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A RESOURCE CAPABILITY STUDY

INTERIM REPORT

by
James F. Parnell
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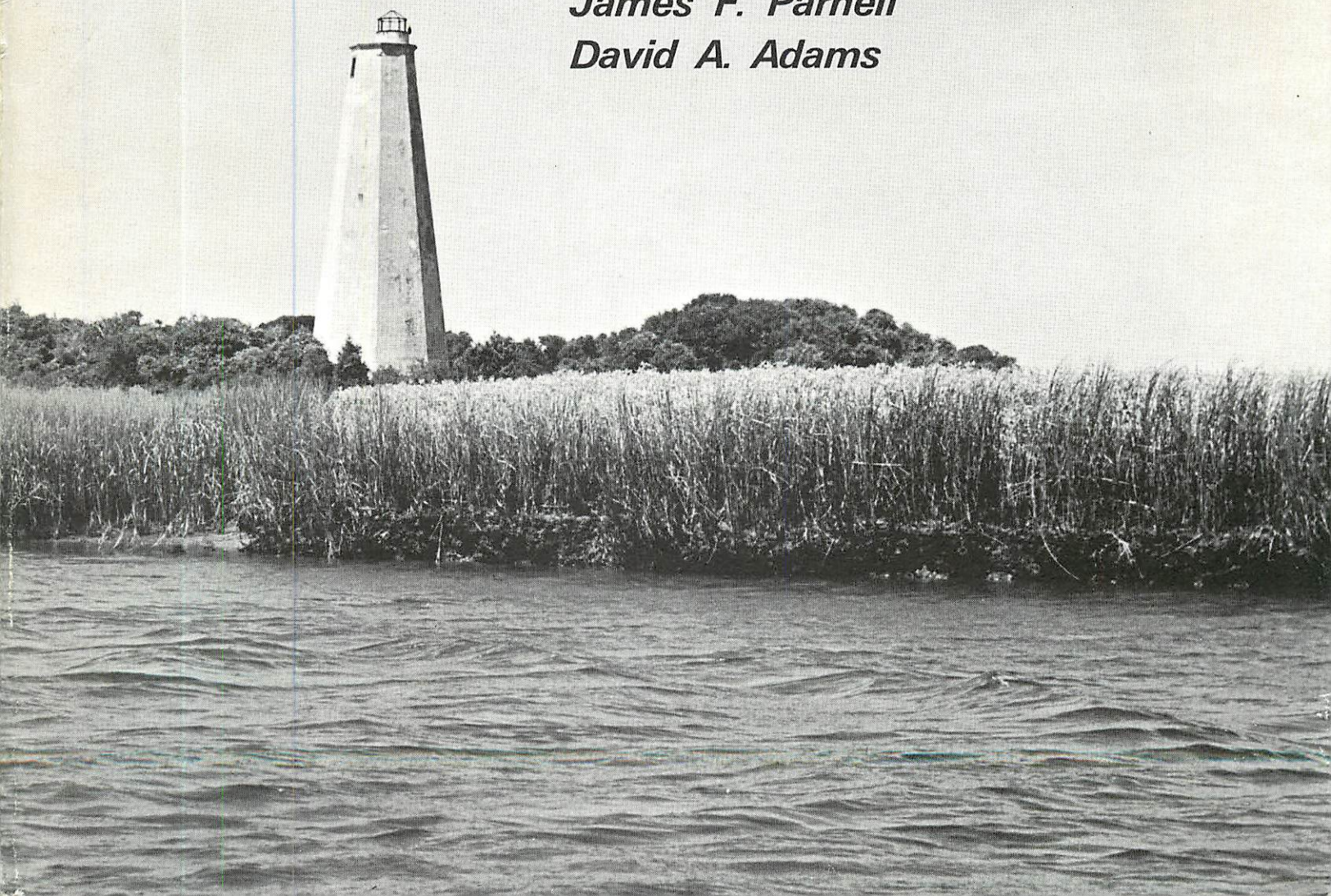

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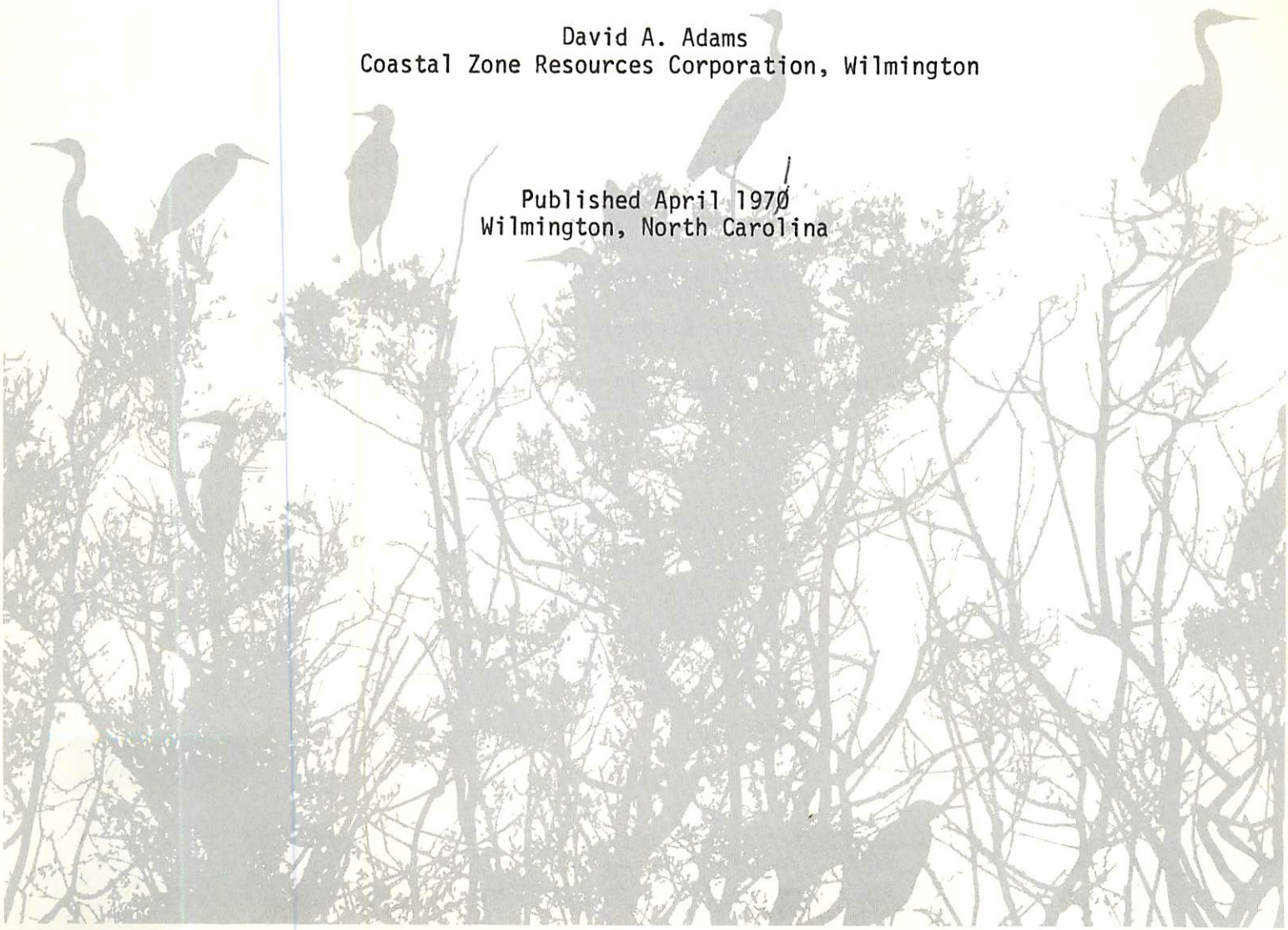

RESEARCH TEAM

Dr. James F. Parnell of the Biology Department, University of North Carolina at Wilmington and Dr. David A. Adams of Coastal Zone Resources Corporation shared overall supervision of the study.

The following professional people assisted with specific phases of the study:

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The United States Soil Conservation Service provided the services of two Soil Scientists, Drs. Erling Gamble and Ray Daniels, to assist with the soil analysis. Numerous other people also provided assistance.

The Carolina Cape Fear Corporation, through its Chairman, Mr. William R. Henderson, was most helpful in allowing access to the island.

Special thanks go to Mrs. Dorothy Roth, Secretary of the Biology Department at the University of North Carolina at Wilmington, for her continuing work throughout the preparation of this manuscript.

The photographs on the covers, the flyleaf, and on pages 31, 35, and 37 were taken by Jack Dermid. All others were taken by James F. Parnell.

The line drawings are courtesy of John Henry Dick and Will Hon.

INTRODUCTION

Smith Island, more popularly known as Baldhead, is an island complex containing about 12,000 acres of beaches, dunes, maritime forest, salt marshes, and tidal creeks, lying at the mouth of the Cape Fear River. This semi-tropical island, constituting the most southern extent of the state of North Carolina, consists of some 3,000 acres of high ground and about 9,000 acres of salt marshes and shallow estuaries (Figure 1).

Smith Island is important in the history of southeastern North Carolina, having been occupied by traders and pirates in the early 1700's, the British during the Revolutionary War, and by a Confederate fort during the Civil War. Later, it housed aunit of the Life Saving Service and still later the U. S. Coast Guard. Efforts were also made in the 1940's to farm parts of the island.

Since the end of the effort to farm the island, Baldhead has not been regularly inhabited by permanent occupants. It has, however, continued to be a place for fishermen to gather and has been often visited by campers seeking its solitude.

In recent years, developers have focussed their attention on the island and several plans have been put forth to transform it into a coastal resort community. Alternate proposals have been made to retain the island in a more natural state and in some form of public ownership.

This project was designed to study the ecology of the island complex and to evaluate the effect of man on the island. This interim report is based on the first one-half year of study. It is anticipated that the research program will continue at least through the fiscal year 1971-72.

Figure 1. Generalized map of Smith Island

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GEOLOGICAL FORMATION

The time or manner of the formation of Smith Island is not clearly understood. There have been no extensive geological studies, but some indications are of interest.

The soils of the island are rather poorly developed and apparently represent early stages of soil genesis. The soils on Bluff Island are somewhat older and better developed than those on Baldhead with the Middle Island soils being intermediate.

These findings correlate well with the general configuration of the island and suggest that it was formed by the complex action of waves setting up longshore drifiting of sand. Smith Island, according to this idea, would have come about in the following manner. Northeast winds during the fall and winter moved sand southward along the eastern coastline, building a sand spit at the point where the coast turned westward. Southerly winds, which dominate southeastern North Carolina during the spring months, pushed sand at the end of the spit back upon itself, bending the point of the spit to the southwest (Figure 2).

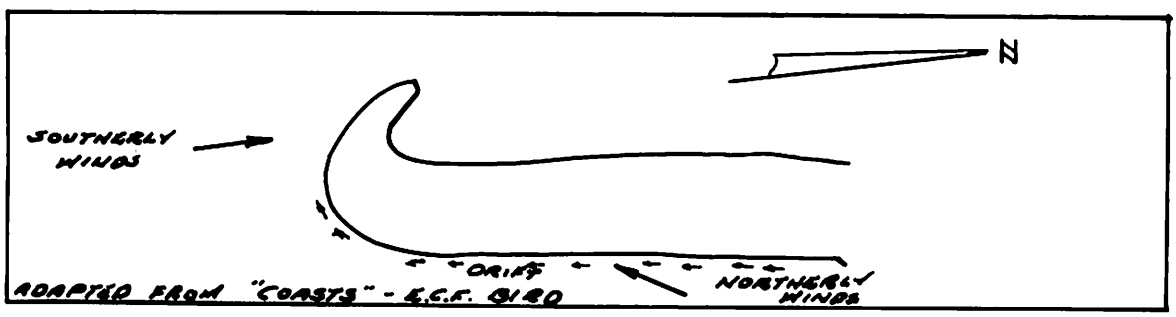


Figure 2. Sand spit formation, early stage

At times northerly winds dominated. During these periods the eastern beach would have grown larger as sand accumulated at its southern end. However, long periods of dominant southerly winds would have resulted in the formation of the westward reaching arms as indicated below (Figure 3).

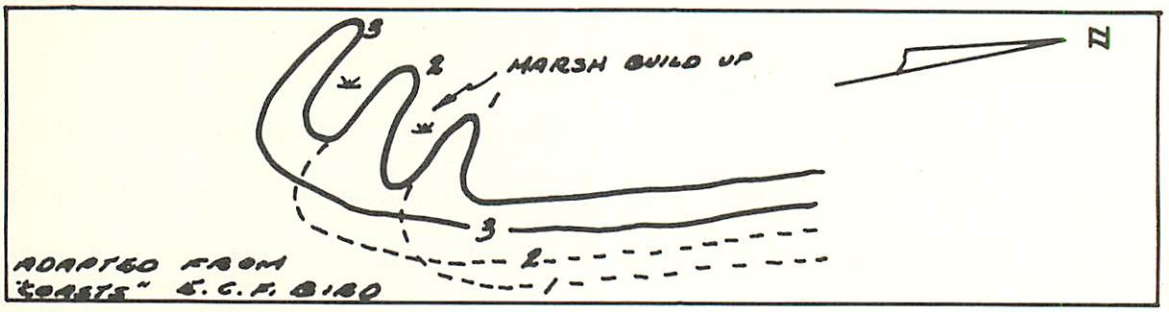


Figure 3. Sand spit formation, late stage

Such action is well defined by geologists as being a major way that offshore islands of this type are formed. It may have happened here. Further work is certainly needed to establish this as fact and there are alternate theories. If Smith Island were formed in the preceding manner, it is of recent origin, and originally was a peninsula which was finally severed from the mainland by erosion.

