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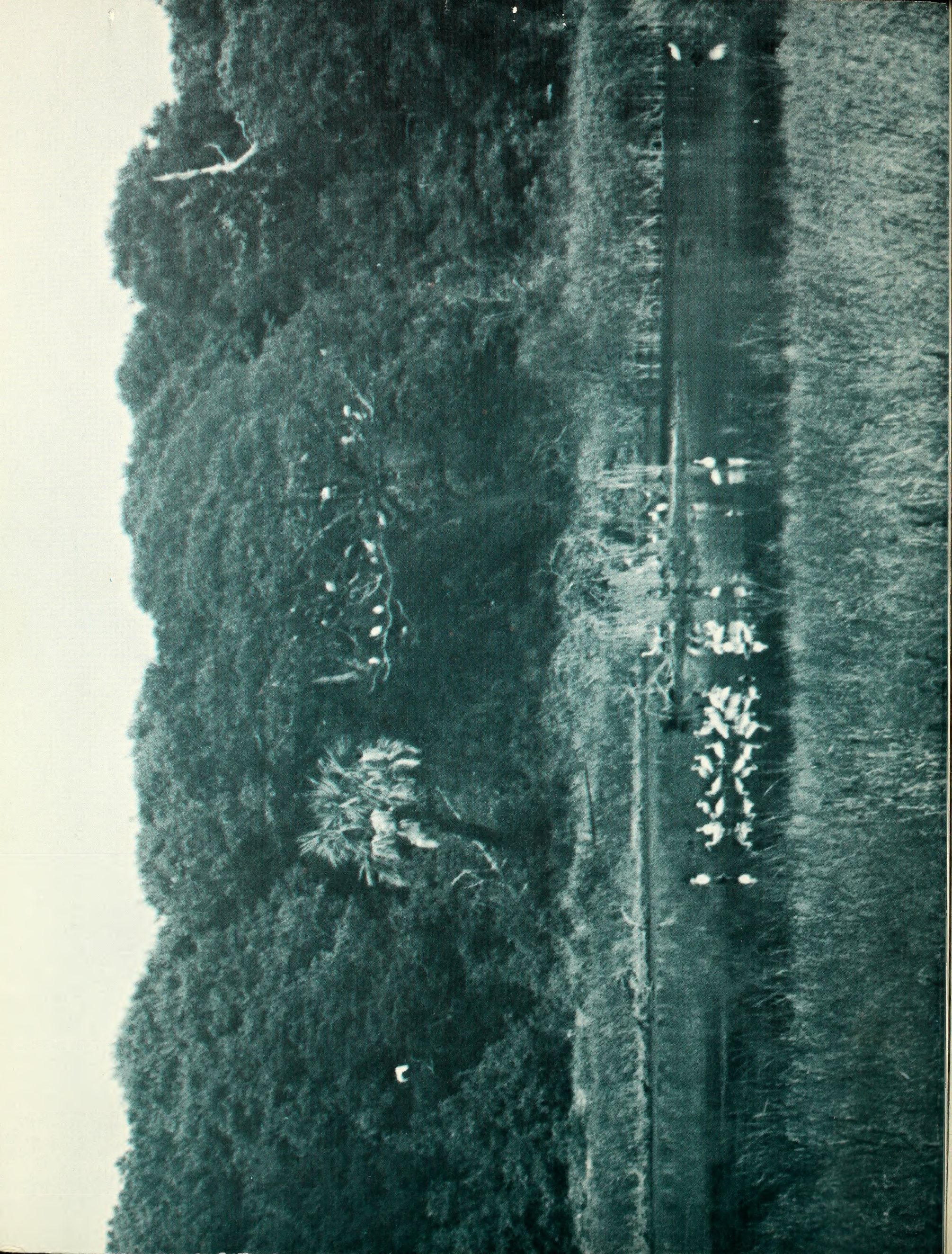
# A STUDY OF STATE USES OF SMITH ISLAND

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*Prepared for the  
Department of Conservation and Development  
State of North Carolina*



