Breeding Birds of Carolina Bays: Succession-related Density and Diversification on Ecological Islands

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Information concerning the animal life of Carolina bays or of the plant communities they typically support in the Southeastern coastal plain is minimal (Sharitz and Gibbons 1983, Wilber 1981). Frey (1951), Bailey and Frey (1958), and Louder (1962) studied the fishes of the major Carolina bay lakes, and Lindquist (e.g. Lindquist et al. 1981) has provided intense follow-up studies on many bay-lake fishes. Fuller (1977) reported on the freshwater molluscs of Lake Waccamaw, and Sharitz and Gibbons (1982), in a review of what is known of the animal life of bays, presented some original information on herpetofauna. Recently Clark et al. (1985) reported on the mammal fauna of pocosins and Carolina bays of eastern North Carolina.

Published information on the bird life of Carolina bays, however, was essentially limited to only two brief reports on aquatic species associated with water-filled bays by Norris (1957) and Post (1969), who conducted studies of individual Carolina bays near Williston, Barnwell County, S.C. Additionally, Clark and Potter (1982) presented a profile of the breeding birds of six plant communities on the North Carolina Biological Survey study site near McCain, Hoke County, N.C. One of these Hoke County communities is a high-shrub pocosin formed in a 5-acre Carolina bay, from which they reported 21 species of nesting birds. All three of these bird studies were overlooked in recent summaries of Carolina bay fauna. Lee (1986) provided an overview of the bird life of North Carolina pocosins and associated plant communities, including some study sites in Carolina bays. With these exceptions, information on the resident bird life of Carolina bays is limited to scattered reports of sightings of locally unusual birds (e.g. Crutchfield and Whitfield 1987). The present study will characterize the breeding-bird fauna for Carolina bays in southeastern North Carolina with the emphasis on terrestrial species.

CHARACTERIZATION OF CAROLINA BAYS

The term "bay" is confusing in that it refers to a number of successional stages of Southeastern wetlands that support several species of bay trees (Sweet Bay, *Magnolia virginiana*; Red Bay, *Persea borbonia*; and Loblolly Bay, *Gordonia lasianthus*), while the term "Carolina bay," partly named for the presence of these bay trees, refers to elliptical depressions that often support various plant communities, including pocosins and bay forests. Carolina bays are permanent geological features and are often specifically named sites (e.g. Jerome Bay, Bladen County, N.C.), whereas bay forests are successional stages of wetlands. Unlike most other wetlands in the Southeast, Carolina bays often lie within xeric and mesophytic systems. Their islandlike nature usually makes them visually delineated and ecologically discrete (Fig. 1 and 2). The wide spectrum of successional stages found

within the bays, combined with their close proximity to each other, makes them excellent study sites (Clark et al. 1986). In my principal study areas in Bladen County, the bays are highly concentrated, and here successional stages probably achieve their greatest diversity.

The first description of Carolina bays was made by John Lawson (1709) in the early 1700s. His descriptions of plant communities near the Santee River in South Carolina were of bay vegetation, and it is believed that in his travels he crossed Cantey Bay, a site now flooded by Lake Marion. In July of 1765, while visiting his brother's home on the Cape Fear River in Bladen County, N.C., John Bartram entered in his journal notes about visits to two bay lakes now believed to have been White Lake and Singletary Lake. A few days later, accompanied by his son William, he visited Lake Waccamaw (Harper 1942, Savage 1970), a bay lake in Columbus County, N.C.

The peculiar elliptical nature of Carolina bays went unnoticed, however, until 1847, when Michael Tuomey, the state geologist of South Carolina, described numerous circular depressions in the Barnwell District (Tuomey 1848). He commented on the possible origin of these bays. In 1895 Learidas E. Glenn, superintendent of schools at Darlington, S.C., wrote of Carolina bays and noted many characteristics each bay had in common (Glenn 1895). Later students of geology, most of whom were unaware of these earlier works or chose to ignore them, published articles on the mystery of the origin of Carolina bays. Of these Smith (1931) wrote the most comprehensive treatment.

In 1930, in order to assist in evaluation of timber, Myrtle Beach Estates had 500 square miles around the Myrtle Beach area photographed from the air. The photographs revealed for the first time the number and geometrical perfection of Carolina bays, leading researchers to suspect that the bays were formed by a meteor shower (Melton and Schriver 1933). In 1933 Congress enacted the Agricultural Adjustment Act in an effort to alleviate a growing farm crisis. One result was a complete aerial photogeographic assessment of the Southeast. Surprisingly the photographs revealed 83,000 square miles of area in which bays were present, with the bays themselves occupying about 10% of the land area, and in some places such as Bladen County, N.C., most of the land surface was covered with bays. There were even bays within bays! All told, researchers estimated more than half a million Carolina bays, with more than 140,000 exceeding 500 feet in length.

Since the discovery made from aerial photography, the mystery of the origin of Carolina bays has been a source of scholarly debate. Paleobotanists, botanists, geologists, and others have proposed theories ranging from glacial-period wave action back to meteors. Savage (1982) provides an intriguing and up-to-date history of the study and mystery surrounding the origin of Carolina bays, though Johnson's (1942) book is perhaps a more scholarly treatment. The most logical explanation appears to be a progressive series of events ["Hypothesis of Complex Origin" of Johnson (1942)] that leads to the characteristic geological features of the bays.