An alternate hypothesis is that this cape was formed by the deposition of river transported sediment as the ocean's edge retreated during the glacial periods. During these times the shoreline regressed and the gradient of the Cape Fear River increased, resulting in less sedimentation along the inland portions of the river and more deposition at the mouth of the river.

As the river mouth moved seaward with the lowering sea level, ridges of sediment would have extended out over the continental shelf. Thus, according to this hypothesis, the cape would have represented deltaic ridges formed during glacial periods.

As the glaciers melted and the oceans rose and reclaimed the continental shelf, these ridges would have been subject to erosion and inundation. This process was, however, apparently not uniform. There were periods of rapid rise in sea level with accompanying severe erosion of these headlands. There were also periods when the rate of rise in sea level was very slow. During these periods, wind action piled sand along the beaches building Cape Fear much higher than the original deltaic ridges. This mechanism may have also projected the cape seaward from its original location. A slight subsequent increase in sea level would have flooded the lowlands to the landward side of these barrier ridges forming the present day estuaries.

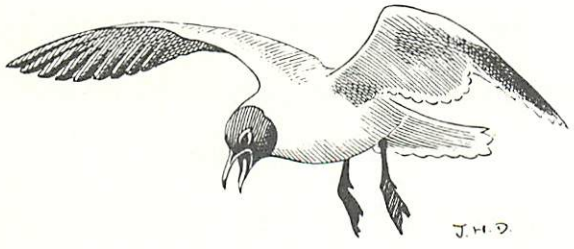
Under both hypotheses, two further things would have occurred. First, the landward extensions of the coastal ridge would have broken the flow of water from the already slow moving Cape Fear River and would have increased the rate of deposition of silt in these areas. As the bays filled, cordgrass would have appeared along the edges of the peninsula. In time, the marshes would have become quite extensive, broken only by the tidal creeks maintained by the scouring action of the daily rush of tide.

A second molding action obvious at Smith Island is the continued erosion of the east beach as long-shore drift continues and as the ocean continues to rise relative to the land.

Continuing our supposition that Smith Island was formed by one of the

above sets of actions, the sequence of events would have continued something like this. As sand accumulated and dried at low tide, the winds would have piled it up until it extended above the high tide mark. Here salt tolerant pioneer plants such as sea oats would have become established. These would have acted as sand traps and continued to increase the elevation of the island.

However, most islands vegetated only by grasses are relatively unstable and storms readily move dunes and modify the appearance of the land over long periods of time. If, however, forests can begin to develop, they too trap wind-blown sand and may eventually form large, relatively stable dunes along their seaward edge. The outer edges of these forests may be gradually buried as the dunes slowly override the forest. However, this is a process of decades, or perhaps centuries, and rich, diverse forests generally develop in the lee of such dunes. Here, protected from the full force of the winds and from the action of wind-blown salt spray, many species of plants grow and provide life support for a variety of animals. Such is the case at Smith Island, where a dune 40 to 50 feet high protects the extensive maritime live oak forest.



SHORELINE CHANGES IN RECENT PAST

The shoreline study of Smith Island is based upon a series of aerial photographs taken over the 32-year interval between 1938 and 1970. During this period there have been general erosion of the eastern coast of the island and a nearly static condition along the south and southwestern beaches. A five mile stretch of beach beginning at about the southern extremity of Buzzard Bay and extending northward to within about one and one-half miles of the Fort Fisher site, appears to be extremely unstable and very susceptible to being cut through by inlets. The sound-estuarine areas immediately to the west of the beach appear to have been shoaling during this period, probably due to material washed or blown from the eastern beach. Cape Fear itself, the southeasternmost point of the island, seems to have followed a pattern of building up during relatively calm periods of weather and eroding away with each hurricane or northeaster.

In 1938, one inlet, known historically as Corncake Inlet, interrupted the eastern beach, and the Cape itself jutted well out toward Frying Pan Shoals (Figure 4, map 1). The 1949 photographs show approximately a 1,000 foot southward movement of this inlet from its 1938 position and a new inlet formed slightly over two miles to the north (Figure 4, map 2). This inlet seemingly was formed by the severe hurricane of 1 August 1944 and probably was the genesis of the inlet now referred to as New Inlet. Cape Fear itself also eroded considerably between 1938 and 1949.

Between 1949 and 1956, New Inlet migrated one-half mile further southward. By 1956, Corncake had started to close by a shoaling action and another inlet had formed at the southern end of Buzzard Bay. This inlet,

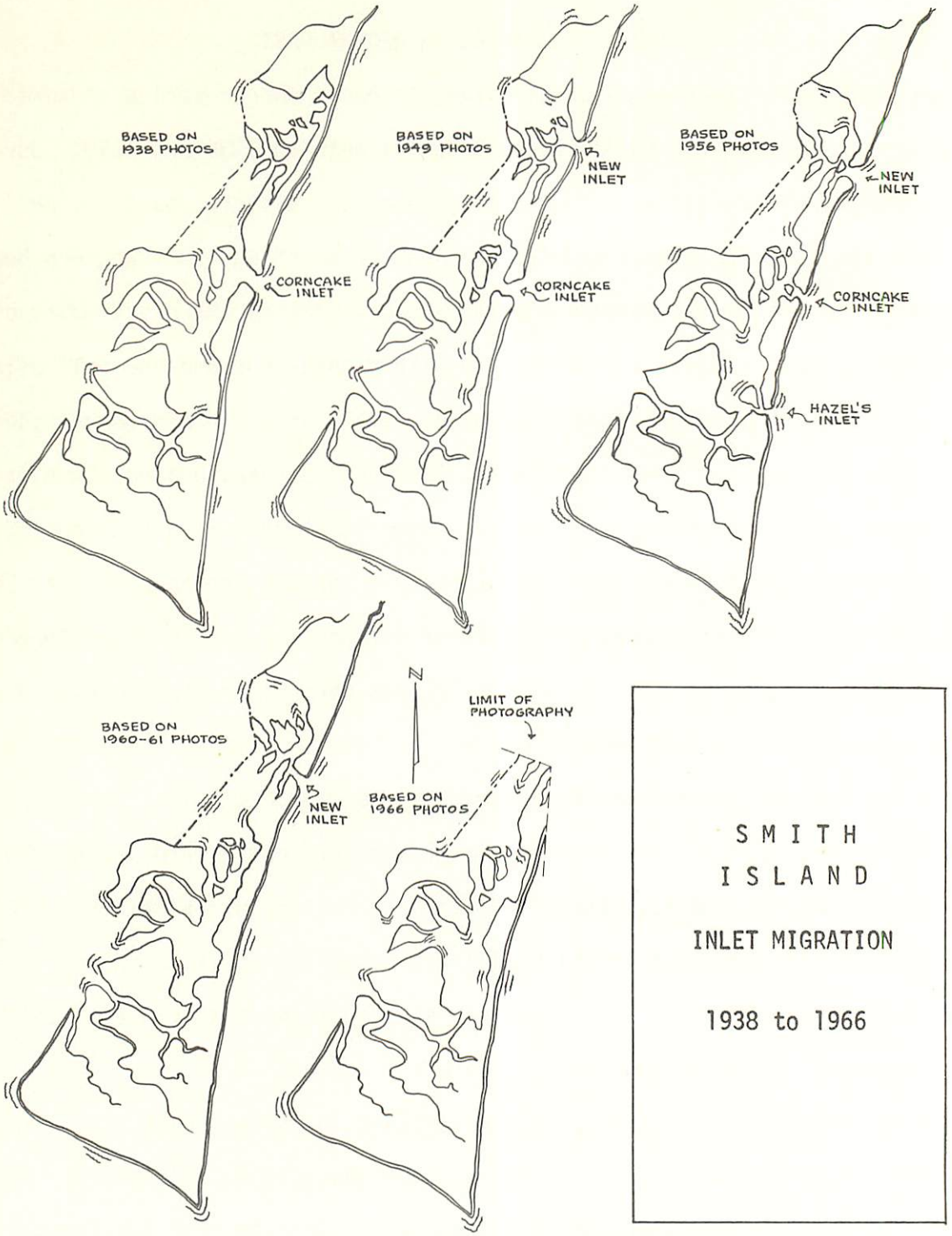


Figure 4. Inlet locations at Smith Island, 1938 to 19~~70~~66

known locally as Hazel's Inlet, was probably a result of Hurricane Hazel on 15 October 1954 and/or Hurricane Connie on 12 August 1955. The large island just inside New Inlet shows significant accretion between 1949 and 1956 with an increase of visible vegetation (Figure 4, map 3).

Between 1949 and 1961, New Inlet moved about 1,500 feet southward at a rate of about 300 feet per year. The other two inlets noted in the 1956 photography were closed (Figure 4, map 4). These changes were probably brought about by the passage of Hurricane Donna, about one month before the photography date. The islands just inside New Inlet continued to build and vegetation seems to have increased since 1956.

The 1966 photography stops just short of the actual opening of New Inlet into the ocean. However, there is enough of the characteristic shoaling visible to the southwest of the inlet to make a fair estimate that the inlet had moved southward about 250 to 300 feet since 1961 (Figure 4, map 5). This rate indicates that the southward movement of the inlet has not been constant.

Two severe hurricanes occurred between 1961 and 1966: Ella in October 1962 and Ginny in October 1963. Either or both of these storms washed over the east beach at the old sites of Corncake and Hazel's Inlets. The shoreline appeared to be extremely unstable at these two points and there was no significant dune structure present.

Since the 1966 photography, either New Inlet has moved southward at a rate of about 700 to 900 feet per year, or New Inlet was closed and another inlet was cut through about 3,000 feet to the south. The former possibility is most likely.

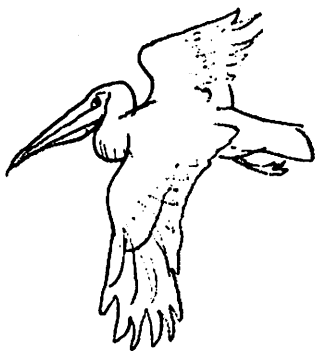
Figure 5. New Inlet and vicinity, early spring 1971

In its present configuration, the channel through New Inlet executes a sharp bend as it penetrates the beach. Along the outer (southern) edge, increased tidal velocities are causing massive erosion; along the inner (northern) edge reduced velocities produce accretion. As a result, New Inlet is now migrating south at a rate which will place it near the former location of Corncake Inlet by 1973. Four hurricanes passed offshore during the period 1966 to 1970, and may have contributed to the self-perpetuating process described above.

The beach still remains very susceptible to erosion and to being pene-

trated by inlets at two locations. There has continued to be a build-up of the small islands in the bay behind New Inlet.

Study of aerial photographs taken between 1938 and 1970 indicate a continuous westward migration of the east beach. The distance moved varies, with maximum erosion occurring along the southern portion of the beach. Here as much as 400 feet of beach has been lost in this 32-year interval.



THE SOILS

The genesis of coastal soils from deposits of loose sand and shell fragments is a long and complicated process. Physical and chemical processes disintegrate and dissolve these materials, and percolating rainwater moves them downward through the developing soil. As plants take root in these young soils, their decay adds organic matter which becomes the humus so important to any soil.

With the continuation of these processes over long periods of time, soils become organized into definite layers or horizons. The first horizon (O) is the layer of decaying material at the surface. The second horizon (A) is the layer of humus incorporation and of maximum loss of fine materials. The third horizon (B) is the layer in which the fine materials washed down from above are redeposited. The fourth horizon (C) consists of unweathered materials similar to those from which the soils above were formed.

In very loose soils where there is relatively heavy rainfall, much of the decaying material may be carried well down into the B horizon where it is redeposited as a dark layer called the Bh horizon.

The resultant horizons are characterized by strong differences in color, particle size, and chemical composition. Such factors allow an evaluation of the age and stage of development of soils.

The soils on Smith Island are relatively young and poorly developed. The most strongly horizonated soils are found on Bluff Island. The well drained soils here have well-developed, brown, B horizons with some accumulation of fine materials. The slightly wetter soils of the swales also have accumulations of iron, modern roots, and humus (Bh horizon) at the water table. All

carbonates have been leached from the upper 65 inches.

On Middle Island, the B horizon shows a weaker color and there is no accumulation of fine materials in the subsurface horizons. Here shell carbonates have been leached only to a depth of 54 inches. In the wet swales, distinct Bh horizons are again found.

On the northeastern side of Baldhead Island both A and B horizons are less well developed. Here shell carbonates are leached only to 15 to 20 inches. These soils grade into the most recent of the soils which occur over most of Baldhead. They show little or no indication or horizonation and shell carbonates are present at the surface. The sands are very soft and fluffy. When disturbed, as by vehicular travel, a thick layer of loose sand is formed at the surface.

Extreme variation in the depth to water table occurs throughout the island. Generally, within the ridges the water table is rather deep, often being over five feet below the surface. In swales between the ridges, the water table may lie just beneath the soil's surface. In these areas, standing water may be present during much of the winter. Further studies of subsurface waters are very much needed.

These soils contain very little humus and are generally medium fine sands. They retain very little water above the water table and are particularly dry on the ridges. The plants appear to compensate for this factor by sending roots into the water table itself. There is also an accumulation of organic matter at the top of the water table indicating that the soils do not act as efficient filters.

THE ISLAND'S ECOLOGICAL COMMUNITIES

The Smith Island complex may be divided into several major communities and several less extensive or secondary community types each of which is discussed below.

Figure 6. Inshore waters and beach, approaching cape from north

Inshore Ocean Waters

The inshore ocean waters at Smith Island are excellent places for viewing the migration of waterbirds. Birds moving north or south appear to come inshore as they pass the Cape. Here during fall or spring tremendous flocks of scoters, loons, Red-breasted Mergansers, and other seabirds may be regularly encountered. In addition, large numbers of many of these birds overwinter in the ocean off Smith Island.