RESEARCH TRIANGLE INSTITUTE  
OPERATIONS RESEARCH AND ECONOMICS DIVISION  
RESEARCH TRIANGLE PARK, NORTH CAROLINA

FINAL REPORT

FR-ON-538

A Study of State Uses of Smith Island

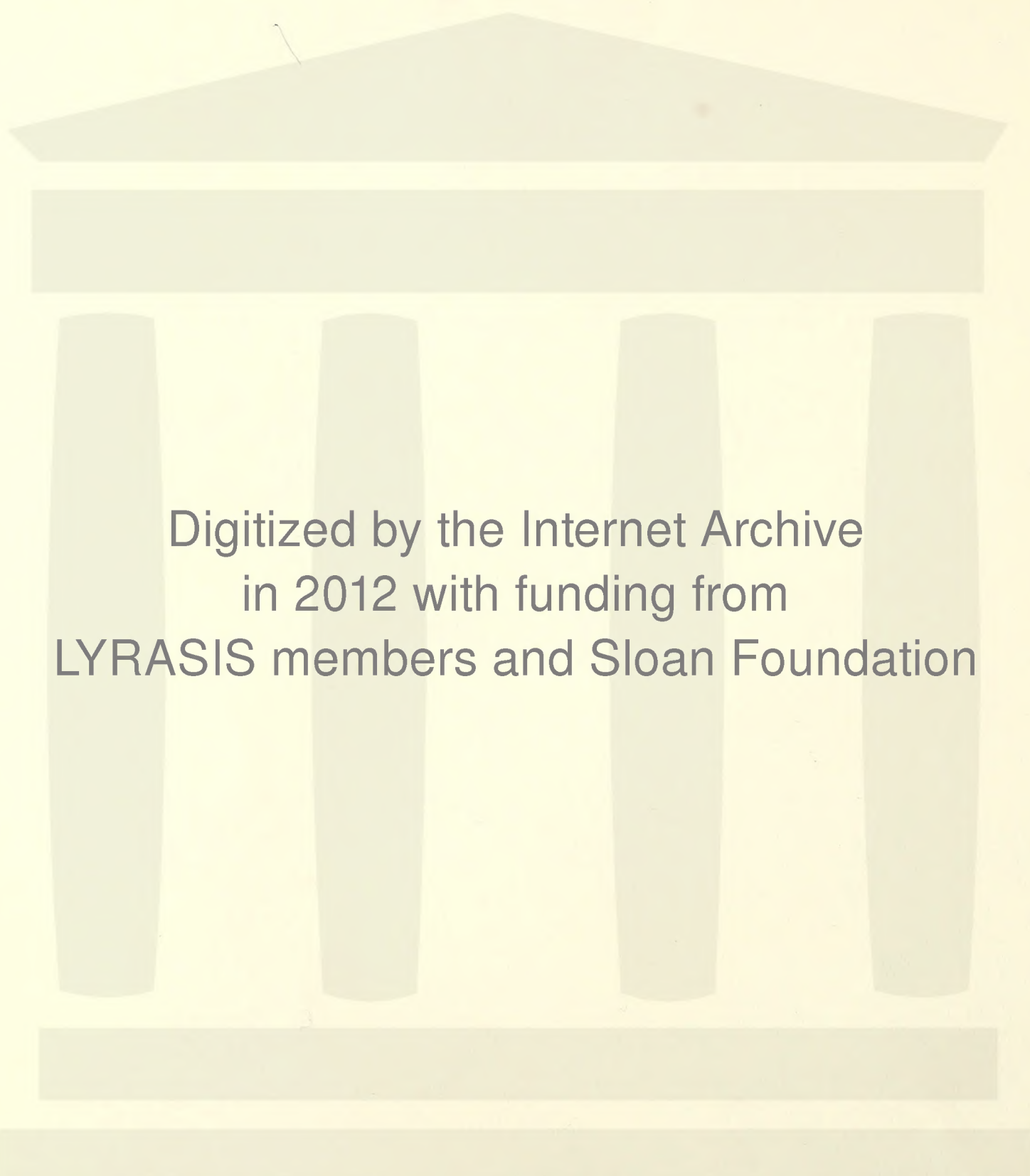
by

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September 4, 1970

Prepared for:

Department of Conservation and Development  
State of North Carolina



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## ACKNOWLEDGMENTS

This study has been another example of the excellent degree of cooperation that has prevailed between the State and the contractor in several projects. In particular, RTI wishes to acknowledge the assistance and comments received from Messrs. Victor Barfield and John Pittman, who served as technical monitors for the State. Throughout the Department of Conservation and Development persons in several divisions were most helpful in providing information, background, and access to relevant files. Extensive assistance was received from the Division of State Parks with respect to the sizes and costs of various units of recreation facilities.

From its beginning, this project has attracted a certain amount of general attention and offers of aid. We wish to acknowledge here the early aid of Dr. William S. Powell, curator of the North Carolina Collection in the library of the University of North Carolina at Chapel Hill, and of B. W. Wells who, in the 1930's, was instrumental in identifying the nature and origin of the dominance of live oaks in the marine forest of Smith Island. The Bureau of Outdoor Recreation and the Army Corps of Engineers also provided helpful inputs, as did faculty of the Consolidated University of North Carolina, including Dr. Arthur W. Cooper. Frank Turner, former property control officer for the State and Sheafe Satterthwaite, writer and visiting Assistant Professor of Landscape Architecture at North Carolina State University, each generously provided extended interviews and access to material unavailable elsewhere.

Gardner Gidley served as recreation planning consultant to the project and his brief report will be found in Appendix A.

Within RTI, major contributions were made by Alex Cole, who prepared the material on climate, access, and costs and sizes of recreation and education facilities, and by Jean Livermore Suttles, who was responsible for most of the material describing Smith Island and the various plans for developing it. Supervision and guidance for the project were provided by James A. Street, Head of the Office of State and Regional Planning, and very helpful reviews of this report were given by Dr. Jay T. Wakeley, Director of the Operations Research and Economics Division and by members of the RTI administration.



## ABSTRACT

This project has the objective of investigating possible State uses of the 11,000 acre Smith Island complex at the mouth of the Cape Fear River in North Carolina. The study identifies objectives that the State could achieve in its use of Smith Island, describes previous attempts at development of the Island, identifies environmental constraints associated with use of the Island, and describes and evaluates certain uses that the State could make.

Smith Island is a collection of islands, barrier beach, marshes, creeks and estuaries, including an area called Bald Head, and Cape Fear itself. The area is of interest because of its social history, but primarily because it is a large, relatively undisturbed, subtropical coastal environment.

The general objectives of the State to which State use of Smith Island could contribute are freedom of the individual, physical security, environmental preservation, and economic well-being. The specific objectives toward which the State could develop programs of use are recreation, education, research, economic growth, and environmental protection and enhancement.

In considering the feasibility of various uses, account must be taken of the forces of the ocean and the climate, which operate to continually alter the shoreline and inlets and which, through storms, make coastal areas less physically secure than many other parts of the State.

Benefits of recreational and educational uses are measured in user-days. Benefits of research are not readily quantifiable. Costs of developing basic facilities of various types are discussed. Particular attention is given to the cost of any uses that adversely affect fisheries output stemming from the marshes and estuaries associated with Smith Island. The incidence of the various benefits upon several groups within the population is discussed.

The report concludes that the decision about State uses of Smith Island must rest upon the weights attached to each of the general objectives, the specific objectives to be served by alternative programs of State use, and alternative programs in other locations that might promote attainment of the specific and general objectives. Finally, it is recommended that the decision about use of Smith Island be made in the context of its role in the North Carolina coastal zone.

