcomb et al. (1981) were more commonly seen in large hammocks.

DISCUSSION

Perhaps the most interesting result of this study is the preference shown by several transient species for large patches of maritime hammock. Transient species encounter and use a wide variety of habitat types (Martin 1980) and thus might not be expected to exhibit strong habitat preferences during migration. The majority of transient species found only in large patches of maritime hammock were migratory warblers (Table 1) that also require large forested patches on their breeding grounds farther north (Whitcomb et al. 1981). Whitcomb et al. (1981) found that the Black-and-white Warbler, Worm-eating Warbler (*Helmitheros vermivorus*), and Ovenbird were rare breeding species in small forested patches, and none of these migratory species was detected in the small tracts of maritime hammock I studied. Whitcomb et al. (1981) described these species as being "area-sensitive" because of their preferences for large forested tracts. Though transient area-sensitive species probably occur in small patches of hammocks in northeastern Florida, larger patches appear to be important to annual migration cycles and contain many more individuals. At some sample points in large hammocks, for example, I estimated an abundance of as many as 5-6 Black-and-white Warblers.

Differences in habitat preference exhibited by transient species may have implications for broad-scale population dynamics in some of these species. Svensson (1978) found that indices of abundance taken during migration in Sweden correlated with independently derived population estimates obtained from later breeding bird censuses. If similar correlations exist for species that seek out large forested areas during migration, reductions in preferred migratory habitat may exert an influence on population size. Terborgh (1980) warns that, because many migratory species concentrate outside of breeding habitats, the alteration of non-breeding habitat may have a greater impact on population numbers than alteration of breeding habitat. This may be particularly true during stressful migratory periods.

Table 2. Cross tabulation of frequency of occurrence of species with similar life-history traits and similar tolerances of habitat fragmentation (as measured along an "edge -to-interior" gradient).

Total frequency	Large hammocks	Small hammocks
Residents		
Interior species	6	2
Interior-edge species	79	81
Field-edge species	5	17
Transients		
Interior species	21	2
Winter residents		
Interior-edge species	1	2
Field-edge species	2	4
Migratory breeders		
Interior	3	1
Interior-edge species	40	32
Field-edge species	8	12

Only a few of the area-sensitive species studied by Whitcomb et al. (1981) breed in Florida (O'Meara 1984), so differences in the frequencies of area-sensitive breeding species (both resident and migratory) found in large and small areas might not be expected. Resident, field-edge species showed a preference for small patches, but little preference was shown for large hammocks by locally breeding, forest-interior species (Table 2). One of the resident field-edge species preferring smaller patches was the Brown-headed Cowbird, a nest parasite that may reduce the breeding success of some area-sensitive species (Gates and Gysel 1978). The Fish Crow, a potential nest predator (Sprunt 1954), also was more common on small tracts.

The density and number of breeding species associated with coastal hammocks in Florida may be less than the density and number found in similar habitats located further inland (Kale and Webber 1969a,b). However, 220+ migratory species may occur in the maritime hammocks found on Cumberland Island, Georgia (Hillestad et al. 1975), and Chamberlain (1982) suggested that coastal forests in South Carolina have the highest numbers of birds during winter. Thus, while the composition of breeding bird communities may be altered by reducing the acreage of maritime hammocks, of greater significance may be changes in the number and diversity of migratory and over-wintering species that might result as formerly contiguous maritime hammocks are increasingly fragmented.

In an unpublished study of bird use of maritime hammocks in this same general area (Environmental Science and Engineering 1984),

Worm-eating and Black-and-white warblers were found in an urbanized area not sampled in this study. The natural vegetation structure of maritime hammocks was incorporated in this development. There also were fairly large patches of maritime hammocks preserved and interspersed throughout the development (M. Allen, pers. comm.). I believe that the maintenance of native vegetation, in combination with large habitat protection areas, will benefit species that otherwise might be negatively affected by reductions in the coverage of maritime hammocks in the region. Considering the linear, north-south orientation of maritime hammocks along the coast of northeastern Florida, it might also be important to distribute several large protection areas across the limited distribution of this habitat type to serve as stepping stones for migratory species moving along a general north-south axis.

Additional studies are needed to determine more precisely the relationship between the acreage of hammocks and species richness throughout the year in this region of Florida. It also is not known how transient species may make use of other vegetation types not sampled here, natural or unnatural. However, these results indicate that large tracts of maritime hammocks may be very important during brief periods of the year when thousands of migrants pass through the area.

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