While no large whales were observed off Smith Island, dolphins were abundant. It was not uncommon to count 50 or more of these small whales close inshore along the eastern beach. Specific identification was impossible, but most were probably the Atlantic Bottle-nosed Dolphin, the most common species in North Carolina waters.

In late summer and fall the surf and offshore shoals provide excellent fishing for a number of species of sport fish. It is considered by many to be one of the best fishing areas in southeastern North Carolina. The major fish caught are Bluefish, Flounder, Speckled Trout, and Channel Bass. All of these species are in some way dependent on estuaries such as those at Smith Island.

Sandy Beaches

Open sand and shell beaches extend from New Inlet to the mouth of the Cape Fear River. No rooted vegetation grows in this community and its form and extent are constantly changed by wind and tide. Such physical actions are strong at Smith Island, and shoals and deep troughs are a constantly changing aspect of the beaches and surf.

Smith Island is an important breeding site for the Loggerhead Sea Turtle. The females come ashore during the summer to lay their eggs in deep cavities just above the high tide mark. Although field work was not begun until July in 1970 and surveys of the beaches were incomplete, 13 nests were located, four on the south beach and nine on the east beach. Other observers reported several additional nests on the island in June, making a total of over 20 nests. In addition to the nests located, four dead turtles were found on the beaches. These turtles were generally unmarked and the cause of the

mortalities was undetermined.

Sea turtles' preference for gently sloping beaches was evident at Smith Island. The east beach slopes gently up to low rolling dunes which provide no barrier to turtles coming to land. Nine nests located were on this segment of beach. The south beach is narrow and often ends against steep banks where wave action is cutting at the dunes. Only four nests were on this beach.

The full moon in June is generally considered to be the time when sea turtles come ashore. At Smith Island turtles appear to nest throughout the summer. We were not on the island during June but reports indicate that several turtles did come ashore at this time. Three nests were located during the third week of July and nine were found during the first week of August. One turtle came ashore and laid its eggs as late as 21 August 1970.

Sea turtles are generally finding it difficult to complete their nesting cycles along the East Coast. Crowded and lighted beaches are unsuitable for successful nesting and most species are in danger of extinction. The remaining undeveloped beaches, such as those at Smith Island, have become very important in maintaining the remnants of these populations. More detailed studies on the Loggerhead Sea Turtle are planned for the summer of 1971.

These beaches are also important resting and feeding areas for a variety of birds. Large numbers of Herring Gulls, Ring-billed Gulls, and Royal Terns are regularly present along the beaches. Twenty species of shorebirds have also been recorded on the beaches and numbers of some species have been impressive. Estimates of as many as 1500 Dunlin have been made along the four to five miles of beach between New Inlet and the Cape. In addition, the

Dowitcher, Black-bellied Plover, and Whimbrel were often present in large numbers.

A remnant of the Peregrine Falcon population, which faces extinction in North America due to pesticide-induced reproductive failure, still stops at Smith Island during its fall migration. Small numbers of these rare birds were seen in October. They utilize the beaches as well as other more open communities of the island for hunting and resting.

The Brown Pelican, another species facing extirpation in North America, regularly utilizes the beaches and inshore ocean waters at Smith Island. These birds do not breed at Smith Island but do overwinter here in relatively large numbers. They were regularly found around New Inlet and at the Cape itself throughout the fall and winter. The largest number recorded was a flock of 48 at New Inlet.

Several animals not usually associated with the beach community are regular visitors to the ocean's edge. It was not at all uncommon to see feral hogs rooting in the intertidal sand or simply strolling along the beach. Their sign was almost always present in the vicinity of a ransacked sea turtle nest, but it is presently unknown whether they discover and excavate the nests themselves or simply investigate the opened nests. The other likely nest predator is the Raccoon which is abundant on the island and regularly patrols the beaches after dark. Less expected is the regular occurrence of the Gray Fox on the beaches after dark and the occasional presence of the Opossum.

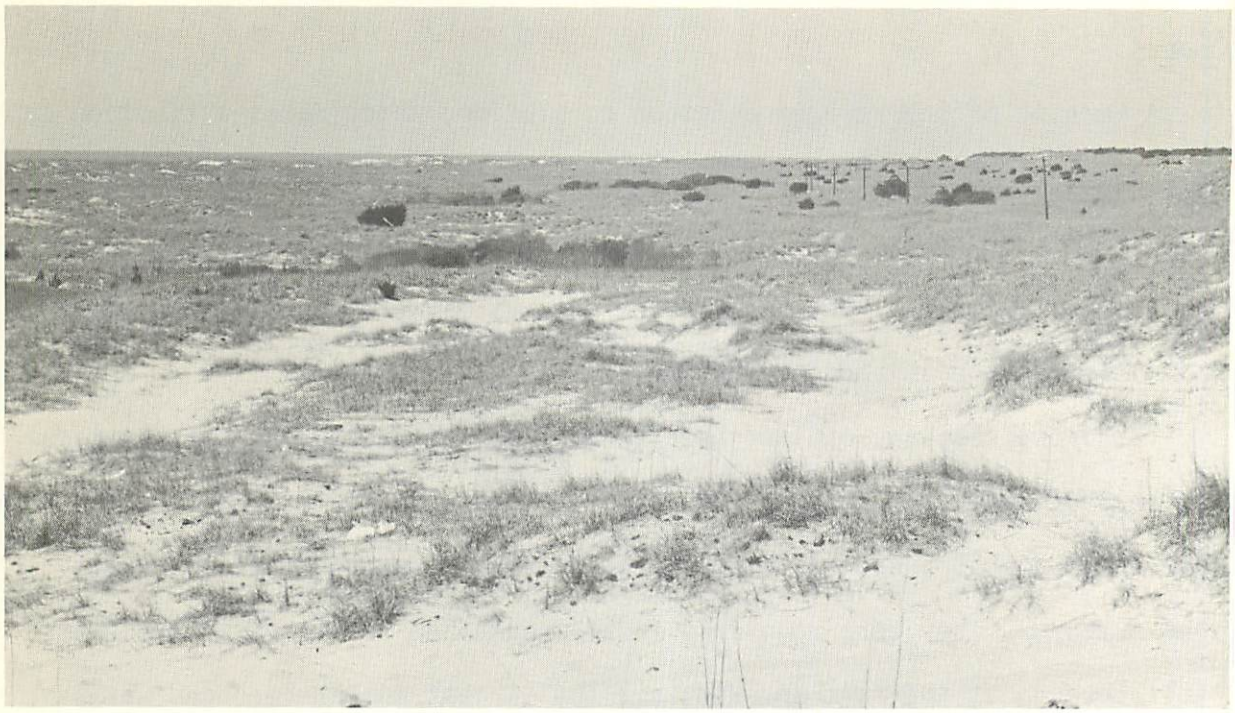


Figure 7. Broad expanse of sea oats dunes on Baldhead

Sea Oats Dunes

This community of rolling dunes is characterized by the dominance of sea oats. Along the eastern shore, the sea oats dunes are generally low and may extend for only a few yards before grading into either shrub thickets or directly into the salt marshes. On Baldhead proper, this community may be as many as 800 yards in width, and the dunes may approach 40 to 50 feet in height.

The importance of this community to the stability of the island cannot be overestimated. As sand is blown from beaches it is trapped by the sea oats, and a dynamic stability is achieved. The dunes gradually grow in size and move only very slowly, even with the almost constant wind action. With-

out the cover of this wind and salt resistant plant, which can further tolerate a slow burial by accruing sand, the dunes would rapidly move landward over the maritime live oak forest. Even so, the sea oats do not completely stop the progression of the dunes. Stumps and snags of trees protruding from the dunes well to the seaward of the present forest border are evidence of this slow process.

These dunes systems have been broached by the ocean along the east beach in several places in recent years. At two locations south of New Inlet, there have been inlets since 1938. Here, the sand dunes are low and only sparsely vegetated, and autumn storms regularly wash fresh sand from the beaches over these areas into the edges of the salt marshes.

While the sea oats dunes are very important to the stability of the island, they do not contain a large variety of vertebrate life, due probably to the generally limited and restricted food supply. The island's larger mammals move regularly through this community but only the Gray Fox seems to make its home here. Its dens have been located beneath the dunes of Baldhead and it probably feeds on the House Mice found there.

Reptiles are few in the sea oats dunes. The Black Racer is the only snake commonly found in this grassland. The burrowing Eastern Glass Lizard and the Race Runner also occupy the dunes.

Relatively few birds utilize the sea oats dunes regularly. One of the most interesting is the Ground Dove. Smith Island seems to be the farthest north that this bird occurs in numbers, with 15 scattered individuals seen there on 21 August 1970, and some present during all months. Flocks of Boat-tailed Grackles and Redwings were also commonly seen feeding on the sea oats in late summer and fall.

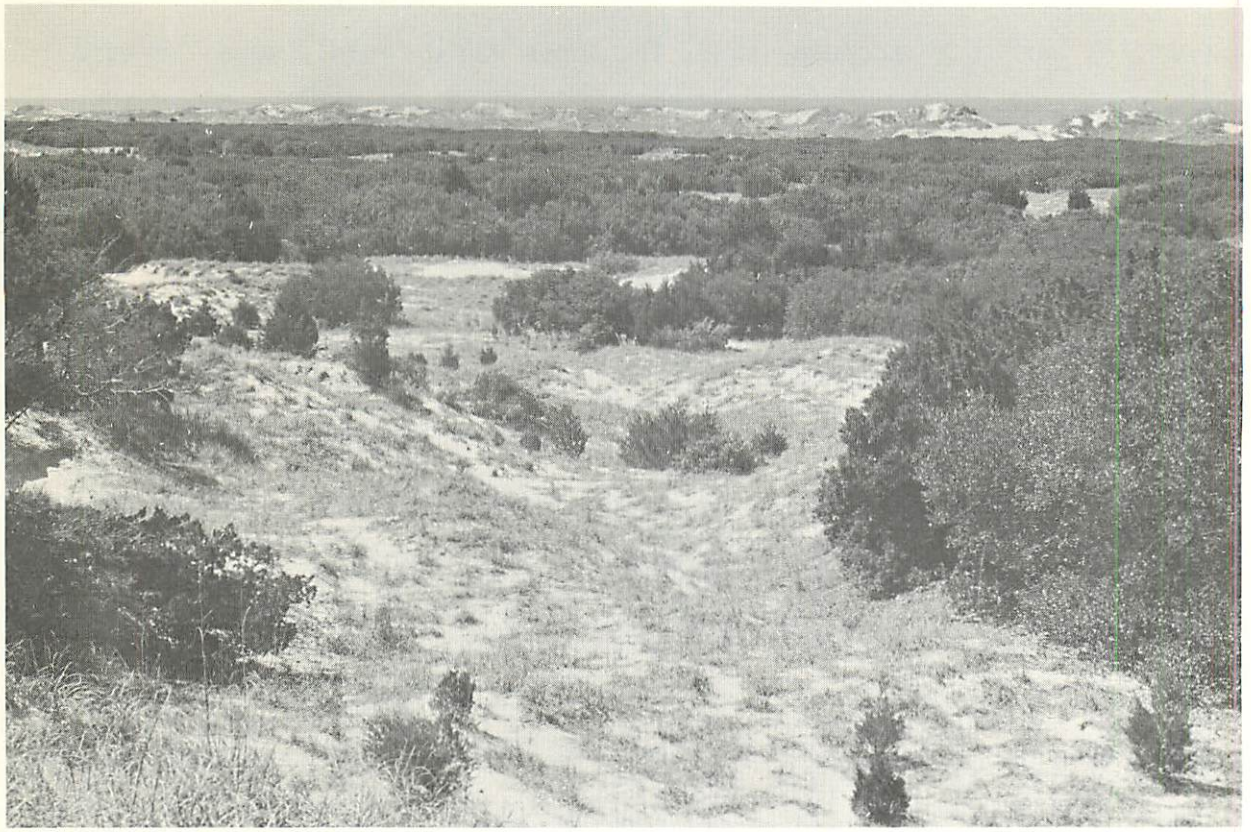


Figure 8. Extensive thickets on southwest part of Baldhead

Thickets

In swales between the dunes where elevations are low and some protection from salt spray is provided, shrub thicket communities have developed. Wax-myrtle, eastern red cedar, and several sedges and rushes are usually the dominant plants. Within some thickets forest species such as live oak and loblolly pine have become established. In time these may become new elements of the maritime live oak forest.

These thickets are important resting sites for a variety of small birds during the fall migration. Between late August and early November, the thick-

ets were often filled with warblers, sparrows, and such unusual birds as the Least Flycatcher and Northern Waterthrush.

The large thickets just south of New Inlet are of particular interest in that they contain populations of at least three species not found further south. The Rufus-sided Towhee is present throughout the summer and appears to nest there, but it appears further south only in the fall and winter. The Cotton Rat was found to be rather common along the edges of these thickets, but was not found further south. A single Cottontail Rabbit was also seen there and droppings indicate the presence of small numbers of the mammals. No rabbits have been found further south. The lack of large thickets between New Inlet and Bluff Island constitute a barrier to the distribution of the Cotton Rat and the Cottontail. However, the Towhee moves into the forest during the fall and winter, and the habitat appears suitable for nesting. Its absence in summer is not explained.