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# A Study of State Uses of Smith Island

## I. SUMMARY AND CONCLUSIONS

### A. Basis and Scope of Study

This investigation originated through a request of Governor Robert W. Scott for a study of State uses of Smith island at the mouth of the Cape Fear River in North Carolina. This study sets forth objectives that the State could achieve in its use of Smith Island, describes previous attempts at development of the Island, identifies environmental constraints associated with uses of the Island, and describes and evaluates certain uses that the State could make.

### B. Smith Island--The Site

Smith Island is the collective name of some 11,000 acres of barrier beach, sand dunes, marine forest, marshes, estuaries, and bays in Brunswick County, beginning below Federal Point and terminating in Cape Fear itself. Three major islands comprise the bulk of the solid or high ground in the complex and total less than 3,000 acres. The largest and southernmost of these is called Bald Head Island. Smith Island forms the eastern side of the mouth of the Cape Fear River and is the southernmost point in the State.

The Island has considerable interest because of both its natural and social history. For the naturalist, Smith Island is a large, relatively undisturbed marine coastal environment of great diversity, providing sites ranging from open ocean beach and dunes to live oak, dogwood, and palmetto forest, to marsh and estuary with many gradations of moisture and salinity. These habitats serve many species of fin and shellfish, shorebirds, and a modest number of other types of birds and animals, including certain unusual species, such as the loggerhead turtle.

The social and cultural history of the Island dates back at least to Indian settlements, of which remains can still be found. As the Carolinas were settled and economic activity grew, ports and shipping increased. Pirates came and went in the area. Lighthouses were built to guide mariners around Cape Fear and the nearby shoals. A life saving service was based on the Island, and river pilots also operated from it

for many years. The Island was fortified at the time of the Civil War because it was near routes used by blockade runners.

Today Smith Island attracts attention not only for its natural and social history, and for its contribution to fisheries of the Cape Fear coast, but also because rising population and level of income have increased the effective demand for outdoor recreation, especially that associated with water. This demand is manifest not only in the short-term use of beaches but also in the development of areas and communities catering to the desire for vacation or retirement homes and for a variety of associated recreation and consumer services. The miles of beaches and acres of forests of Smith Island, presently unstructured and unoccupied by humans, are a highly attractive resource for such intensive development.

### C. The Objectives

As a framework for decisionmaking about Smith Island there are certain general objectives that the State may seek to achieve through uses that accomplish specific objectives. The general objectives are:

- 1) Freedom of the individual.
- 2) Physical security.
- 3) Environmental preservation.
- 4) Economic well-being.

Each possible use is seen as affecting a segment of the population with respect to one or more of these general objectives.

The specific objectives that the State may wish to promote are identified as:

- 1) Recreation.
- 2) Education.
- 3) Research.
- 4) Economic Growth.
- 5) Environmental Protection and Enhancement.

Recreation may begin simply with relaxation in a pleasant outdoor environment, but it can move on to heightened perception of other living things and of natural processes, and to investigation of the events and ways of life of earlier times.



Education in many aspects of natural sciences can be based upon the Smith Island environment and provided in various ways from informal to formal. At one extreme it is a form of recreation; at the other it is a scholarly endeavor.

Research using Smith Island as a site for observations and experiments can take several directions: first, an exploration of the matters that are unique to that site, such as the behavior of certain animals or plants; second, utilization of parts of the Island as control areas in which to make comparisons with processes underway in areas more heavily affected by man's actions. A third possible use is as a site for a center for research with objectives broader than (or even unrelated to) the first two directions.

Economic growth for areas adjacent to Smith Island is significant for certain groups and should not be overlooked but has never been proposed as a specific objective to be achieved by State use of the Island.

Environmental protection and enhancement is one of the State's most important specific and general objectives. As a use of Smith Island, however, it has relatively low visibility because, at least initially, it involves not doing something. Later, as it becomes clear how the environment in that area can be enhanced, definite actions may be in order.

#### D. Types of Use

During the past 50 years Smith Island has changed ownership several times and has reverted twice to the county government for nonpayment of taxes. Each of the private owners has asserted, upon acquisition, an intention to develop the Island for vacation homes. Sometimes more elaborate plans have been proposed, involving development of entire communities based upon recreation enterprises.