Carolina bays occur between southern Maryland and Florida, reaching their greatest abundance in southeastern North Carolina and adjacent South Carolina (Savage 1982). Bays range in size from only a few acres to many hundreds of acres. An exposed sand rim of varying width marks each bay's perimeter. Many bays have

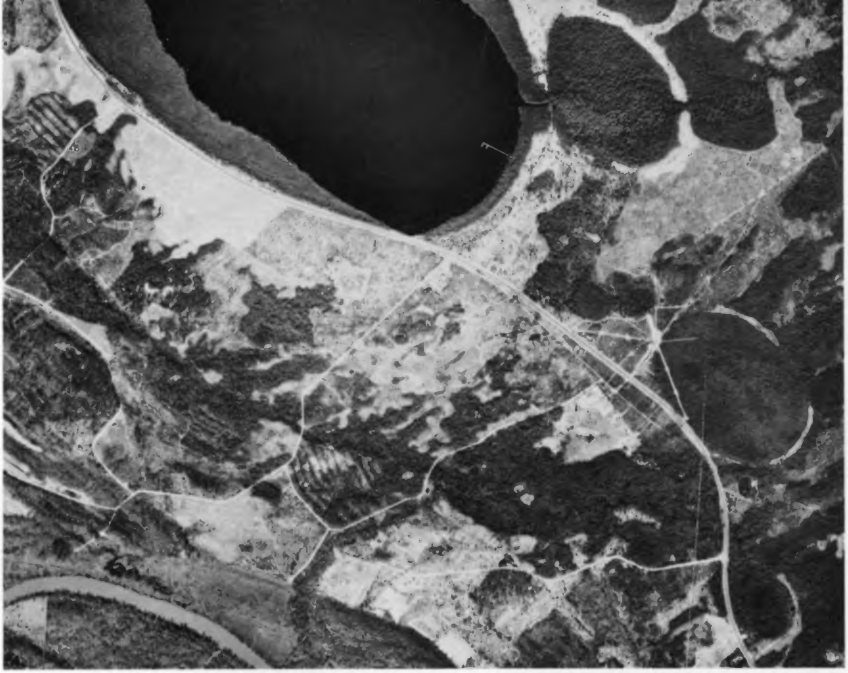

Fig. 1a. Singletary Lake (a bay lake within a Carolina bay) and adjacent unnamed bays, Bladen County, N.C. A portion of the Cape Fear River and NC 53 can also be seen in the photograph.

Fig. 1b. Small unnamed Carolina bays along the Cape Fear River, Bladen County, N.C. Note variation in the extent of the sand rims on the southeast side of the bays and the similar orientation of the bays of different sizes. Variation in the type and extent of forest cover can be seen (note foliage contrast between evergreen and deciduous trees, and the sparseness of the trees in the bay in upper center of photograph).

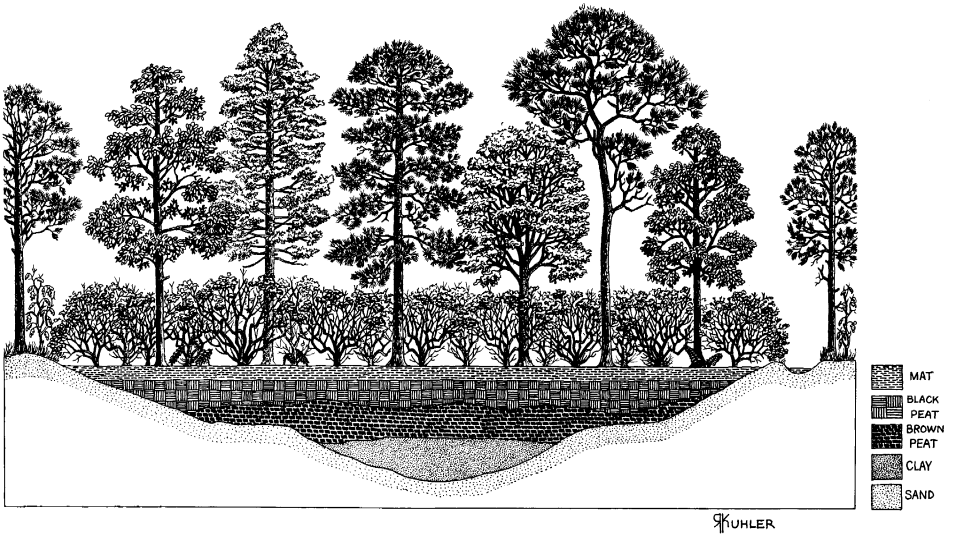

Fig. 2a.

Fig. 2b.