Figure 9. Forest - sea oats dunes edge along top of barrier dune

Maritime Live Oak Forest

The sea oats dune community on Baldhead extends to the crest of the major barrier dune ridge, approximately 40 to 50 feet in elevation. Behind this dune the maritime live oak forest begins. This forest is molded by two major environmental factors. The barrier dune protects it from the full force of the wind, but at the same time salt spray is regularly deposited on the leaves and twigs on the ocean side. This process leads to a dramatic shearing and shaping of the seaward side of the forest. The major tree species along this edge of the forest is the live oak. It is more resist-

ant to salt spray than most trees and protects the plants beneath it from the salt. Further back in the forest, laurel oak and loblolly pine become dominant with the live oak. Sabal palmetto appears as scattered individuals throughout the forest. This palm reaches its northernmost point of distribution on Smith Island and is the major semi-tropical component of the forest. The lichen, Herpothallon sanguineum, which occurs on the live oaks of Smith Island also reaches its most northern point of distribution on Smith Island.

The canopy of the maritime live oak forest averages only about 20 to 30 feet in height on the seaward side, rising gradually to 50 to 60 feet adjacent to the salt marshes. There is relatively little understory vegetation on the seaward side of the forest, but further back low tree and shrub strata may become well developed. As much of this vegetation is evergreen, little light penetrates to the forest floor, and there is almost no herbaceous flora.

The forest is not completely uniform. Several pine thickets indicate the presence of old openings and small scattered ponds and willow swamps add to the diversity of the forest.

The forest is dissected by a road extending from the old lighthouse at the mouth of the Cape Fear River to the Cape and by a road through the center of the forest from salt marsh to the dunes. In addition, several small fields were cleared in the 1940's for agricultural purposes. Numerous old cedar stumps and tops give evidence of rather extensive cutting of this species in the past. The full extent of this cutting and its effect on the present forest composition are unknown.

Figure 10. Old road through maritime live oak forest

In addition to the forest on Baldhead, there are well developed forests on both Middle and Bluff Islands. These forests appear basically similar to the Baldhead unit, but the Middle Island forest contains several sweet pignut hickory trees, a species not found on Baldhead.

A number of exotic plants are included in the forest flora as a result of man's activities on the island. Fig trees are associated with the old Coast Guard buildings, and pear trees are still found around the edges of the old clearings. A small group of trees growing along the edge of an old field represents the only known site in North Carolina for the Chinese date

other than in cultivation.

The vertebrate fauna of the forest is the most varied of the upland communities. Amphibians are less well represented than the other groups, but the Southern Toad, Southern Leopard Frog, and Squirrel Tree Frog are rather widely distributed. They appear to breed in the small pools that are scattered throughout the island's forest. Little Grass Frogs, Narrow-mouthed Toads, and Carolina Tree Frogs were less widespread but were found around some of the ponds. No salamanders have been discovered.

While several kinds of reptiles have been found in the forest, only the Black Racer appears to be common. The only other snakes found were the Rough Green Snake, the Banded Water Snake, the Yellow Rat Snake, and the Coachwhip.

No lizards were found to be common, but the Six-lined Racerunner did occur in small numbers over much of the island. It was usually found along the edges of the forest or thicket communities. Only a single Green Anole was discovered, indicating that it may be less common than indicated in earlier reports. The Eastern Glass Lizard is also rather widespread over the island. Its burrowing habits may mean that it is more abundant than observation indicated. A single Five-lined Skink was also collected from the forest.

Bird life in the forest varies considerably with the season. Summer residents are relatively few in kind, with the Carolina Wren, Cardinal, and Painted Bunting being most common. Notable by their absence were the Rufous-sided Towhee and Blue Jay, both of which are very abundant on the nearby mainland. The Towhee was a resident in the thickets just south of New Inlet, but does not occur in summer on the lower island.

The situation changes dramatically with the advent of the southward mi-

gration of small land birds in late summer. Twenty-two species of warblers were recorded in the forest in August, September, and October including the Blackburnian, Golden-winged, Magnolia, Mourning, and Black-throated Blue Warblers, which are not regularly recorded along the coast. Catbirds, which are not found on the island during the breeding season, become very abundant by early September, and Towhees and Blue Jays also become numerous. About 60 species of birds not recorded during the breeding season were found in the forest during the period between August and December.

Some of the immigrants remain on Smith Island for only a short period of time before passing on to wintering grounds further south. However, at least 25 species of forest birds winter on the island.

Of particular interest were several White-crowned Sparrows found along the edge of the forest on Bluff Island on 23 October 1970. This western species wanders to North Carolina in small numbers each year, but is seldom seen along the southeastern coast.

The most abundant forest mammal was the Gray Squirrel which is common on all three islands. Raccoons and Opossums also utilize the forest and an Otter and a Mink were seen passing from the salt marshes into the forest.

Hogs are common on all three of the upland areas. They are reproducing successfully, and sows with one to four small pigs were seen regularly during the fall and winter. Hogs are occasionally shot by hunters, but it is unknown whether or not this is a restrictive factor on population size.

Feral hogs utilize the forest heavily, and their rooting and wallowing in the low swampy parts of the forest may play a significant role in the ecology of these areas.

The food taken by these hogs appears to vary widely. They have been seen feeding on acorns in the forest and rooting in the forest floor, the old fields, the dunes, the beaches, and along the edges of the salt marshes. They are thus apparently omnivorous scavengers taking a very wide range of foods.

Small rodents are scarce in the forest. The Cotton Mouse was the only small rodent taken here during the mid-winter trapping program. It was found to be scattered throughout the forest but only in very low numbers.

If the Florida Wood Rat still remains on the island, it has evaded detection. The last record was of a single indivdual trapped in March 1966. This record represents the most northern recent observation of this species along the East Coast.

Figure 11. Remains of old field near lighthouse

Old Fields

During the early 1940's, an attempt was made to grow vegetables commercially on the island. Several small fields were cleared and irrigation systems were installed. The venture did not prove successful and the fields were abandoned. The reforestation of these areas gives some indication of the speed and nature of the process of secondary plant succession in maritime forest areas.

In the largest of the fields, located near the old lighthouse, the boundaries of the field are still evident. Red cedars and live oaks have

grown up as scattered individuals in the field, but most woody vegetation has apparently moved out from the forest edges by vegetative means. After nearly 30 years, much of this field is still covered with dense smilax thickets and open sandy patches of horsemint and other weedy plants. Hogs use this area extensively and their activities may have slowed down the process of reforestation. Further work on the community succession in these fields is planned.

Figure 12. Fresh-water pond and marsh on Bluff Island

Fresh-water Ponds and Marshes

Several shallow fresh-water ponds are found in the old dune valleys within the forests on Smith Island. They are usually bounded by willows and may have a variety of rushes and sedges along their edges. These ponds serve as fresh-water reservoirs for the island's forest animals, and are heavily used during the warm months as wallowing places for the island's feral hogs. They also appear to accommodate limited numbers of waterfowl, mostly Wood Ducks, during the winter months. During spring and early summer, they are important breeding sites for frogs. Their importance as breeding

areas for fresh-water mosquitoes has not yet been studied but may be significant.

There are also two open ponds on the island. The largest, on Bluff Island, comprises about one-half acre of shallow, open water and two to three acres of fresh marsh. The marsh flora is diverse and many of the island's fresh water marsh plants occur only at this site. This pond is also very important to the island's animals and is usually heavily utilized. It may, however, dry up in late summer. It was very nearly dry in late summer of 1970.

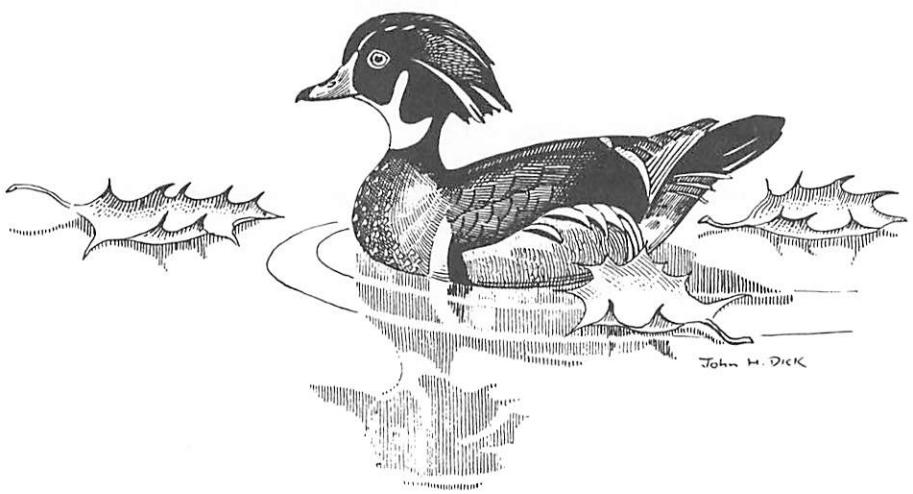
The Bluff Island pond was very heavily used by water birds. During late summer as many as 50 to 100 wading birds of five to six species could regularly be found feeding here. As fall approached, migrating flocks of Blue-winged Teal made heavy use of this pond, with a maximum of 150 recorded on 12 September. Mallards, Green-winged Teal, Shovelers, American Widgeon, and Gadwalls were also found here during the fall and winter. Florida Gallinules, Coots, Kingfishers, and several species of shorebirds also utilized this pond.

Raccoons forage along its margins regularly, and during the summer the Squirrel Tree Frog breeds here in large numbers. No fish were found in this pond, but two Mud Turtles were discovered at its edge.

The other open fresh water pond is located just a few yards behind the beach on Baldhead. It is only about 15 to 20 feet wide and perhaps 100 feet long but averages five to six feet in depth. It is surrounded by about an acre of marsh which grades into a very extensive wax myrtle thicket. This pond contains Mosquito Fish and was utilized by Wood Ducks, Mallards, Black Ducks, and some wading and marsh birds during the winter. The surrounding

fresh marsh had the densest population of small rodents found on the island. Rice Rats were abundant and House Mice were common.

The full impact of this marsh on the island's animals is not known at present. However, the deep water, which would appear to preclude the drying up of the pond during the summer, may make it particularly important.



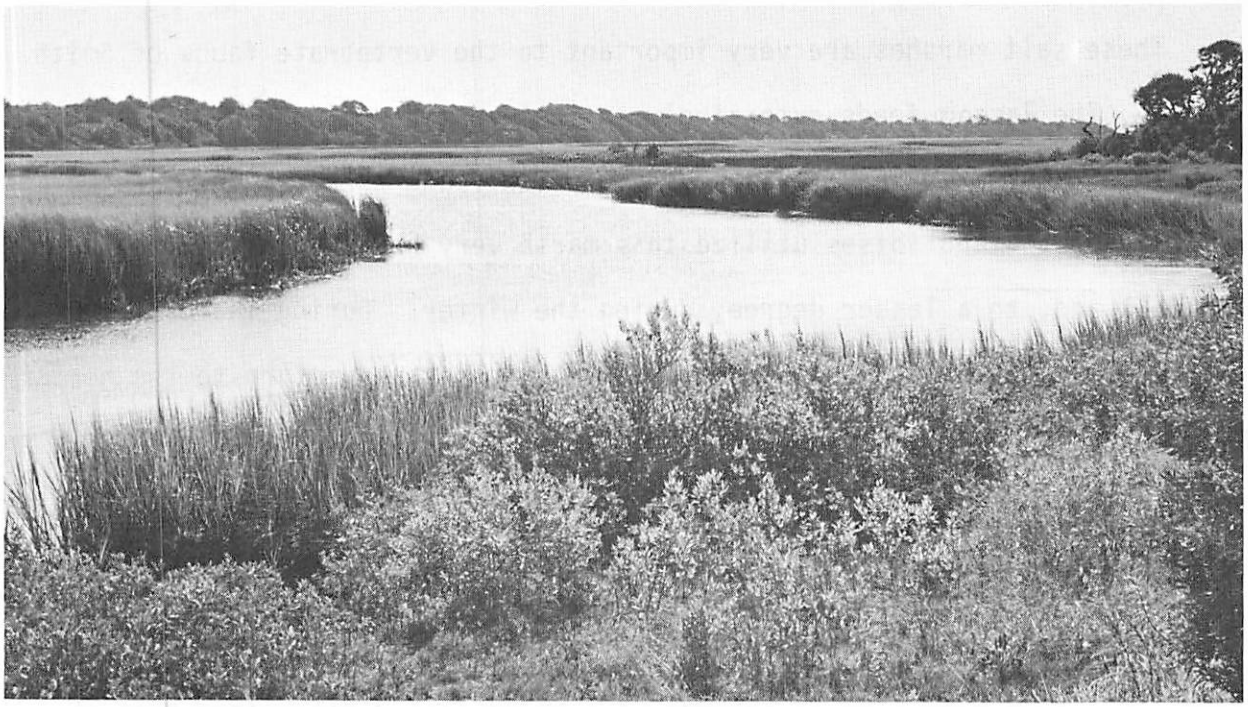


Figure 13. Salt marsh and tidal creek

Salt Marshes

The forest gives way rather abruptly to the extensive salt marshes. Usually, a narrow band of black rush occurs adjacent to the forest. It grades rapidly into an almost pure stand of smooth cord grass.

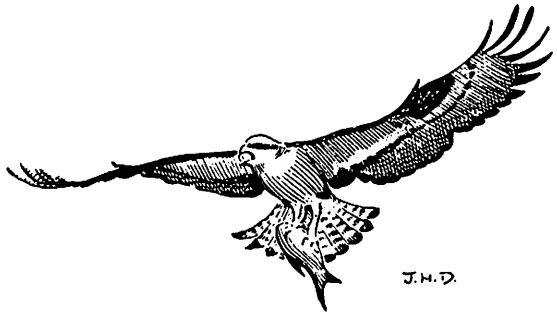
Along the eastern edge of the island the salt marsh usually borders the sea oats dunes or shrub thickets, with an intermediate band of saltmeadow cord grass where only the highest tides flood the grasses.

