

Avian population density in the maritime forest of two South Carolina barrier islands

An investigation of the factors that influence species diversity on these islands

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INTRODUCTION

THE BARRIER ISLAND system of the southeastern United States is under increasing developmental and recreational pressure. Little is known of the faunal communities associated with the maritime forest on most of these islands. In South Carolina research on island avian communities has been limited to qualitative statements produced by general field studies and Christmas Bird Counts. This study was designed to document avian density in maritime forests and to predict the impact of recreational and developmental pressures on barrier island habitat.

STUDY AREAS

DATA WERE GATHERED from Caper's Island, 15 miles north of Charleston, Charleston County, South Carolina, and Kiawah Island, 21 miles south of Charleston. These islands were selected because of their differences in size, accessibility and vegetation. Caper's Island is a small state-owned wildlife sanctuary with approximately 830 acres of high land (Warner 1976). Accessible only by small boat, Caper's Island enjoys light recreational use limited to nature observation and occasional primitive camping. On the other hand, Kiawah Island, with approximately 3300 acres of high land, (Warner 1976) is privately owned, and undergoing intense development as a resort and second home community. It is accessible by bridge, and there is heavy recreational and residential use over one half of the island.

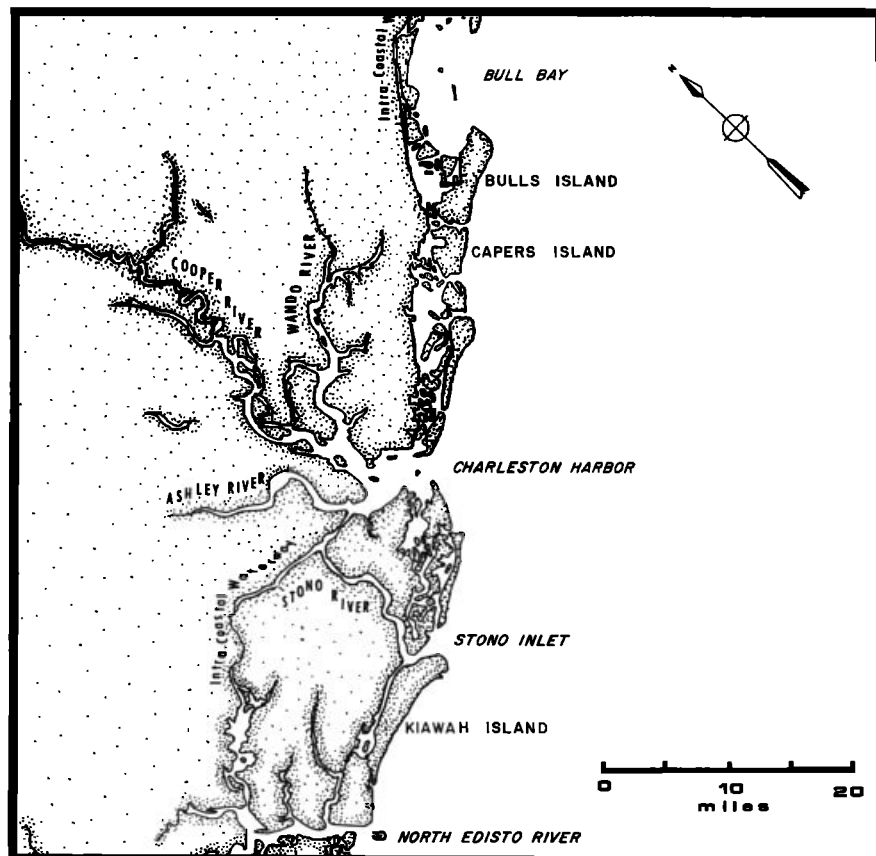
Maritime forest communities on both Kiawah and Caper's islands are dominated by Laurel Oak (*Quercus laurifolia*), Live Oak (*Quercus vir-*

giniana), Cabbage Palmetto (*Sabal palmetto*) and Loblolly Pine (*Pinus taeda*). The understory vegetation is dominated by Wax Myrtle (*Myrica cerifera*), Yaupon (*Ilex vomitoria*) and Cabbage Palmetto (Table 1).

The topography of both islands is characterized by alternating dune ridges and high ground with drains and depressions. These low areas often have standing water. This pattern of alternate xeric and mesic sites allows the development of several vegetation communities which vary in extent on each island.

METHODS

A MODIFIED STRIP census method (Emlen 1971) was employed, with three transects laid out on each island. All transects traversed the width of the island from salt marsh to dune field. Each transect was 400 feet (122 m) wide and crossed a variety of habitats. Transects were designed to measure areas of heavily disturbed, lightly disturbed and undisturbed habitat. All transects were sampled biweekly from March-September 1979 between 0600



General study area map/courtesy of Pete Laurie, South Carolina Wildlife and Marine Resources Department.