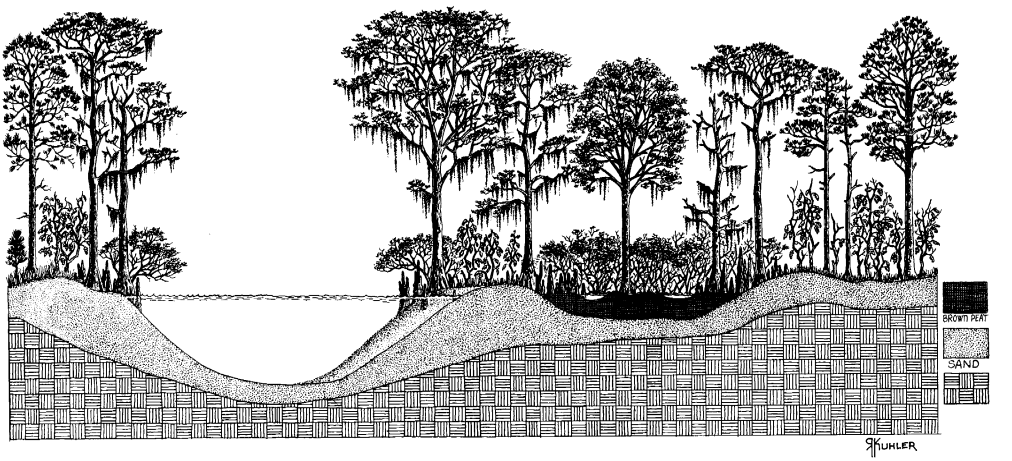

Fig. 2a,b. Profiles of two Carolina bays. Upper illustration shows relation of plant community to shallow bay depression. Lower illustration is of a bay lake within a Carolina bay. Again the basin of the bay is quite shallow. The successional relation of bay lakes to the larger depression is not clear.

multiple sand rims. Naturally wetter at all seasons than are most surrounding areas, bay depressions contrast markedly with their dry sand rims, which support xeric plant communities. Many, perhaps most, Carolina bays contain pocosin plant communities in various serial stages, but some also contain sizable lakes, ponds, marshes, bogs, and swamps. In many bays natural fires have been suppressed so long that the plant community in them is now mature deciduous bay forest. The elliptical shape and the tendency for the deepest portion of the depression to be southeast of the center often causes concentric vegetative zonation rings in the interior of the bay as well as an ecotonal ring around the perimeter (Fig. 2). This pattern of vegetative zonation, combined with the xeric nature of the sand rim and pronounced edge effects, allows for considerable faunal diversity, even in small areas.

The characteristic flora and the development of pocosin plant communities within Carolina bays and on other sites in the Southeast have been discussed by Buell and Cain (1943), Kologiski (1977), Clark et al. (1985), and Lee (1986). Lee (1986) graphically illustrated the succession of major plant communities as they relate to fire or other disturbance, soil type, and hydroperiod. The nature of succession of the bird fauna as it relates to devleopment of pocosin and bay forest communities, the major terrestrial communities developing in Carolina bays, was also presented by Lee (1986). The findings of that study are similar to the vegetative influences on bird communities discussed below.

METHODS AND STUDY SITES

Conducted over a 5-year period between 1980 and 1985, this study is based on more than 100 field days, approximately one-fourth of these including evenings spent listening for nocturnal birds. Methods of censusing were described in detail by Lee (1986). Inventories (species list and species dominance) were compiled for all sites and habitats surveyed. In that the density of the plant cover made it impractical to survey many of the bays by traditional spot mapping or transect methods, a more expedient comparative method was necessary. Counts of singing males were made for each bay (and each habitat within a bay) from walked transects and from scattered specific stations within, as much as possible, pure stands of certain habitat types. Each bay was revisited at different periods of the nesting season (late April to late June). For crude comparisons of density in different bay communities, I simply averaged the number of resident birds encountered per minute during prime survey hours (0600-0800) and seasons (mid-May through the first week of June). Study sites were chosen to include a variety of terrestrial vegetation types, with the primary focus being on mature bay forest and shrub pocosin. In that most survey work was done from land, information on aquatic species was simply tallied as to presence or absence, although some effort was made to confirm the nesting of aquatic species from boats and canoes in the late spring and early summer of 1984.

The following Carolina bays were censused systematically, and those marked with an asterisk are the primary sites of study. *Bladen County*: Bay Tree Lake (Black Lake)*, Jones Lake*, Little Singletary Lake, Salters Lake*, Singletary Lake*, Suggs Mill Pond (Horseshoe Lake), White Lake*, Wamm Squam Bay*,

Jerome Bay (on Cumberland/Bladen Co. line), Smith Mill Pond (on Sampson/Bladen Co. line), one unnamed bay 9 miles N of Elizabethtown on NC 242, one unnamed bay 1.6 miles E of Kelly on NC 53, and another 10 miles E of Kelly on NC 53. *Columbus County*: Lake Waccamaw. *Hoke County*: Bay on North Carolina Biological Survey study site at McCain*.

Information on the date when a particular bay was last completely burned was obtained from local residents, the North Carolina Forest Service, or both.

CHARACTERISTICS OF BIRD LIFE

A total of 107 species of nesting and summering birds have been recorded from Carolina bays (Table 1). Of these, nine are simply regarded as summer visitors, although individuals of most nest in nearby areas or adjacent habitats. Twenty-five (23.4%) of the nesting and presumed nesting species are aquatic or semiaquatic. These figures attest to the habitat diversity provided by Carolina bays in that the combined tallies include nearly all nesting species associated with the inner coastal plain of the Carolinas. As will be pointed out later, several species breeding at the limit of their range appear to be associated exclusively, or nearly so, with Carolina bays.

Table 1 lists by habitat and known or presumed nesting status all avian species found in association with Carolina bays during this and other studies. Birds found in ecotonal communities around natural openings resulting from fire damage, wind-thrown trees, and lake edges within the forested bay are included in the figures and tables under bay forest, but censusing of interior bay communities was conducted in a manner that kept encounters with these species to a minimum. Most of the species found in this study are ubiquitous. Those birds that seem noteworthy from either geographical or ecological perspectives are discussed in Appendix A.