These salt marshes, along with the creeks that drain them and the associated shallow bays, constitute the Smith Island estuary. While these units are discussed separately, it should be kept clearly in mind that they are in fact an inseparable functioning unit. The separation here is purely one of

convenience.

These salt marshes are very important to the vertebrate fauna of Smith Island. The Raccoon feeds extensively in the marsh and along the tidal creeks that drain the marsh, and feral hogs are often found there. Nine species of herons, egrets, and ibises utilize this marsh very heavily during the summer and fall and, to a lesser degree, during the winter. During the breeding season these birds feed in the Smith Island marshes and return to the heronry on Battery Island to feed their young.

The White Ibis, which moved into the Battery Island Rookery only recently, has become one of the most abundant waders in the area and remains in large numbers throughout the winter. Scattered flocks of 25 to 50 may regularly be found in the marshes even in December and January, and over 1,000 nest on Battery Island each summer.



Tidal Creeks

The salt marshes are drained by a network of tidal creeks which flow into the Cape Fear River or the shallow bays between the river and the marshes. Within the creeks significant environmental changes occur over relatively short periods of time. During periods of low river flow, the salinity may approach that of sea water; when the river is high, the water may reach very low salinities. Actual measurements varied between 15 $^{0}/_{00}$ and 35 $^{0}/_{00}$.

Water temperature also fluctuates significantly in these creeks. In early fall the temperatures reached 30^{0} C. but by January the water temperature had fallen to 10^{0} C.

While turbidity was not measured in this study, it also fluctuates greatly and may affect organisms living there.

Trawl samples were taken twice monthly at several places in the tidal creeks. Forty-nine species of nekton (large, free-swimming organisms such as fish, shrimp, and crabs) were taken in these samples during late summer, fall, and early winter. Approximately 25 others, including several important sport and commercial species, probably occur but are not readily captured by trawling.

The dominant species taken in the early fall were Blue Crab, Brown Shrimp, Common Anchovy, Lookdown, Northern Puffer, Pinfish, Silver Perch, Spot, Squid, and Striped Anchovy. As temperatures dropped in late fall and early winter, American Shad, Blueback, and Silversides became more common and Lookdowns and Northern Puffers became less common.

The diversity of the nekton in the Smith Island estuary appears very high in comparison to other estuaries studied along the Atlantic and Gulf coastlines.

That is to say, the number of species caught in relation to the total number of individuals caught was very high.

A part of this diversity may be explained by the fact that Smith Island lies near the edges of the ranges of both warm water and cold water species. Thus, both cold water fish, such as the Blueback, and warm water fish, such as the Lookdown and Jack Crevalle, were found at Smith Island. One of the Puffers collected had not been recorded north of Florida prior to this time.

While studies are very incomplete, it is evident that several fish spawn in these creeks. In addition, 42 species were taken as juveniles, indicating that they utilize this estaury as a nursery ground. Twenty-five species are utilized as either food, oil, fish meal or for sport (Appendix B).

Figure 14. Feeding birds on an exposed mudflat

Bays and Mudflats

A series of shallow, interconnected bays extends along the northern portion of the island's estuaries. At low tide, much of this area is completely drained and consists of extensive flats and oyster bars; at high tide, the flats are flooded by as much as three feet of water.

This daily tidal rhythm and the drastic changes that it imposes result in the use of these areas by two rather different groups of animals. On the rising tide, aquatic organisms move from the deeper creeks into the shallow bays. The bays are also utilized extensively by waterfowl during the winter

months. The American Widgeon is the most common species present with 500 to 1000 ducks often present in Buzzard Bay. Black Ducks and Mallards are also common; and Pintails, Gadwalls, and Green-winged Teal were found in smaller numbers. Few kinds of diving ducks use these shallow bays, but small groups of Bufflehead are regular visitors, and Golden-eyes, Canvasbacks, and Scaup occasionally occur along the rock jetty at the northwest end of the island's marshes.

As the tide falls, exposing the extensive mudflats, the aquatic organisms retreat to the deeper creeks and many of the waterfowl leave the area. Many American Widgeon often remain along the rock jetty, however, feeding on the exposed beds of algae. Flocks of Black Ducks, Mallards, and Pintails may also remain, loafing on the flats through the period of low tide.

These flats are also frequented by large flocks of several species of shorebirds. This is particularly true in late summer and early fall when migrants are passing through. During the fall, 19 species were recorded with Dunlin, Black-bellied Plovers, and Short-billed Dowitchers being most abundant.

White Ibis, Great-blue Herons, Snowy Egrets, Louisiana Herons, and other wading birds also frequent the mud flats, feeding on aquatic organisms left in small tidal pools.

As the tide rises, shorebirds move slowly toward higher ground and during the peak of the tide are concentrated in large numbers along the zones of overwash where sand has washed from the beach onto the edge of the marshes. At these times several thousand birds may occur on an area of only a few acres. Some species of shorebirds move onto the beaches at this time and concentrations there on high tides are much greater than on low tides.

Figure 15. Herons and egrets in the Battery Island Rookery

Battery Island

Battery Island is a rather specialized community and will be discussed separately even though it consists of units of communities previously discussed. This island is composed of two areas of high ground almost surrounded by salt marsh. The island is bounded on the west by the Cape Fear River and on the east by shallow bays.

Battery Island consists primarily of low sea oats dunes and dense shrub thickets. The thickets are composed largely of wax myrtle, red cedar, and live oak with trees averaging 15 to 30 feet in height. In late March each

year, thousands of herons, egrets and ibises of eight species begin to gather here. They court, mate, and begin construction of nests. Often the nests will be only three to four feet apart and a single small tree may house 25 to 30 nests of several species. Young begin to appear in the nests by late April and by late May or early June most eggs have hatched. The Cattle Egret, a recent addition to the colony, arrives last and often does not begin to lay its eggs until most other species have already hatched. By early June, most Cattle Egret clutches were complete, but no young birds had hatched.

Numbers of breeding adults in the colony vary somewhat from year to year with Cattle Egrets and White Ibises increasing in numbers in recent years. Other species have remained about the same or perhaps have decreased slightly.

In 1970, there were 150 to 200 Common Egrets, 125 to 150 Snowy Egrets, 200 to 250 Louisiana Herons, 75 to 100 Little-blue Herons, 150 to 200 Cattle Egrets, 1,000 to 1,500 White Ibises, and 150 to 200 Glossy Ibises, six to ten Green Herons, and 25 to 35 Black-crowned Night Herons in the colony.

This island is also an important breeding site for several other birds. Eastern Willets nest commonly in the dense grasses of the open dunes, and Nighthawks and Mourning Doves also nest here. Red-winged Blackbirds nest commonly along the edges of the shrub thickets and Boat-tailed Grackles build their nests among those of the herons.

Dredging activities in the Cape Fear River channel off Battery Island have resulted in several small dredge spoil islands being constructed between Battery Island and the river. Fifteen to 20 pairs of Black Skimmers and several pairs of American Oystercatchers nested on these islands.

No reptiles or mammals were found on this island. Its isolated position

has apparently kept it free of most predators: this is an important factor in the success of these nesting colonies which are very susceptible to predation and disturbance.

Community Generalizations

Several generalizations can be drawn from the study of the island's communities.

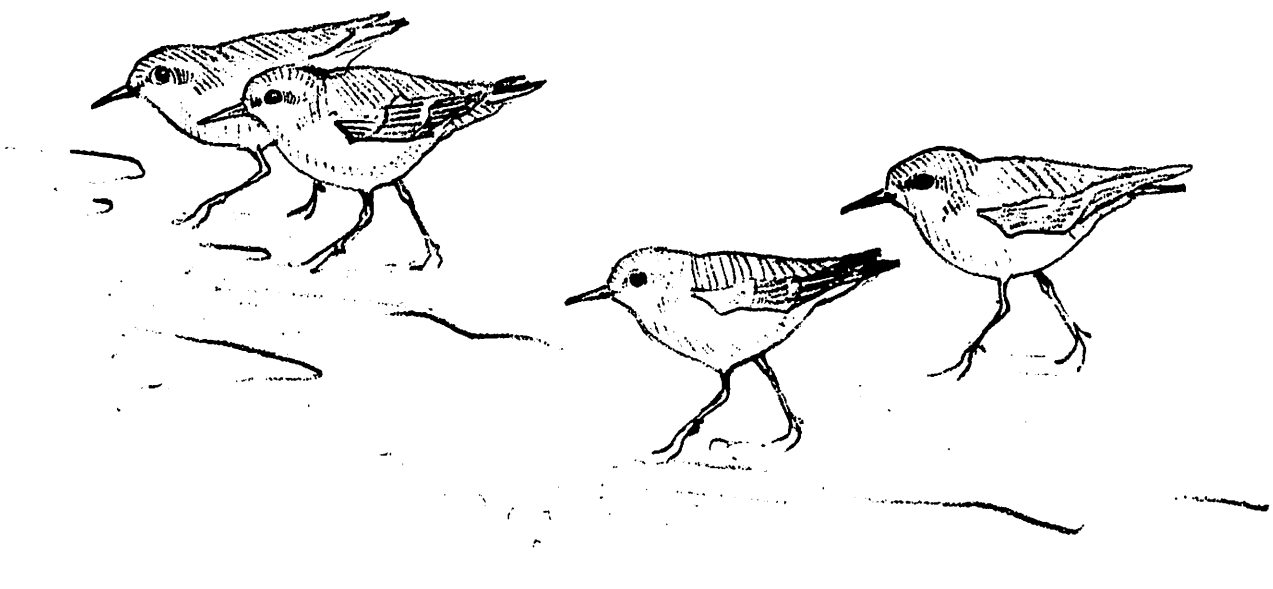
In spite of the fact that man has occupied the island for a variety of purposes in recent years and continues to affect the communities by his transient activities, the island is still relatively wild. Man has littered the island with his trash, but the low level of irregular use minimizes his effect. It remains the nearest thing to a maritime wilderness to be found in North Carolina.

It is particularly obvious that the whole eastern section of the island complex from beach to salt marsh edge is very unstable. New Inlet is rapidly moving south, the beach is moving back on the edge of the salt marsh, and overwashes are common.

There is an abundance of life on the island. The nesting of sea turtles on the beaches and the good populations of Gray Squirrels, Raccoons, and Gray Foxes indicate minimal disturbance by man. The tremendous flocks of shorebirds and waterfowl found along the eastern edge of the island and scattered throughout the estuary, and the abundance of land birds in the thickets and forest during the fall migration establish the island complex as an important natural bird refuge.

The approximately 4,500 acres of low salt marsh in the Smith Island complex is the largest unit of such marsh in North Carolina. The productivity of these marshes is well established, and the diversity of life in the creeks that drain the Smith Island marshes is great. While pollution of this estuary is evident, other effects of man appear minimal.

All of the above factors indicate that the island remains an important natural system. While current studies do not yet indicate whether or not the process of speciation has led to recognizable differences between organisms living on the island and those living on the nearby mainland; it is clear that the composite fauna and flora of the island is unique. The combination of undisturbed, naturally operating environmental processes, minimal effect by man, and the presence of large components of open beach, sea oats dunes, maritime live oak forest, and extensive marshes and shallow bays is unique.



THE FUTURE OF SMITH ISLAND

Over the centuries, the Smith Island complex has been used for military fortifications, agriculture, resort development, lighthouses, Life Saving Service and Coast Guard Stations, forest products production, and hunting, fishing, and other outdoor recreation. While the uses have been diverse, their intensity has been low, and their effect upon the natural systems of the island has been minimal.

Marshes to the north and the river channel to the west have posed serious barriers to occupancy and development. As demands on coastal resources increase, however, the island will be subjected to increased pressure. A number of development alternatives exist, each of which produces different degrees and types of interactions with the natural communities now existing on the island. One cannot consider only the effect of man upon nature, for the relationship between development and the natural environment is a two-way street - each affects the other. Interactions between various kinds of human use and the biotic communities on the island are discussed below.

Although development and human occupancy rarely take place within the beach community, it profoundly affects the use of adjacent property. The beach and its esthetic and recreational attributes bring people to the coast, and enhance the value of contiguous lands and facilities. On Smith Island, the eastern beach forms the major north-south transportation corridor, permitting vehicular traffic by beach buggy between New Inlet and Cape Point. The beach community, then, is a major catalyst in promoting the development of coastal lands.

On Smith Island, however, the dynamic nature of this community and its associated inlets poses serious hazards to intensive development of contiguous areas, particularly when that development includes erection of fixed structures. For the beach is always in motion. At low tide beach sands are windswept onto the dunes or into the ocean; at high tide they are moved laterally and offshore by the currents. The winter beach is short and steep. The summer beach is broad and flat. The eastern beach is migrating westerly, encroaching upon the adjacent dunes and maritime forest. Along this beach, storm tides frequently overwash the beach and the low dunes, forcing sand hundreds of yards into and over the salt marsh behind.

Inlets pose particular problems to developers. They provide routes of access between the ocean and estuaries for vessels and marine organisms. They furnish clean sea water to flush the bays and tidal streams, but they are notoriously untrustworthy. During recorded history there has always been at least one inlet along the eastern beach, and sometimes as many as three. Typically, the inlets form during storms, migrate southward, and are closed by succeeding storms. The location and time at which future inlets will appear cannot be reliably predicted, nor can their subsequent rate and distance of migration. As a result, emplacement of any fixed structures along the eastern beach north of Bluff Island would be particularly precarious. Eventually, we know not when, they will be destroyed.