Table 1 Vegetation density of undisturbed Maritime Forest in two South Carolina barrier islands

Community		Height (ft)	Canopy Cover %	Canopy trees/ 100 sq.m.	Understory trees/ 100 sq.m.	Shrubs and saplings/ 16 sq.m. ¹
Kiawah Island Transect 3	Loblolly Pine—Cabbage palmetto	70–80'	60%	5.0	5.5	11.0
	Laurel Oak—Magnolia	30–40'	65–80%	6.8	9.0	4.0
	Cabbage Palmetto	20–30'	50–60%	7.2	5.0	.5
	Maritime Shrub	10–20'	20–50%	—	13.5	6.2
	Loblolly Pine—Sweetgum—Live Oak	40–80'	60–70%	5.0	10.5	1.0
Laurel Oak—pine—Cabbage Palmetto	30–70'	60%	14.8	9.5	3.5	
Caper's Island Transect 3	Laurel Oak—magnolia	30–40'	65–80%	3.8	3.2	.5
	Loblolly Pine—Live Oak	60–75'	60%	2.2	3.8	1.5
	Cabbage Palmetto ²	20–30'	50–60%	11.5	27.8	10.0
	Laurel Oak—pine	40–70'	60%	4.2	10.5	.2

¹A sapling is a tree species <6.6 cm (3 in.) dbh.

²The presence of Chinese Tallow Tree drastically increased the density of this community.

[Source: Gaddy, unpublished ms.; Sharitz, 1975]

and 1000 hours. The data presented are confined to observations made in maritime forest communities. Overflying marine and estuarine species were not included. Similarly, swallows and similar species were omitted because of the difficulty of accurate counting imposed by the dense vegetation. Care was also taken to avoid the error imposed by "driving" species along the transect. Individuals observed were mapped indicating position on each transect and distance from the center line. Additional notations were made for singing males, copulating pairs or active nests.

Transects were laid out on each island to take advantage of varying vegetation communities and levels of disturbance. On Kiawah Island, Transect 1 was through highly altered maritime forest. Portions of this transect included developed areas of single family housing while the majority was along a golf course fairway. All portions of Transect 1 were heavily disturbed. Transect 2 on Kiawah Island ran along a lightly used dirt road through maritime forest and into an old pasture that was reverting to the surrounding forest type. Transect 3, ran through undisturbed maritime forest and included the margin of a small brackish pond.

On Caper's Island, Transect 1 ran a short distance through maritime forest and included the margins of two large brackish impoundments. These pond margins were dominated by maritime shrub species such as Wax Myrtle, Sea Myrtle (*Baccharis halimifolia*), Yaupon and Chinese Tallow Tree (*Sapium sebiferum*). Disturbance on Transect 1 was light and limited primarily to hikers and campers. Transect 2 was located entirely in maritime forest along a lightly travelled dirt road. Caper's Is-



Caper's I., Transect 1, Maritime shrub.

land Transect 3 traversed undisturbed maritime forest.

Because continuing disturbance was a factor on both islands, botanical data were gathered only for undisturbed transects. Sample plots were selected in representative communities along each undisturbed transect. Plots were 400m² in area with 10m² areas sampled for trees, and 4m² for shrubs and saplings.

RESULTS

OVER THE SAMPLE period a total of 3054 individuals representing 77 species was recorded. The density range for individual species ranged from <1 individual/km² to 66/km². On Kiawah Island the average density was 260 individuals/km², while the average on Caper's Island was 237 indi-

viduals/km² (Table 2). Analysis of the results by island and transect reveals considerable variation particularly in average density.

Although the study lasted less than a year, seasonal variations both in individuals and in densities were noted. Individuals seen monthly per transect are given for both islands. Patterns associated with the departure of winter residents and the influx of spring and fall migrants are more apparent on Caper's Island (Table 3). Further examination of seasonal distribution revealed the greater number of species of all transects were permanent residents. Migratory species were approximately evenly distributed throughout the transects (Table 4).

Habitat relationships strongly influenced both the number of species



Kiawah I., Transect 1, Heavily disturbed maritime forest.