DIVERSITY/DENSITY

If the terrestrial Carolina bay fauna is analyzed as it relates to serial successional stages, the bird life exhibits a spectrum ranging from species found in low shrubs to those of the mature, closed-canopy forest. Because the thick rootstocks of bay vegetation persist after fires in the moist bay soil, it is unusual for the pioneering grass/sedge (old-field) successional stages to become established in Carolina bays. Along a similar line, Atlantic White Cedar (*Chamaecyparis thyoides*) can seldom become established in large numbers because of the competitive nature of the shrub community (see Clark et al. 1986). Nevertheless, a White Cedar forest was present in Jerome Bay. Because I did not find this forest to be typical of bays I studied, this community is not discussed here (see Lee 1986 for a characterization of the fauna of White Cedar stands).

Although bays with transitional plant communities were studied, the focus of the field work was on Carolina bays in distinct vegetative stages. Figures 3 through 6 and Table 1 compare bays having (1) early shrub successional stages—low shrub pocosins surveyed 1 to 5 years after intensive fire, (2) full-term shrub regeneration—high shrub pocosin surveyed approximately 10 to 30 years after intensive fire, (3) young bay forest surveyed 40 years after burning, and (4) mature bay forest that had not burned for at least 60 years.

TABLE 1. Summer birds of Carolina bays. X = nesting or presumed nesting, O = regular visitor, + = irregular visitor (1-5 records). Fly-overs are not included. Sources for species not encountered in this study are indicated by footnotes. Species listed under Bay Lakes and Altered include *only* birds primarily associated with these habitats or ones whose populations expand in these areas. The other four habitat lists contain all species encountered.

	HABITATS					
SPECIES	**Sand Rims**	**Bay Lakes, Marshes**	**Forest**	**High Shrub**	**Low Shrub**	**Altered**
Pied-billed Grebe		X[1]				
Double-crested Cormorant		O				
Anhinga						X
American Bittern		+[2]				
Least Bittern		X[1,2]				
Great Blue Heron		O				O
Great Egret		O				O
Little Blue Heron		+[2]				
Cattle Egret						O
Green-backed Heron		X		O		X
Yellow-crowned Night-Heron		+[2]				
White Ibis		O				O
Wood Duck	X	X	X	O		X
American Black Duck		X				
Mallard		X				X
Black Vulture	X		X			
Turkey Vulture	X		X	X	X	
Osprey		O				
Bald Eagle		X				
Red-shouldered Hawk			X			
Red-tailed Hawk	X				X	
American Kestrel						+
Wild Turkey	+					
Northern Bobwhite	X		X	X	X	X
King Rail		X[1]				
Purple Gallinule		+[2]				
Common Moorhen		X[1]				
American Coot		X[1]				
Limpkin						+
Killdeer						X
Spotted Sandpiper		O				O
American Woodcock		X[1]				
Rock Dove						X
Mourning Dove	X		X	X	X	
Yellow-billed Cuckoo	X		X	X	X	
Eastern Screech-Owl	X					
Great Horned Owl	X					
Barred Owl	X		X			
Common Nighthawk	X					
Chuck-will's-widow	X			X		

TABLE 1. Continued.

SPECIES	HABITATS					
	Sand Rims	Bay Lakes, Marshes	Forest	High Shrub	Low Shrub	Altered
Whip-poor-will	X					
Chimney Swift	O		O	O		
Ruby-throated Hummingbird	X		X			
Belted Kingfisher		O		+		X
Red-headed Woodpecker				X	X	
Red-bellied Woodpecker			X	X	X	
Downy Woodpecker	X		X	X		
Hairy Woodpecker				X		
Red-cockaded Woodpecker	X					
Northern Flicker	X					
Pileated Woodpecker	O		X	X	X	
Eastern Wood-Pewee	X		X			
Acadian Flycatcher			X			
Great Crested Flycatcher	X		X	X	X	
Eastern Kingbird		O		X	X	
Purple Martin				O		X
Northern Rough-winged Swallow						X
Barn Swallow						X
Blue Jay	X		X	X	X	
American Crow	X		X	X	X	
Fish Crow	X		X	X	X	
Carolina Chickadee	X		X	X	X	
Tufted Titmouse	X		X	X	X	
White-breasted Nuthatch	X					
Brown-headed Nuthatch	X		X	X	X	
Carolina Wren			X	X		
Blue-gray Gnatcatcher	X		X	X		
Eastern Bluebird	X			X		
Wood Thrush			X	O		
American Robin						X
Gray Catbird			X	X	X	
Northern Mockingbird						X
Brown Thrasher			X	X		
Loggerhead Shrike						X
European Starling		X		O		X
White-eyed Vireo			X	X		
Red-eyed Vireo			X	X		
Northern Parula			X			
Black-throated Green Warbler			X	X		
Yellow-throated Warbler			X	X		X
Pine Warbler	X		X	X	X	
Prairie Warbler			X	X	X	
Black-and-white Warbler			X			
American Redstart			X			

TABLE 1. Continued.