At many locations along the North Carolina coast engineers have attempted to stabilize beaches and inlets, but their efforts have met with only limited success. Basically, the problem is one of providing a mechanism which will

counter the tremendous energy impinging upon the beach from waves, currents, and wind, compounded by a relative rise in sea level. Such mechanisms are extremely costly. In 1965 the U. S. Army Corps of Engineers constructed an artificial dune and beach fill along 3.3 miles of Wrightsville Beach to retard erosion in that area. The initial cost of the project was $711,583; subsequent maintenance has added $755,186 to the cost, and future maintenance is estimated to cost about $126,000 per year. A similar project along five miles of beach at Carolina Beach constructed in 1964-65 at an expense of $885,255 requires about $200,000 per year for maintenance. Masonboro Inlet has been stabilized through the emplacement of a rock jetty and sand by-pass mechanism. This project required the initial investment of $911,507 in public funds, with an additional expenditure of $477,891 for maintenance during 1969-70.

One phenomenon not fully appreciated by beach developers is the process of long-shore transport of beach materials. On Smith Island these currents are constantly moving sand southward along the east beach. The amount of sand in transit varies with the velocity of the current; the greater the velocity the more sand being moved. Any interruption of this process will cause sand deposition where currents are reduced and accelerated erosion where they are increased. Engineers frequently take advantage of this principle, constructing groins perpendicular to the beach which temporarily reduce the velocity of long-shore currents and cause sand deposition upcurrent of the groin. Sometimes overlooked, however, is the fact that the current will regain its natural velocity downstream of the groins causing severe erosion in these areas as

additional sand is picked up.

Although limited human activity on the beach temporarily disrupts the gulls, terns, and shorebirds feeding and loafing there, the birds are able to move to nearby undisturbed areas, and are little affected. When human occupancy becomes intensive, however, alternate sites are also pre-empted, and the birds permanently leave these developed areas.

Beach use and development would have a profound effect upon the population of Loggerhead Sea Turtles now using it as a nesting area. These animals, already much reduced in numbers, must be undisturbed during the egg-laying process. The nests must lie unopened during the 10-12 week incubation period, and the baby turtles must have unimpeded access to the ocean after hatching. Large numbers of curious humans, attracted to the beaches following development, would probably eliminate the nesting sea turtle population.

The dunes also possess a number of factors inimical to human habitation. They, too, are an unstable land form. Instability in this case results from salt-laden wind, low soil moisture, and low soil nutrient content, all of which militate against establishment of a continuous vegetative cover. As a result, the dunes are constantly in motion. In lower, protected areas where shrubby vegetation has been established, slow accretion of wind-blown sand may occur until such time as the shrubs are buried or die from lack of water. On more exposed, poorly vegetated areas, a constant stream of sand flows across the surface, causing whole dunes and dune systems to migrate downwind. This process is particularly evident on the southwest shore of Baldhead, where the dune community is encroaching over the maritime forest behind.

The absence of shade and the constantly moving sand are adverse to permanent occupancy of this community, whereas the expansive vista provided across the dunes and adjacent beach attracts temporary and transient human use. If such use is infrequent and not intensive, it has little effect on the dune community; where it is of sufficient intensity to remove the stabilizing effect of dune vegetation, the consequences can be severe. Dunes formerly migrating at imperceptible rates may suddenly accelerate, covering vegetation, roads, driveways, and even cottages. The fore-dune, existing as it does in a precarious position closest to the ocean, is particularly vulnerable to this abuse. Destruction of the fore-dune, either through the removal of vegetation or by engineering methods, removes the natural barrier between man and sea, opening all lands behind to the effects of storm tides. Thus the alteration of this community can produce profound results, not only upon its own biota but upon landward communities and the development thereon.

Most of the animal life associated with the high dunes and thickets will readily adjust to limited development. The song birds now utilizing these areas will continue to live in those remnants remaining after development, and even the foxes may persist for some time.

The low dunes and overwashes along the eastern beach present a different situation. These open expanses furnish protected loafing areas for thousands of shorebirds during periods when the flats are covered by water. Permanent human occupancy would eliminate this essential requirement, and may greatly reduce the shorebird population utilizing the entire complex south of Federal Point.

The maritime forest is the most stable community on the island, and the most conducive to human occupancy. Here, time and protection have permitted the establishment of a forest community, providing shade and protection from the effects of salt spray. Spreading live oaks and gently rolling topography provide attractive sheltered home sites. Land elevations are generally above the effects of all but extreme hurricanes, and the dune community to seaward affords protection from the direct effects of storms.

Within this community, judicious development can occur without extreme adverse environmental effects, but even here the unique nature of coastal ecology must be taken into consideration. The trees provide protection from the wind, but wind discourages activities of the mosquitoes which breed in large numbers in the marshes and other low areas within the maritime forest. If the mosquito nuisance is to be controlled by mechanical means, these wet areas must be drained or converted into clean ponds and ditches. In either case, the natural ponds now existing within the forest will be destroyed.

The forest soils are coarse-textured and have little water retention capability. Vegetation occurring naturally within the forest undoubtedly relies heavily upon ground water. A lowered water table, resulting from mosquito control activities, would increase the basic soil aridity and could necessitate the need for supplemental irrigation in developed areas.

Surficial soils are largely non-cohesive sands. If disturbed, they will erode under the forces of gravity, wind, and water, particularly on the steeper slopes within the forest. These soils also possess little filtering capability. This fact, coupled with the present high water table in many areas,

creates unfavorable conditions for septic tanks.

Shade is a particularly attractive characteristic of the maritime forest from the development standpoint, but too much shade is undesirable. In an effort to provide areas for structures, open space, lawns, and vistas, and to improve the otherwise overgrown and messy appearance of the maritime forest, developers frequently remove all vegetation except isolated shade trees. This practice would be disastrous on Smith Island. Its location exposes it to both northeasterly storms of fall and winter and the southerly summer storms from the sea carrying large quantities of salt spray. Under natural conditions, only the exposed tree tops receive the full brunt of salt spray. These portions are continually being killed back, producing the pruned appearance characteristic of the seaward side of the maritime forest. The understory and lower portions of canopy trees, protected from this effect, perpetuate the community. Openings in the forest permit salt spray to reach these lower levels. As a result, not only are the "shade trees" killed, but a progressive die-back of the forest bordering the clearing occurs.

Like the maritime forest, the salt marshes behind Smith Island are relatively stable communities. Except where covered by swashes across the barrier beach or cut by the slow meandering of tidal streams, they persist relatively unchanged for centuries. Unlike the forest, they are more properly a part of the marine system, producing food and haven for aquatic organisms, and the environmental factors which sustain the marsh are particularly inimical to development. The average marsh elevation approximates the elevation of mean high tide; that is, it is the height of the average tide and will be flooded

by any tides exceeding the average. During Hurricane Hazel, the marsh community was under more than 10 feet of water.

The marsh substrate consists primarily of fine sands, silts, and clays. This material has a high shrink-swell potential, a low load-bearing capacity, tends to flow upon loading, and may be more than 20 feet deep in some places. In addition, these sediments naturally contain large concentrations of reduced metals. If utilized as hydraulic fill and permitted to dry, these metallic compounds will oxidize, resulting in a pH change from pH 7-8 to pH 2-3. In such condition they can support little vegetative life.

Development of these marshes poses extreme engineering as well as environmental problems. Customarily, areas to be developed are diked, and fill materials of suitable consistency piped in by hydraulic dredge. Due to the instability of the substrate, dikes frequently fail, releasing their contents into the nearby creeks; and fill requirements frequently exceed engineering estimates as a result of compaction and dehydration. If acceptable land elevations can be obtained through fill, light structures may be supported on piling. Even here, the low load-bearing strength of the underlying sediments and the extreme depth to hard bottom necessitate excessive numbers and excessive lengths of piling.

Within the salt marsh community, development and human occupancy are completely incompatible with the natural system. Neither can exist under conditions required by the other.

This community can be left as it is to provide its esthetic component of the coastal landscape; to furnish a habitat for Clapper Rails, periwinkles,

fiddler crabs, and other marsh denizens; and to contribute energy and food to the estuarine ecosystem. It can be converted into high land and human residency. There is no middle ground.

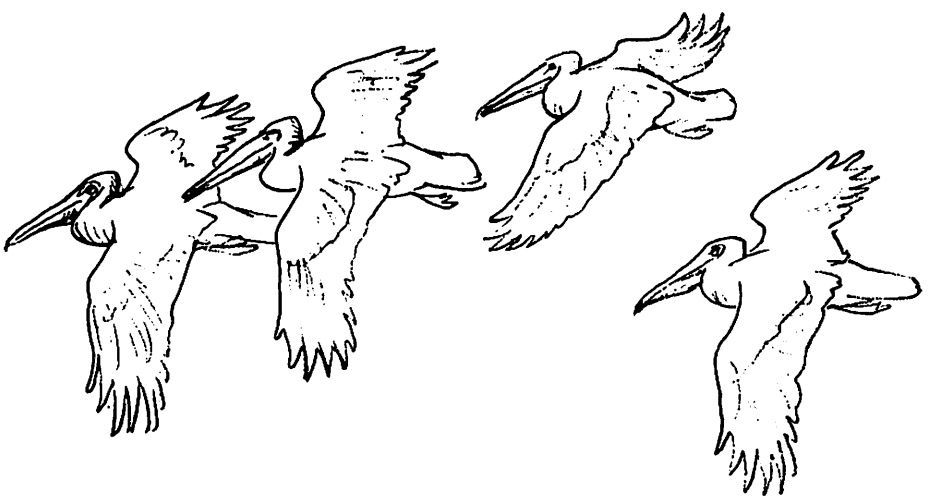
The tidal creeks, bays, and mud flats, all components of the same marine ecosystem of which the salt marsh is a member, are also both catalysts and impediments to development. In their natural condition, they compose an important segment of the coastal scene - broad expanses of open waters, flats, and meandering tidal channels through the marsh. At high tide, most of these areas may be traversed by boat. At low tide, only the deeper creek channels are navigable. The emergent bars and flats, an eternal hindrance and frustration to boatsmen, then become the feeding areas of shorebirds and waterfowl, while remnant pools furnish wading birds a ready source of food.

Deepening these areas to provide more ready access for navigation destroys the shallow food-producing flats, reduces the water surface area, and requires dedication of adjacent lands for initial spoil disposal and subsequent maintenance dredging. In the absence of such improvements, only a small portion of the waters between Federal Point and Baldhead can be used by fishermen and boaters except at high tide.

The isolated location and small size of Battery Island detracts from its potential for intensive development. In addition, portions of Battery Island and its environs have been periodically utilized for dredge spoil disposal, a practice not compatible with permanent human occupancy. Perhaps the greatest deterrent to the development of this island, however, is its value as a nesting area for wading birds and shorebirds. The wading bird colony has existed here

for over 30 years, many of its residents apparently coming from a similar colony at Orton Pond which no longer exists. During the nesting season, the birds can tolerate only very limited disturbance. Development and human occupancy would eliminate this colony. The existence nearby of acceptable alternate sites to which the colony could move is questionable today, and becomes more unlikely as development proceeds within the Lower Cape Fear Region.

Of the future of Baldhead, this much is certain. It will not continue to be a private landholding, in quasi-natural state, to which the public has free right of access. The types and intensities of use and their attendant environmental effects pose a challenge for this generation; our wisdom will be judged by the next.



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APPENDIX A

PRELIMINARY CHECKLIST OF AMPHIBIANS, REPTILES, BIRDS AND MAMMALS

The vertebrates listed below were recorded from a variety of habitats in the Smith Island Complex. After each species name, the code letters indicate the habitat or habitats in which the species was usually found. The habitats and code letters are as follows:

A - Inshore Ocean Waters
B - Beach
C - Sea Oats Dunes
D - Salt Marshes
E - Tidal Creeks
F - Bays
G - Mud Flats
H - Rock Jetty
I - Maritime Live Oak Forest
J - Shrub Thickets
K - Fresh Water Pond and Marshes
L - Battery Island Rookery

AMPHIBIANS

Common Name	Scientific Name	Habitats
Anura		
Southern Toad	*Bufo terrestris*	I, J, K
Green Tree Frog	*Hyla cinerea*	K
Squirrel Tree Frog	*Hyla squirella*	I, K
Little Grass Frog	*Hyla ocularis*	K
Eastern Narrow-mouthed Toad	*Gastrophryne carolinensis*	K
Southern Leopard Frog	*Rana pipiens sphenocephala*	I, K

REPTILES

Common Name	Scientific Name	Habitats
Chelonia		
Eastern Mud Turtle	Kinosternon subrubrum	K
Atlantic Loggerhead Turtle	Caretta caretta	A
Diamond-backed Terrapin	Terrapin centrata	E
Lacertilla		
Green Anole	Anolis carolinensis	I
Six-lined Racerunner	Cnemidorphorus sexlineatus	C, I, J
Southeastern Five-lined Skink	Eumeces inexpectatus	I
Eastern Glass Lizard	Ophisaurus ventralis	C, I
Serpentes		
Banded Water Snake	Natrix sipedon fasciata	K
Northern Black Racer	Coluber constrictor	C, D, I, J
Eastern Coachwhip	Masticophis flagellum	C, I, J
Rough Green Snake	Opheodrys aestivus	I
Yellow Rat Snake	Elaphe obsoleta quadrivittata	I