Table 2. Number of bird species, individuals and average density by transect

	Transect	Area in Acres (Hectares)	Total Species	Total Individuals	Average Density Individuals/km ²
Caper's I.	1	33.6 (13.6)	51	548	287
	2	31.8 (12.8)	30	305	170
	3	30.3 (12.2)	35	438	254
Kiawah I.	1	48.7 (19.7)	38	309	112
	2	42.4 (17.1)	49	742	309
	3	34.9 (14.0)	47	712	361

Table 3 Seasonal abundance of individuals on two coastal South Carolina Islands

	Transect	March	April	May	June	July	August	September
Caper's I.	1	114	84	63	69	96	62	69
	2	34	45	44	57	33	34	58
	3	77	48	43	32	56	122	68
Total		225	177	150	158	185	218	195
Kiawah I.	1	46	65	49	55	37	35	41
	2	85	90	131	128	92	107	110
	3	109	143	84	98	84	103	91
Total		240	298	264	281	213	245	242

recorded on each transect and the total number of individuals. Species diversity was clearly determined by the total diversity of available habitats. This factor was particularly significant on Kiawah Island where the presence of an abandoned pasture reverting to maritime forest accounted for a number of species absent from the other transects. On Caper's Island the influence of seral vegetation was also important on Transect 1 where maritime shrub growth is present along the pond margins.

Disturbance factors noted on each transect did not appear to significantly affect bird populations with the exception of Kiawah Transect 1. Dramatic impacts related both to continuing disturbance and the wholesale removal of understory vegetation were immediately apparent (Table 5).

The structure of populations was also examined employing feeding guilds (Salt 1953, Manuwal 1968). The feeding



Kiawah I., Transect 2, Old pasture reverting to maritime forest.

guilds and their number of representatives emphasize the importance of habitat. As would be expected, transects with seral stages displayed larger numbers of ground-seed and ground-insect guild representatives. The impact of habitat alteration noted on Kiawah Transect 1 is again demonstrated by the paucity of ground-seed and ground-insect representatives. The lack of foliage-nectar representatives on two of the Caper's Island transects and



Caper's I., Transect 2, Maritime forest. All photos/WDC.

timber-searching representatives on Kiawah Island appear to be related to the overall size (Table 6).

A total of 25 species of singing males was recorded on Kiawah Island and of

these, 15 were permanent residents. On Caper's Island 14 species were noted with seven being permanent residents. Significant differences in the number of singing individuals were noted between the islands; the average numbers of singing species encountered each sample day were 15.6 species for Kiawah, 6.6 for Caper's.

Common species were also omitted from the list of singing males for both islands. Two such species were the Great Crested Flycatcher (*Myiarchus crinitus*) which was present but gave only a short alarm call, and the Carolina Chickadee (*Parus carolinensis*) which did likewise. The Solitary Vireo (*Vireo solitarius*) recorded on Kiawah is a winter resident which apparently begins singing prior to its spring departure.

Table 4. Species totals by transects on two South Carolina barrier islands

	Perm. Res.	Sum. Res.	Wint. Res.	Trans.
Kiawah I.				
Transect 1	23	9	5	1
Transect 2	32	9	6	3
Transect 3	27	12	6	2
Caper's I.				
Transect 1	30	10	7	6
Transect 2	16	7	5	3
Transect 3	17	9	6	4

¹Permanent resident species including non-breeding species, are present year round. Summer residents are those occurring and breeding during the summer. Winter residents are those species present from fall to early spring. Transient species are those appearing only during migration.

DISCUSSION

THE LIMITED duration of this study resulted in insufficient data for conclusive statistical treatment and pointed out the need for additional studies in these habitats, especially in winter months when large numbers of visitors move into the area. Passerine density could well be greatest during this season

Density figures for the heavily dis-

Table 5. Habitat utilization of birds on two South Carolina barrier beach islands

Transect	Habitat	Disturbance Factor	Type	Average number Species per sample	Average number individuals per sample
Caper's I.	1 pond margins, maritime shrub, maritime forest	light	nature observation, camping	13.4	39
	2 maritime forest, dirt road	light	foot traffic	8.3	22
	3 maritime forest	undisturbed		8.6	31
Kiawah I.	1 disturbed maritime forest	heavy	residential development, golf course	11.1	22
	2 abandoned pasture, dirt road, maritime forest	medium	road traffic	8.5	53
	3 pond margin, maritime forest	undisturbed		16.2	51

Table 6. Feeding guild distribution on two South Carolina barrier islands

	Transect	Ground-seed	Foliage-seed	Foliage-nectar	Ground-insect	Air-insect	Timber drilling	Timber searching	Foliage-insect	Misc
Caper's I.	1	12	1	1	7	3	2	1	18	6
	2	6	2		1	1	1	1	15	4
	3	7	2		4	3	2	1	13	3
Kiawah I.	1	5	2	1	2	3	4	—	17	4
	2	10	1	1	6	2	3	—	21	6
	3	9	1	1	4	3	3	—	21	5

turbed transect on Kiawah Island are well below all other transects while other differences in individual species densities are related to habitat. On Kiawah Island Transect 2 for example, the heavy density of White-eyed Vireos (*Vireo griseus*) and Painted Buntings (*Passerina ciris*) is associated with the old field-seral component. Similarly on Caper's Island the large number of Red-winged Blackbirds (*Agelaius phoeniceus*) on Transect 1 reflects the importance of pond margins to this species. Caper's Island also displayed an overall low density along Transect 2. This lightly disturbed transect through the maritime forest did not appear to differ in habitat quality. This unexplained scarcity can perhaps be attributed to patchy distribution. The unduly high density level of the Common Grackle (*Quiscalus quiscula*) on Caper's Transect 3 is an artifact created by a single large foraging flock encountered only once.