SPECIES	HABITATS					
	Sand Rims	Bay Lakes, Marshes	Forest	High Shrub	Low Shrub	Altered
Prothonotary Warbler			X	X		
Worm-eating Warbler			X	X		
Swainson's Warbler			X			
Ovenbird			X			
Louisiana Waterthrush			X			
Kentucky Warbler			X	X		
Common Yellowthroat			X	X	X	
Hooded Warbler			X	X		
Yellow-breasted Chat			X	X	X	
Summer Tanager	X					
Northern Cardinal	X		X	X	X	
Blue Grosbeak	X					
Indigo Bunting	X			X		
Rufous-sided Towhee	X		X	X	X	
Bachman's Sparrow	X					
Chipping Sparrow	X					
Field Sparrow						X
Red-winged Blackbird		X				
Eastern Meadowlark	X					X
Common Grackle				O		X
Brown-headed Cowbird	X		X	X	X	
Orchard Oriole				X		
American Goldfinch	X			X		
House Sparrow						X
Total Nesting Species (107)	40	-	48	42	24	-

[1]Post 1969
[2]Norris 1957

Examining a series of known-age bay communities (1-60+ years), I found a progressive increase in avian diversity and a progressive decrease in population density with age of the plant community (Table 2, Fig. 8). The exception is a sharp decline in density in high-shrub pocosins. Here, although the diversity is still a progression from low-shrub to young-forest birds, the habitat is not really suitable for substantial numbers of birds from either earlier or later successional stages, and none were restricted to this stage. Thus, density in high-shrub communities falls below that found in any other bay habitat studied.

Within given-aged plant communities in any bay, the land-bird fauna was nearly identical. Analysis of birds recorded in three large bays with mature bay forests (the most diverse communities) in Bladen County showed a 96.9% overlap in the fauna.

Sand Rim

Bird associates of sand rims are presented in Table 1 and Figure 7. In general, plant communities of the sand rims, while a characteristic vegetational feature of a Carolina bay's perimeter, were in direct contrast with the pocosin vegetation types within the bays. These sand rims are dominated by Longleaf Pine (*Pinus palustris*), Turkey Oak (*Quercus laevis*), and Wire Grass (*Aristida stricta*). Fire and drainage play an important role in maintaining the xeric open-community structure on the sand rims. The edge effect produced by the contrast between the open canopy and open understory of the sand-rim community and the closed canopy of the mature bay-forest community allow for a dense shrub zone around the perimeter of the bay depression. In this zone small numbers of all the shrub-stage birds of Carolina bays normally could be found.

Aquatic and Peripheral Species

The aquatic habitats varied considerably from bay to bay, and there was little similarity or predictable regularity in the aquatic bird life in any of the bays studied. Aquatic species found in bays with permanent water are among the most interesting associates, but many of these are not breeding birds (e.g. herons, Osprey, Limpkin). Some of the aquatic birds are, to date, restricted to bays converted into mill ponds (e.g. Anhinga, White Ibis).

Peripheral populations of several aquatic and woodland birds (e.g. Worm-eating Warbler, Louisiana Waterthrush, Chipping Sparrow) that reach the limits of their breeding distributions in southeastern North Carolina seem to be confined to Carolina bays or pocosin habitats (see Lee 1986). The geological features of the bays provide permanent sites for the aquatic communities and for the successional development of some terrestrial communities that otherwise would not be present locally. For the species associated with shrub communities, the bays may have been

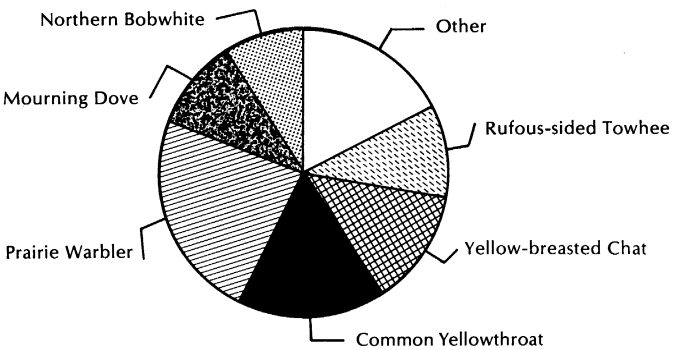

Fig. 3. Faunal composition of a Carolina bay housing a shrub community in a very early stage of succession. Census was conducted 2 years after the vegetation had completely burned. Study site is 9 miles N of Elizabethtown, Bladen County, N.C., on NC 242. The size of the section labeled "other" gives a general idea of the degree of diversity represented in this and the following figures.

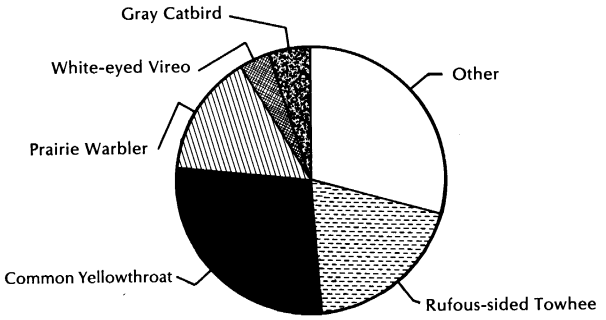

Fig. 4. Faunal composition of Carolina bays housing pocosin (shrub-Pond Pine) communities. Information was pooled from several study sites. Although the exact time period since the last fire was not known for many, all sites were intermediate between what was surveyed in Figures 3 and 5.