BIRDS

Gaviiformes		
Common Loon	Gavia immer	A, F
Red-throated Loon	Gavia stellata	A

Common Name	Scientific Name	Habitats
Podicipediformes		
Horned Grebe	Podiceps auritus	A, E, F
Pied-billed Grebe	Podilymbus podiceps	E, F
Pelicaniformes		
Brown Pelican	Pelecanus occidentalis	A, B, F
Gannet	Morus bassanus	A
Double-crested Cormorant	Phalacrocorax auritus	A, E, F
Ciconiiformes		
Great Blue Heron	Ardea herodias	D, E, G
Green Heron	Butorides virescens	D, E, K, L
Little Blue Heron	Florida caerulea	D, E, K, L
Cattle Egret	Bubulcus ibis	L
Common Egret	Casmerodius albus	D, E, G, K, L
Snowy Egret	Leucophoyx thula	B, D, E, G, K, L
Louisiana Heron	Hydranassa tricolor	D, E, G, L
Black-crowned Night Heron	Nycticorax nycticorax	D, E, K, L
Yellow-crowned Night Heron	Nyctanassa violacea	D, E
American Bittern	Botaurus lentiginosus	D
Glossy Ibis	Plegadis falcinellus	D, E, K, L
White Ibis	Eudocimus albus	D, E, K, L
Anseriformes		
Mallard	Anas platyrhynchos	A, E, F, K

Common Name	Scientific Name	Habitats
Black Duck	Anas rubripes	E, F, K
Gadwall	Anas strepera	E, F
Pintail	Anas acuta	A, F, G
Green-winged Teal	Anas carolinensis	E, G, K
Blue-winged Teal	Anas discors	A, E, K
American Widgeon	Mareca americana	E, F, K
Shoveler	Spatula clypeata	K
Wood Duck	Aix sponsa	K
Greater Scaup	Aythya marila	A
Lesser Scaup	Aythya affinis	A
Common Goldeneye	Bucephala clangula	E, F
Bufflehead	Bucephala albeola	A, E, F
White-winged Scoter	Melanitta deglandi	A
Surf Scoter	Melanitta perspicillata	A
Common Scoter	Oidemia nigra	A
Ruddy Duck	Oxyura jamaicensis	F
Hooded Merganser	Lophedytes cucullatus	E
Red-breasted Merganser	Mergus serrator	A, E, F
Falconiformes		
Sharp-shinned Hawk	Accipiter striatus	I
Red-tailed Hawk	Buteo jamaicensis	D, I
Red-shouldered Hawk	Buteo lineatus	I
Marsh Hawk	Circus cyaneus	C, D, K

Common Name	Scientific Name	Habitats
Osprey	Pandion haliaetus	A, E, F
Peregrine Falcon	Falco peregrinus	B, C, D, G
Pigeon Hawk	Falco columbarius	B, K
Sparrow Hawk	Falco sparverius	C, I, J, K
Gruiformes		
Clapper Rail	Rallus longirostris	D
Virginia Rail	Rallus limicola	D
Sora	Porzana carolina	D, K
Common Gallinule	Gallinula chloropus	K
American Coot	Fulica americana	E, K
Charadriiformes		
American Oystercatcher	Haematopus palliatus	B, E, G, H
Semipalmated Plover	Charadrius semipalmatus	B, G
Piping Plover	Charadrius melodus	B, G
Wilson's Plover	Charadrius wilsonia	B, C, G
Black-bellied Plover	Squatarola squatarola	B, E, G, K
Ruddy Turnstone	Arenaria interpres	B, G, H
American Woodcock	Philhela minor	I
Long-billed Curlew	Numenius americanus	G
Whimbrel	Numenius phaeopus	B, G
Spotted Sandpiper	Actitus macularia	E, H
Willet	Catoptrophorus semipalmatus	B, G
Greater Yellowlegs	Totanus melanoteucus	G

Common Name	Scientific Name	Habitats
Lesser Yellowlegs	Totanus flavipes	B, E, G
Knot	Calidris canutus	B, G
Least Sandpiper	Erolia minutilla	B, G, H
Dunlin	Erolia alpina	B, E, G
Short-billed Dowitcher	Limnodromus griseus	B, E, G, K
Semipalmated Sandpiper	Ereunetes pusillus	B, G
Western Sandpiper	Ereunetes mauri	B, G
Buff-breasted Sandpiper	Tryngites subruficollis	B, G
Marbled Godwit	Limosa fedoa	B, G
Sanderling	Crocethia alba	B
Parasitic Jaeger	Stercorarius parasiticus	A
Great Black-backed Gull	Larus marinus	A, B
Herring Gull	Larus argentatus	A, B, F, G
Ring-billed Gull	Larus delawarensis	A, B, F, G
Laughing Gull	Larus atricilla	A, B, F, G
Bonaparte's Gull	Larus philadelphia	A, F
Gull-billed Tern	Gelocheliden nilotica	A, B, D, F, G, K
Forester's Tern	Sterna forsteri	A, B, E, F, G
Common Tern	Sterna hirundo	A, B, F, G
Least Tern	Sterna albifrons	A, B, F, G
Royal Tern	Thalasseus maximus	A, B, F, G
Sandwich Tern	Thalasseus sanduicensis	A, B, G
Caspian Tern	Hydroprogne caspia	A, B, F, G

Common Name	Scientific Name	Habitats
Black Tern	Chlidonias niger	A, B, F, G
Black Skimmer	Rynchops nigra	E, F, G
Columbiformes		
Mourning Dove	Zenaidura macroura	C, I
Ground Dove	Columbigallina passerina	C, I, J
Cuculiformes		
Yellow-billed Cuckoo	Coccyzus americanus	I, J
Strigiformes		
Barn Owl	Tyto alba	J
Caprimulgiformes		
Whip-poor-will	Caprimulgus vociferus	I
Apodiformes		
Chimney Swift	Chaetura pelagica	I
Ruby-throated Hummingbird	Archilochus colubris	I
Coraciiformes		
Belted Kingfisher	Megaceryle alcyon	E, F, K
Piciformes		
Yellow-shafted Flicker	Colaptes auratus	I, J
Yellow-bellied Sapsucker	Sphryapicus varius	I
Red-bellied Woodpecker	Centurus carolinus	I
Red-headed Woodpecker	Melanerpes erythrocephalus	I

Common Name	Scientific Name	Habitats
Downy Woodpecker	Dendrocopos pubescens	I
Passeriformes		
Eastern Kingbrid	Tyrannus tyrannus	I
Eastern Phoebe	Sayornis phoebe	I, K
Least Flycatcher	Empidonax minimus	I, J
Tree Swallow	Iridoprocne bicolor	C, F, K
Barn Swallow	Hirundo rustica	C, F, I, K
Blue Jay	Cyanocitta cristata	I
Fish Crow	Corvus ossifragus	J
Brown Creeper	Certhia familiaris	I
House Wren	Troglodytes aedon	I, J
Winter Wren	Troglodytes troglodytes	I, J
Carolina Wren	Thryothorus ludovicianus	I
Long-billed Marsh Wren	Telmotodytes palustris	D, K
Short-billed Marsh Wren	Cistothorus platensis	K
Mockingbird	Mimus polyglottos	I, J
Catbird	Dumetella carolinensis	I J
Brown Thrasher	Toxostoma rufum	I, J
Robin	Turdus migratorius	I, K
Hermit Thrush	Hylocichla guttata	I
Swainson's Thrush	Hylocichla ustulata	I
Veery	Hylocichla fuscescens	I

Common Name	Scientific Name	Habitats
Golden-crowned Kinglet	Regulus satrapa	I
Ruby-crowned Kinglet	Regulus calendula	I
Water Pipit	Anthus spinoletta	B
Cedar Waxwing	Bombycilla cedrorum	I, K
Starling	Sturnus vulgaris	I
White-eyed Vireo	Vireo griseus	I
Solitary Vireo	Vireo solitarius	I
Red-eyed Vireo	Vireo olivaceus	I
Black and White Warbler	Mniotilta varia	I
Prothonotary Warbler	Protonotaria citrea	I
Worm-eating Warbler	Helmitheros vermivorus	I
Golden-winged Warbler	Vermivora chrysoptera	I
Orange-crowned Warbler	Vermivora celata	I, J
Parula Warbler	Parula americana	I
Yellow Warbler	Dendroica petechia	D, I
Magnolia Warbler	Dendroica magnolia	I
Cape May Warbler	Dendroica tigrina	I
Black-throated Blue Warbler	Dendroica caerulescens	I
Myrtle Warbler	Dendroica coronata	I, J
Blackburnian Warbler	Dendroica fusca	I
Prairie Warbler	Dendroica discolor	I, J
Palm Warbler	Dendroica palmarum	D, I, J
Ovenbird	Seiurus aurocapillus	I
Northern Waterthrush	Seiurus noveboracensis	I, J

Common Name	Scientific Name	Habitats
Louisiana Waterthrush	Seiurus motacilla	I
Mourning Warbler	Oporornis philadelphia	I
Yellowthroat	Geothlypis trichas	D, I, J, K
Hooded Warbler	Wilsonia citrina	I
Canada Warbler	Wilsonia canadensis	I
American Redstart	Setophaga ruticilla	I
Bobolink	Dolichonyx oryzivorus	D
Eastern Meadowlark	Sturnella magna	C, D, K
Red-winged Blackbird	Agelaius phoeniceus	C, D, K
Baltimore Oriole	Icterus galbula	I
Boat-tailed Grackle	Cassidix mexicanus	B, C, D, E, G, I, J, K, L
Common Grackle	Quiscalus quiscula	D
Cardinal	Richmondena cardinalis	I, J
Indigo Bunting	Passerina cyanea	I, J
Painted Bunting	Passerina ciris	I, J
American Goldfinch	Spinus tristis	C, I, J
Rufous-sided Towhee	Pipilo erythropthalmus	I, J
Ipswich Sparrow	Passerculus princeps	C
Savannah Sparrow	Passerculus sandwichensis	C, D, J, K
Grasshopper Sparrow	Ammodramus savannarum	K
Sharp-tailed Sparrow	Ammospiza caudacuta	D
Seaside Sparrow	Ammospiza maritima	D
Lark Sparrow	Chondestes grammacus	C

Common Name	Scientific Name	Habitats
Slate-colored Junco	Junco hyemalis	I
Field Sparrow	Spizella pusilla	I, J
White-crowned Sparrow	Zonotrichia leucophrys	I, J
White-throated Sparrow	Zonotrichia albicollis	I, J
Swamp Sparrow	Melospiza georgiana	D, J, K
Song Sparrow	Melospiza melodia	D, J, K
	MAMMALS	
Marsupalia		
Opossum	Didelphis marsupialis	B, C, I, J
Insectivora		
Least Shrew	Cryptotis parva	
Eastern Mole	Scalopus aquaticus	C, I
Lagomorpha		
Eastern Cottontail	Sylvilagus floridanus	J
Rodentia		
Gray Squirrel	Sciurus carolinensis	I
Marsh Rice Rat	Oryzomys palustris	D, K
Cotton Mouse	Peromyscus gossypinus	C, I, J
Hispid Cotton Rat	Sigmodon hispidus	J
Norway Rat	Rattus norvegicus	I
House Mouse	Mus musculus	C, D, I, J, K

Common Name	Scientific Name	Habitats
Cetacea		
Atlantic Bottle-nosed Dolphin	Tursiops truncatus	A
Carnivora		
Gray Fox	Urocyon cinereoargenteus	B, C, I, J
Raccoon	Procyon lotor	B, C, D, E, G, I, J, K
Mink	Mustela vison	D
River Otter	Lutra canadensis	D
Bobcat	Lynx rufus	I
Artiodactyla		
Feral Hog	Sus scrofa	B, C, D, I, J, K

APPENDIX B

NEKTON OF THE TIDAL CREEKS OF SMITH ISLAND*

Species	Scientific Name	Nursery Yes	Nursery No	Comm. Value Yes	Comm. Value No	**
Crabs						
Blue Claw Crab	Callinectes sapidus	x		x		
Spider Crab	Libinia emarginata	?			x	
Shrimp						
White Shrimp	Penaeus setiferus	x		x		
Brown Shrimp	Penaeus aztecus	x		x		
Pink Shrimp	Penaeus duorarum	x		x		
Snapping Shrimp	Alpheus hermanni	x				
Whiptail Stingrays						
Southern Stingray	Dasyatis americana	x			x	
Tarpons and Ladyfishes						
Tenpounder	Elops saurus	x			x	
Herrings						
Menhaden	Brevoortia tyrannus	x		x		x
American Shad	Alosa sapidissima	x		x		
Blueback	Pomolobus aestivalis	x		x		

Species	Scientific Name	Nursery Yes	Nursery No	Comm. Value Yes	Comm. Value No	**
Anchovies						
Common Anchovy	Anchoa mitchilli	x				x
Striped Anchovy	Anchoa epsetus	x				x
Pompanos and Jacks						
Lookdown	Selene vomer	x			x	
Jack Crevalle	Caranx hippos	x		x		
Round Pompano	Trachinotus falcatus	x		x		
Bluefish						
Bluefish	Pomatomus saltatrix	x		x		
Snapper						
Schoolmaster	Lutianus apodus	x		x		
Grunts						
Pigfish	Orthopristis chrysopterus	x		x		
Porgies						
Pinfish	Lagodon rhomboides	x		x		
Mojarras						
Common Mojarra	Eucinstomus gula	X			x	

Species	Scientific Name	Nursery Yes	Nursery No	Comm. Value Yes	Comm. Value No	**
Croakers						
Silver Perch	Bairdella chrysura	x		x		
Spot	Leistomus xanthurus	x		x		
Croaker	Micropogon undulatus	x		x		
Black Drum	Pogonias cromis	x		x		
Southern Whiting	Menticirrhus americanus	?		x		
Spadefish						
Spadefish	Chaetadipterus faber	x		x		
Lizard Fish						
Sand Diver	Synodus intermedius	x			x	
Silversides						
Rough Silversides	Membras vagrans	x		x		x
Seahorses and Pipefishes						
Florida Pipefish	Sygnathus floridae	?			x	
Mullets						
Striped Mullet	Mugil cephalus	x		x		x
Lefteye Flounders						
Summer Flounder	Paralichthys dentatus	x		x		
Windowpane	Scophthalmus aquosus	x		x		

Species	Scientific Name	Nursery Yes	Nursery No	Comm. Value Yes	Comm. Value No	**
Gulf Stream Flounder	Citharichthys arctifrons		?		x	
Gulf Flounder	Paralichthys albigutta	x			x	
Soles						
Hogchoker	Centrata	x			x	
Striped Sole	Achirus lineatus	x			x	
Tonguefishes						
Blackcheeked Tonguefish	Symphurus plagiosa	x			x	
Sea Basses						
Black Sea Bass	Centropristis striatus	x		x		
Cobia						
Cobia	Rachycentron canadus	x		x		
Stargazers						
Stargazer (Northern)	Astrocopus guttatus	?			x	
Stargazer (Southern)	Astrocopus y-graecum	?			x	
Searobins						
Sea Robin	Prionotus scitulus	x			x	
Spiny Sea Robin	Prionotus tribulus	x			x	
Filefish						
Filefish (common)	Monacanthus hispidus	x			x	

Species	Scientific Name	Nursery Yes	Nursery No	Comm. Value Yes	Comm. Value No	**
Puffers						
Northern Puffer	Spheroides maculatus	x			x	
Harper's Puffer	Spheroides harperi	x			x	
Spiny Boxfish						
Spiny Boxfish	Chilomycterus schoefi	?			x	
Toadfish						
Toadfish	Opsanus tau	x			x	

*Taken in periodic trawl samples. Species not succeptible to this collecting technique are not represented.