It is clear that there are differences in species diversity between individual barrier islands which are directly related to the complexity of vegetation. Perhaps more important are the differences in avian density. While this too can be attributed to island size, to some degree it can perhaps be assigned to the patchy bird distribution. Patchy distribution has been noted in tropical areas of extensive homogeneous habitat (MacArthur and Pianka 1966) and could well apply to maritime forest. Additionally, tropical species in homogeneous habitats have been found to have larger home ranges (Karr and Roth 1971). At present home ranges have not been studied on barrier islands, but this concept may aid in explaining the absence of several common species and the role of large predatory species.

Each island lacked sixteen species recorded on the other. On Kiawah all sixteen species were observed off the transects or have been recorded previously (Chamberlain and Chamberlain 1975). On Caper's Island, none of the sixteen species was observed off the

transects, but the Hairy Woodpecker (*Picooides villosus*), Eastern Phoebe (*Sayornis phoebe*) Acadian Flycatcher (*Empidonax vireescens*), Eastern Wood Pewee (*Contopus virens*), Carolina Chickadee, and Tufted Titmouse (*Parus bicolor*) were not recorded. While several of these species may not have had preferred habitat available, the absence of the Carolina Chickadee and Tufted Titmouse remains a mystery. Both islands failed to host a number of common winter residents, but this was probably owing to the brevity of the study. The House Sparrow (*Passer domesticus*) and Starling (*Sturnus vulgaris*) were the only abundant mainland species that were not observed.

While this study focused primarily on passerines, some interesting information on large predatory species was also gathered. The low density figures for hawks, owls, and vultures possibly reflects a lack of preferred habitat in the case of the Red-tailed Hawk (*Buteo jamaicensis*) and American Kestrel (*Falco sparverius*), the size of the island and consequent range restriction in the case of vultures; and the difficulty in locating prey in the case of owls. Hawks and owls are both apparently limited by the density of vegetation through most of the forest. Avian density was also clearly related to disturbance. This factor was particularly evident on Kiawah Island where the heavily disturbed Transect 1 showed 20% fewer species and a 66% reduction in average density.

At present there exists little information on South Carolina mainland habitats which allows a density comparison. Densities obtained by Emlen (1978) for northern Florida (305 individuals/km²) are perhaps similar to the regional mainland. Indications are that maritime forest densities are substantially below the adjacent mainland.

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LITERATURE CITED

- CHAMBERLAIN, W.D. and E.B. CHAMBERLAIN. 1975. Avifauna of Kiawah Island in: Environmental Inventory of Kiawah Island. Environmental Research Center, Inc. Columbia, S.C.
- COCKFIELD, B.A., J.B. TORMEY and D.M. FORSYTHE. 1980. Barrier 1 Maritime Forest, WB-PS. *Am. Birds* 34:29.
- EMLEN, J.T. 1971. Population densities of birds derived from transect counts *Auk* 88:323-342.
- . 1978. Density anomalies and regulatory mechanisms in land bird populations on the Florida Peninsula. *The Amer. Naturalist* 112:265-286.
- KARR, J.R. and R.R. ROTH. 1971. Vegetation structure and avian density in several New World areas. *The Amer. Naturalist* 105:945.
- MACARTHUR, R.H. and E.R. PIANKA. 1966. On optimal use of a patchy environment. *The Amer. Naturalist* 100:603-609.
- MANUWAL, D.A. 1968. Breeding bird populations in the coniferous forest of western Montana. M.S. Thesis Univ. Mont. 176 p.
- SALT, G.W. 1953. An ecological analysis of three California avifaunas. *Condor* 55:258-273.
- SHARITZ, R.R. 1975. Forest communities of Kiawah Island in: Environmental Inventory of Kiawah Island. Environmental Research Center, Inc. Columbia, S.C.
- TORMEY, J.B., B.A. COCKFIELD and D.M. FORSYTHE. 1980. Barrier 1 Golf Course Subdivision. WB-PS. *Am. Birds* 34:40.
- WARNER, L. 1976. The status of the barrier islands of the southeastern coast. Open Space Institute and Natural Resources Defense Council. New York

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