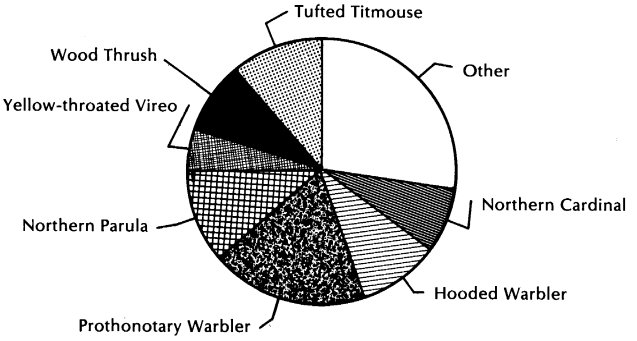

Fig. 5. Faunal composition of Wamm Squam Bay near White Lake, Bladen County, N.C. This bay was surveyed 40 years after a fire had completely burned out the vegetation. At the time of the survey the bay contained a young bay forest that, except for the perimeter, was relatively free of shrub vegetation.

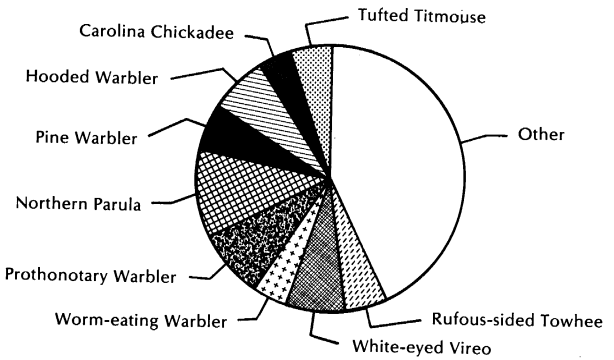

Fig. 6. Faunal composition of mature bay forest growing in various Carolina bays in Bladen Lakes State Park, Bladen County, N.C.

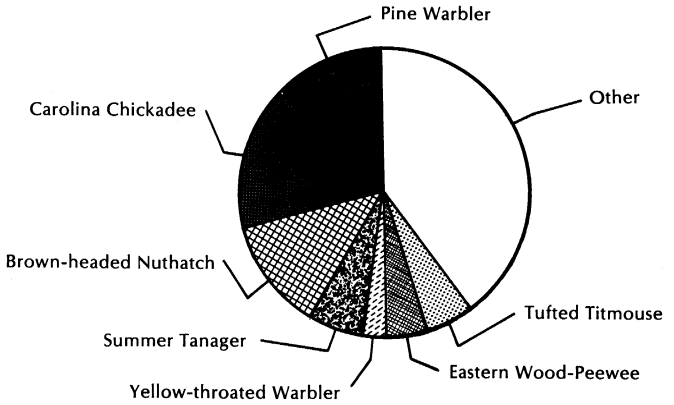

Fig. 7. Faunal composition of Longleaf Pine, Turkey Oak, Wire Grass sandhill communities found on sand rims of various Carolina bays in Bladen County, N.C.

valuable inholdings during the precolonial period prior to massive land clearing and subsequent advance of early vegetative succession.

SPECIES AFFECTED BY DISTURBANCE

Disturbance of bays had various effects on the bird life, obviously varying with the nature and degree of disturbance. Towns and residential development on sand rims provided habitat for American Robins, Northern Mockingbirds, European Starlings, and House Sparrows—species not encountered, or rarely encountered, when bays were in a natural state. Clearing of natural understory of pine and bay forest for residential and recreational cottages at White Lake resulted in an increase in Yellow-throated Warblers, Orchard Orioles, and perhaps other subcanopy species. Draining of bay soils and the planting of blueberry farms provided habitat for many widespread species normally associated with natural, open, shrub-filled bays as well as for the Field Sparrow, a species not found in any natural bays. Flooding of bays for millponds attracted some aquatic species that were not recorded in natural bay lakes. Dead trees resulting from flooding increased the

TABLE 2. Diversity and density of breeding birds in different-aged terrestrial communities in Carolina bays.

	Low Shrub (1 to 3 years after burn)	High Shrub	40-year-old Bay Forest	Mature Bay Forest (60+ years after burn)
Diversity (number species)	19	21	24	44
Density (number individuals encountered per minute)	2.03	.78	1.5	1.34
Total Survey Time (in hours)	3.08	.95	2.15	20.5

habitat suitable for cavity-nesting birds. Docks and piers on developed bay lakes provided nesting sites for Barn Swallows.

CONCLUSIONS

Collectively, Carolina bays support a diverse assemblage of bird species, but unless dissected this statement is somewhat misleading. In that Carolina bays are vegetatively characterized by a succession of fire-respondent communities, the diversity could be largely duplicated by surveying equal-sized areas of appropriate-aged habitats almost anywhere in the coastal plain. Successional stages are so diverse that no single group of birds could be considered characteristic of bays. Many of the species are ubiquitous ones found in almost any disturbed community. Those associated with sand rims are typically found throughout the xeric area surrounding the bays. Approximately 10 species are present as a result of alterations by man. The islandlike nature of Carolina bays and variations in the amount of soil saturation in individual bays do, however, arrest development of plant communities and allow various-aged communities to persist in bays in close proximity. In many cases several communities co-exist in the same bay, and large bays typically house plant communities of several ages.