**Important forage species for commercially important nekton.

APPENDIX C

PRELIMINARY CHECKLIST OF THE VASCULAR PLANTS OF SMITH ISLAND

Common Name	Scientific Name
Anacardiaceae	
Dwarf or Winged Sumac	Rhus copallina L.
Poison Ivy	Rhus radicans L.
Apiaceae	
Marsh Pennywort	Centella asiatica (L) Urban
Pennywort	Hydrocotyle bonariensis Lam.
Pennywort	Hydrocotyle verticillata Thunberg
Bishop's Weed	Ptilimnium capillaceum (Michaux) Raf.
Snakeroot	Sanicula canadensis L.
Aquifoliaceae	
American Holly	Ilex opaca Ait.
Yaupon	Ilex vomitoria Ait.
Arecaceae	
Palmetto	Sabal minor (Jacquin) Persoon
Cabbage Palmetto	Sabal palmetto Lodd. ex Schultes
Asclepiadaceae	
Milkweed	Cynanchum palustre (Pursh) Heller
Aspleniaceae	
Ebony Spleenwort	Asplenium platyneuron (L.) Oakes

Common Name	Scientific Name
Asteraceae	
Ragweed	Ambrosia artemisiifolia L.
Frost Aster	Aster pilosus Willd.
Aster	Aster subulatus Michaux
False Willow	Baccharis angustifolia Michaux
Sea Myrtle	Baccharis halimifolia L.
Spanish Needles	Bidens bipinnata L.
Sea Ox-Eye	Borrichia frutescens (L.) DC.
Elephant's Foot	Elephantopus tomentosus L.
Fireweed	Erechtites hieracifolia (L.)
Butterweed	Erigeron canadensis var. pusillus (Nuttall) Ahles
Dog Fennel	Eupatorium capillifolium (Lam.) Small
Thoroughwort	Eupatorium serotinum Michaux
Blanket Flower	Gaillardia pulchella Foug.
Rabbit Tobacco	Gnaphalium obtusifolium L.
Cudweed	Gnaphalium purpureum L.
Silverleaf Sunflower	Helianthus argophyllus T. & G.
Camphorweed	Heterotheca subaxillaris (Lam.) Britton and Rusby
Hawkweed	Hieracium gronovii L.
Marsh Elder	Iva frutescens L.
Sea Elder	Iva imbricata Walter
Wild Lettuce	Lactuca canadensis L.

Common Name	Scientific Name
Asteraceae (con't.)	
Marsh-Fleabane	Pluchea camphorata (L.) DC.
Seaside Goldenrod	Solidago sempervirens L.
Goldenrod	Solidago tenuifolia Pursh.
Araliaceae	
Prickly Ash	Aralia spinosa L.
Brassicaceae	
Sea Kale	Cakile edentula (Bigelow) Hooker
Sea Rocket	Cakile harperi Small
Poor Man's Pepper	Lepidium virginicum L.
Bromeliaceae	
Spanish Moss	Tillandsia usneoides L. Black
Cactaceae	
Prickly Pear	Opuntia compressa (Salisbury) MacBride
Campanulaceae	
Venus' Looking-Glass	Specularia perfoliata (L.) A. DC.
Caprifoliaceae	
Japanese Honeysuckle	Lonicera japonica Thunb.
Coral Honeysuckle	Lonicera sempervirens L.

Common Name	Scientific Name
Caryophyllaceae	
Sandwort	Arenaria lanuginosa (Michaux) Rohrback
Willow Wart	Paronychia riparia Chapman
Wire Plant	Stipulicida setacea Michaux
Chenopodiaceae	
Mexican Tea	Chenopodium ambrosioides L.
Cistaceae	
Pinweed	Lechea villosa Ell.
Commelinaceae	
Dayflower	Commelina erecta L.
Convolvulaceae	
Hedge Bindweed	Calystegia sepium L.
Morning Glory	Ipomoea sagittata Cav.
Cornaceae	
Flowering Dogwood	Cornus florida L.
Cucurbitaceae	
Creeping Cucumber	Melothria pendula L.
Cupressaceae	
Red Cedar	Juniperus virginiana L.

Common Name	Scientific Name
Cyperaceae	
Sedge	Carex stipata var. maxima Chapman
Sedge	Cyperus strigosus L.
Spike Rush	Eleocharis sp.
Starrush	Dichromena colorata (L.) Hitchcock
Sedge	Fimbristylis spadicea (L.) Vahl.
Threesquare	Scirpus americanus Persoon
Saltmarsh Bulrush	Scirpus robustus Pursh
Nut Rush	Scleria triglomerata Michaux
Ebenaceae	
Persimmon	Diospyros virginiana L.
Ericaceae	
Sparkleberry	Vaccinium arboreum Marshall
Euphorbiaceae	
3-Seeded Mercury	Acalypha gracilens Gray
Sand Croton	Croton glandulosus (L.) Muell-Arg.
Gray Shrubby Croton	Croton punctatus Jacquin
Spurge	Euphorbia ammannioides HBK.
Dune Spurge	Euphorbia polygonifolia L.
Fabaceae	
Beggar's Lice	Desmodium paniculatum (L.) DC.

Common Name	Scientific Name
Fabaceae (cont.)	
Milk Pea	Galactia macreei M.A. Curtis
Yellow-Sweet Clover	Melilotus officinalis (L.) Lam.
Wild Bean	Strophostyles helvola (L.) Ell.
Fagaceae	
Laurel Oak	Quercus laurifolia Michaux
Live Oak	Quercus virginiana Miller
Gentianaceae	
Marsh Pink	Sabatia stellaris Pursh
Hypericaceae	
St. Andrew's Cross	Hypericum hypericoides (L.) Crantz
Juglandaceae	
Sweet Pignut Hickory	Carya ovalis (Wang.) Sargent
Juncaceae	
Rush	Juncus biflorus Ell.
Rush	Juncus coriaceus MacKenzie
Rush	Juncus dichotomus Ell.
Black Rush	Juncus roemerianus Scheele
Lamiaceae	
Spotted Horsemint	Monarda punctata L.
Blue Curls	Trichostema dichotomum L.

Common Name	Scientific Name
Lauraceae	
Red Bay	Persea borbonia (L.) Sprengel
Lemnaceae	
Duckweed	Lemna perpusilla Torrey
Greater Duckweed	Spirodela polyrrhiza (L.) Schleid
Liliaceae	
Field Garlic	Allium vineale L.
Asparagus	Asparagus officinalis L.
Greenbrier	Smilax bona-nox L.
Common Yucca (Bear Grass)	Yucca gloriosa L.
Loganiaceae	
Mitterwort	Cynoctonum mitreola (L.) Britton
Yellow Jessamine	Gelsemium sempervirens (L.) Aiton f.
Spreading Wire-Plant	Polypremum procumbens L.
Lythraceae	
Marsh Loosestrife	Ammannia teres Raf.
Narrow-leaved Loosestrife	Lythrum lineare L.
Malvaceae	
Seashore Mallow	Kosteletskya virginica (L.) Presl.
Meliaceae	
China-berry	Melia azedarach L.

Common Name	Scientific Name
Moraceae	
Fig	Ficus carica L.
Red Mulberry	Morus rubra L.
Myricaceae	
Wax Myrtle	Myrica cerifera L.
Oleaceae	
Privet	Ligustrum sinense Lour.
Wild Olive	Osmanthus americana (L.) Gray
Onagraceae	
Butterfly-Weed	Gaura sp.
False Loostrife	Ludwigia alata Ell.
Seedbox	Ludwigia alternifolia L.
Water-purslane	Ludwigia palustris (L.) Ell.
Ludwigia	Ludwigia sphaerocarpa Ell.
Ludwigia	Ludwigia virgata Michaux
Evening Primrose	Oenothera humifusa Nuttall
Passifloraceae	
Maypops	Passiflora incarnata L.
Passion Flower	Passiflora lutea L.
Phrymaceae	
Lop-Seed	Phryma leptostachya L.

Common Name	Scientific Name
Phytolaccaceae	
Pokeberry	Phytolacca americana L.
Pinaceae	
Loblolly Pine	Pinus taeda L.
Plumbaginaceae	
Sea Lavender	Limonium sp.
Poaceae	
Broom Sedge	Andropogon virginicus L.
Sandspurs	Cenchrus sp.
Fingergrass	Chloris petraea Swartz
Bermuda Grass	Cynodon dactylon (L.) Persoon
Crab Grass	Digitaria sanguinalis (L.) Scopoli
Salt Grass	Distichlis spicata (L.) Green
Wild Millet	Echinochloa walteri (Pursh) Heller
Wild Rye Grass	Elymus virginicus L.
Love Grass	Eragrostis hirsuta (Michaux) Nees
Cutgrass	Leersia virginica Willd.
Sprangletop	Leptochloa fascicularis (Lam) Gray
Melic Grass	Melica sp.
Panic Grass	Panicum amarum Ell.
Paspalum	Paspalum setaceum Michaux
Reed	Phragmites communis Trinius

Common Name	Scientific Name
Poaceae (cont.)	
Foxtail	Setaria geniculata (Lam.) Beauvois
Giant Foxtail	Setaria magna Grisebach
Johnson Grass	Sorghum halepense (L.) Persoon
Smooth Cord Grass	Spartina alterniflora Loisel
Saltmeadow Cord Grass	Spartina patens (Ait.) Muhl.
Smut Grass	Sporobolus poiretii (R&S) Hitchcock
Needle Grass	Stipa avenacea L.
Purple Top	Tridens flavus (L.) Hitchcock
Sandgrass	Triplasis purpurea (Walter) Chapman
Sea Oats	Uniola paniculata L.
Grass	Uniola laxa (L.) BSP.
Polygonaceae	
Dotted Smartweed	Polygonum punctatum Ell.
Dock	Rumex hastatulus Baldwin ex. Ell.
Primulaceae	
Water Pimpernel	Samolus parviflorus Raf.
Pteridaceae	
Bracken	Pteridium latiusculum Desvaux
Rhamnaceae	
Supple-Jack Rattan	Berchemia scandens (Hill) K. Koch.
Chinese Date	Ziziphus jujuba Mill.

Common Name	Scientific Name
Rosaceae	
Chickasaw Plum	Prunus angustifolia Marshall
Carolina Laurel Cherry	Prunus caroliniana Aiton
Pear	Pyrus communis L.
Blackberry	Rubus betulifolius Small
Dewberry	Rubus trivialis Michaux
Rubiaceae	
Rough Buttonweed	Diodia teres Walter
Buttonweed	Diodia virginiana L.
Bedstraw	Galium pilosum Ait.
Bedstraw	Galium uniflorum Michaux
Partridge Berry	Mitchella repens L.
Clustered Bluets	Oldenlandia uniflora L.
Richardia	Richardia brasiliensis (Moq.) Gomez
Ruppiaceae	
Widgeon Grass	Ruppia maritima L.
Rutaceae	
Hercules' Club	Zanthoxylum clava-herculis L.
Salicaceae	
White (Silver) Poplar	Populus alba L.
Swamp Willow	Salix caroliniana Michaux

Common Name	Scientific Name
Scrophulariaceae	
Water Hyssop	Bacopa monnieri (L.) Pennell
Figwort	Lindernia dubia (L.) Pennell
Woolly Mullein	Verbascum thapsus L.
Solanaceae	
Ground Cherry	Physalis pubescens L.
Ground Cherry	Physalis viscosa ssp. maritima (M.A. Curtis) Waterfall
Horse-Nettle	Solanum americanum Miller
Nightshade	Solanum gracile Link
Typhaceae	
Narrow-leaved Cattail	Typha angustifolia L.
Cat-tail	Typha domingensis Persoon
Urticaceae	
False Nettle	Boehmeria cylindrica (L.) Swartz
Verbenaceae	
French Mulberry	Callicarpa americana L.
Frog-Fruit	Lippia nodiflora (L.) Michaux
Frog-Fruit	Phyla nodiflora (L.) Greene
Vervain	Verbena scabra Vahl.

Common Name	Scientific Name
Vitaceae	
Pepper Vine	Ampelopsis arborea (L.) Koehne
Virginia Creeper	Parthenocissus quinquefolia (L.) Planchon
Muscadine	Vitis rotundifolia Michaux