As natural succession progresses in a Carolina bay, bird population density declines and species diversity increases. Although no examples of bays protected from fire or other disturbance for extremely long periods were studied intensively, casual visitations to these sites indicate that both density and diversity decline sharply in advanced-age forest in Carolina bays (Fig. 8). Clark et al. (1985) found a similar pattern in mammal fauna, as did Lee (1986) in a study of birds of pocosins.

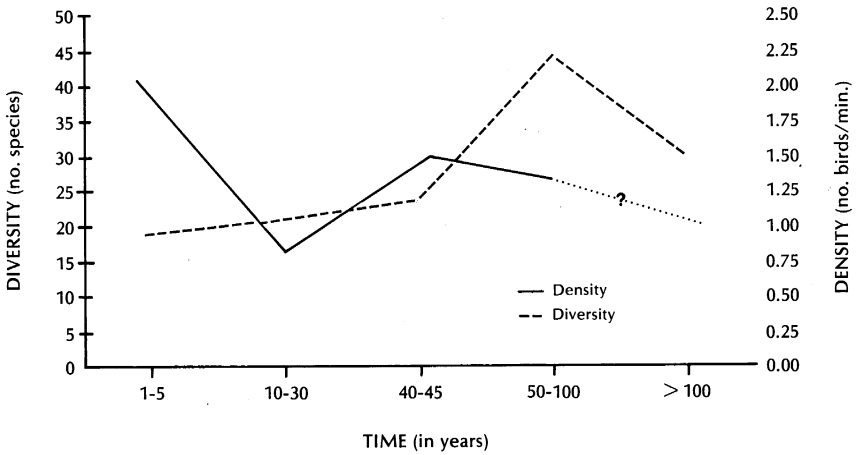

Fig. 8. The effect of vegetative succession in Carolina bays on bird diversity and density. Years 1 to 5, recently burned, low-shrub community (Fig. 3); years 10 to 30 intermediate- to high-shrub pocosin community (Fig. 4); years 40 to 45, young bay-forest community (Fig. 5); 50 to 100 years, mature bay-forest community (Fig. 6); greater than 100 years (projected for density), mature swamp-hardwood forest.

Several species of aquatic birds reach (or reached) the limits of their breeding ranges at sites in Carolina bays, and unusual vagrant aquatic species have also been found in bays. This is not particularly surprising in that bay lakes provide one of the few natural lenthic communities in the southeastern coastal plain of the Carolinas. Perhaps of more significance, several species of woodland birds reach the limits of their breeding distributions in Carolina bays and pocosin-associated communities. In all cases these are birds of advanced-age bay forest. Although it is obvious that this community is important to these peripheral populations, the association may not be locally obligatory. Because the inner coastal plain has not to date been systematically surveyed during the nesting season, statements about the importance of Carolina bays to certain locally unusual land birds are speculative.

A modest number of local Carolina bays are currently under protection of the State Parks System, State Forests, or The Nature Conservancy. It appears that a good sampling is now in public ownership. However, the species composition of individual bays is dictated by fire-induced serial stages of succession, and land protection *per se* will not maintain diversity *or* unique elements of the biota. Forthcoming phases of Carolina bay conservation will need to address manipulating and coordinating successional patterns of individual bays.

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APPENDIX A
Noteworthy Birds Associated with Carolina Bays During the Breeding Season

Pied-billed Grebe: Post (1969) found 11 pairs on a 62-acre Carolina bay study site in Barnwell County, S.C.

Double-crested Cormorant: Small numbers of adult- and juvenal-plumaged cormorants are seen from time to time on all the bay lakes and occur regularly on Black Lake. A single specimen collected there in late May 1982 appears to be the southeastern subspecies (*Phalacrocorax auritus floridanus*) or an intergrade with it, which implies the birds are residents and not lingering migrants.

Anhinga: Individual birds were seen on Suggs Millpond, and Crutchfield and Whitfield (1987) discovered a small nesting colony on a bay converted into a millpond in Cumberland County.

Least Bittern: Post (1969) and Norris (1957) each reported two nesting pairs in their Barnwell County study sites.

White Ibis: Several adult individuals were seen at Smith Mill Pond from 19 to 21 May 1983. It is assumed that they had dispersed from the Battery Island breeding colony. They were encountered regularly around Lake Waccamaw.

Waterfowl: None of the summer-resident waterfowl were commonly encountered, although all were believed to be nesting locally. Wood Duck nest-box programs at several sites and watefowl management by a hunting club at Suggs Millpond enhanced some populations. At White Lake a semi-tame flock of wild Mallards has nested on the south shore for a number of years. Thirty-five individuals were counted from the single flock on White Lake on 3 July 1987.

Osprey: Individual Ospreys were seen on White Lake and Singletary Lake (perhaps the same bird) in May and June of 1984. There is no present indication of local nesting, and to my knowledge there are no historic records of Ospreys nesting on any bay lakes.

Bald Eagle: David Clark of Elizabethtown informed me of a single eagle nest that was active at White Lake during the 1950s. The nest was in the heavily wooded southwest section of the bay and could be easily seen only from the air. This is the only record of which I am aware of Bald Eagle nesting associated with bay lakes.

Wild Turkey: A single bird was seen on 18 May 1983 crossing the sand rim at Singletary Lake. Although turkeys occur nearby in the swamps on the Cape Fear River, no others were seen during this study.

King Rail: Post (1969) noted two pairs in the South Carolina bay he studied.

American Coot: Post (1969) reported three pairs from his study site.

Common Gallinule: Post (1969) recorded two nesting pairs, and Norris (1957) noted a summer visitor in each of the three bays he studied.

Limpkin: A single bird was seen briefly at Smith Mill pond on 20 May 1983, flying from a heavily wooded swamp forest. The spotted plumage, slightly decurved bill, and characteristic awkward flight were noted. This represents only the second record for this species from North Carolina. The first was reported from Lake Waccamaw, a bay lake in Columbus County, by Wiley and Wiley in 1979 (Chat 40:94-95).

Spotted Sandpiper: Individual birds and small groups of birds were seen regularly throughout the spring and were common through early June. Although this departure date is well into the birds' nesting season, there was no indication of local breeding.

Common Nighthawk: These birds nest on bay sand rims in the eastern portion of the state (New Hanover and Brunswick Counties) and in the Sandhills. A hiatus between these two populations is present throughout much of the inner coastal plain. No nesting individuals were seen in Bladen County in spite of extensive inventory.

Chuck-will's-widow: Common on sand rims of bays, these birds were essentially absent from the interior of bays no matter what vegetative community was present.

Whip-poor-will: This species is uncommon on sand rims of bays, but it is found regularly along the Cape Fear River in Bladen County.

Belted Kingfisher: Although kingfishers were seen irregularly at most bay lakes, nesting individuals were confined to sites with earth dykes or similar artificial nesting areas.

Red-cockaded Woodpecker: Although these woodpeckers were found in several sandhill communities near bays in Bladen County, the only nesting association with bays was several cavity trees on the sand rim of Salter's Lake.

Eastern Kingbird: This species was common in low-shrub habitats with scattered Pond Pines and around the interior of bay forests bordering lakes.

Barn Swallow: Barn Swallows were common as nesting species on piers and docks on developed bay lakes. It is not known when they expanded their range into this section of the coastal plain, but they were nesting in small numbers at Jones Lake when I first visited this area in 1976.

American Crow and Fish Crow: Both species were recorded at most sites, with no indication of any local ecological preference for any habitat type. Interpretation was hindered, however, by the impossibility of separating fly-over individuals from birds nesting in the immediate vicinity, and by the large foraging area of nesting pairs.

Northern Mockingbird: This species was not encountered at any undisturbed bays, and only a few individuals were recorded around towns (White Lake, Lake Waccamaw) and farmlands within bays. Lee (1986) failed to find any breeding-season mockingbirds in his pocosin study, although a few individuals were recorded from disturbed pocosins in Dare County during the winter (Potter, pers. comm.).

European Starling: In addition to their presence around towns and farms in bays, starlings were found nesting in modest numbers in woodpecker cavities in Bald Cypress on the undeveloped side of Black Lake. Based on habitat in the immediate area, they must have commuted to foraging sites more than a mile from the nesting trees.

Black-and-white Warbler: Single pairs found at several bays in Bladen County represent some of the easternmost breeding-season records for the coastal plain.

Black-throated Green Warbler: Present in small numbers in most mature bay forests, these warblers were common in the White Cedar forest in Jerome Bog.

Worm-eating Warbler: These warblers were moderately common in Bladen County bays with mature bay forest. These populations represent some of the most eastern and southern ones known on the Atlantic coastal plain.

Louisiana Waterthrush: A single bird that appeared to be on territory was seen regularly throughout the 1983 nesting period in a Carolina bay 50 yards from the outlet of Singletary Lake. This represents the most southeastern breeding-season record for the state. Several other single-date sightings indicate the species is uncommon but widespread in the immediate area.

Chipping Sparrow: This sparrow was quite rare. Individuals were present in the sand-rim communities in Hoke County, and one was found in the same habitat at Singletary Lake in June 1983. This represents the eastern extreme of the nesting-season distribution of the Chipping Sparrow on the coastal plain. During the winter, however, these sparrows are quite common in the area.

Field Sparrow: Field Sparrows were found near White Lake at several small bays that supported farmlands of cultivated blueberries.

American Goldfinch: Though apparently uncommon, one group was heard on 26 May and 10 June 1984 in a hardwood forest on the sand rim of Bush Lake, and small numbers have been found every year since 1979 on the sand rim of the Hoke County bay.

House Sparrow: House Sparrows were recorded only at the towns of White Lake and Lake Waccamaw.

Backyard Birding

... with Gail T. Whitehurst

Oddities of Color, or Lack of Color, in Birds

One of the rewards of Backyard Birding on a consistent basis is catching sight of some of Nature's oddballs. Keeping a sharp eye out for the new, unusual, and differently marked bird enables the watcher not only to pick up a new species, but also to see some of the quirks of Nature. From time to time we get reports of albino birds, strangely marked birds, and birds with extra colors not normally found.

Before we go any further, we might stop here and remind our readers that during the post-nuptial molt we can, if not careful, be fooled by split-tailed robins, no-tailed towhees, and bald-headed cardinals and jays. The post-juvenal molt can also contribute confusion. For instance, the Rufous-sided Towhee undergoes a number of changes. The finely streaked head and breast of the fledgling, as these feathers are shed, go through a series of changes until the white breast, dark head, and rufous sides are well defined. These are the times when knowing one's birds well—size, shape, calls, and behavior—saves the birder from wasting much time and energy trying to find the "new" bird in the field guide.