Also, throughout this period, various State and Federal officials or agencies have studied the Island and advocated some form of public ownership and development. These recommendations often criss-crossed: the State would advocate Federal action while the Federal report would indicate the State as the proper level for governmental action.

Heretofore, no one has simultaneously had a plan, finances, and the ability to act to develop Smith Island; that period may now be ending.

The uses that have been considered in this study include:

- 1) Ad hoc use--a continuation of the unstructured use, largely by residents of the Smith Island locale.
- 2) Recreation--development of specific areas for such activities as picnicking, swimming, camping, and cabins.
- 3) Education--can range from a simple nature trail to a complete interpretive center suitable for exposition of both the natural and cultural history of the Island.
- 4) Research--may involve merely the use of the Island as a site for making observations or might involve the location of substantial laboratory facilities for a major marine science or other program.

These were the sorts of uses that were considered. It is apparent that some of them can be combined and that some of them must be kept separate. Moreover, they can be programmed at widely varying levels of intensity.

#### E. Feasibility of Uses

Before considering the benefits and costs of the several uses, the physical feasibility of certain uses was considered. In particular, it is apparent that coastal areas, such as the barrier beach forming the east edge of Smith Island, are not permanent, but represent the present balance of the forces of wind, water, and sun, and of man and his works. Beaches grow and diminish in size, inlets open and close, dunes advance and retreat. Attempts by man to impose his own form of permanence in such areas are often partially frustrated by the enduring natural forces. It is possible, however, by careful planning, to find niches in which man's structures have the greatest chances for lasting in this environment.

A second aspect of feasibility involves climate and particularly storms. The overall climate, deeply influenced by the surrounding river and ocean, is one of the most moderate to be found in North Carolina. It is subject, however, not only to the wind and water that accompany storms throughout the State, but also by surges of the sea that result from the winds. Together these forces can make coastal storms formidable in their destructive powers. At least one serious storm comes upon the North Carolina coast each year. The prevalence of such forms of physical

insecurity suggests that investments made in this environment may not have the life expectancy and freedom from damage that could be expected in other locations. This, in turn, may lead to an investment policy designed to gain some benefits from the area without making investments that would hurt deeply if lost.

F. Evaluation of Uses

The benefits to be achieved from various uses of Smith Island range from a potential 10,000 user days per year of camping to 297,500 user days of swimming for basic units of recreation facilities to 48,000 user-days per year for an educational, interpretive center. Naturally, a basic unit of any type of facility can be duplicated if additional spaces will be used.

Benefits to the economy of the Smith Island area would include employment resulting from construction of facilities, but this would be relatively temporary. Operation of recreation or education facilities would provide a number of permanent positions as well as some seasonal ones. It is likely that employment induced through the growth of businesses associated with tourism and travel would be the major permanent change in employment associated with State uses of Smith Island for objectives that would serve large numbers of persons. Based on travel statistics, Brunswick County appears to be somewhat behind some other areas of the State in development of the recreation sector of its economy, but perhaps is in a catching-up phase.

The fisheries output associated with the marshes and estuaries around Smith Island is a benefit of present use of the Island. In 1969 Brunswick County landed seven percent of the total State commercial fisheries production, a quarter of the hard clams, and a third of the oysters. Its oyster reef, though presently polluted by the Cape Fear River, provides most of the seed oysters for planting in other beds in the State. The value of the fish catch totalled \$904,000 in 1969. Parts of this sum circulate through the local economy as wages and as payments for goods and services used by the fishing industry. Thus, an important aspect of further use of Smith Island is the maintenance or improvement of this fisheries resource.

The benefits of research cannot readily be quantified for comparison with recreation, education, or fisheries; it is only possible to note the importance of the research process in yielding the knowledge that improves our well-being.

The Island presently also provides some protection for the ocean shipping channel in the Cape Fear River.

Finally, merely by being a natural area, the Island yields an "option" benefit to some persons who recognize that they might wish to visit it.

When costs of State use of Smith Island are considered it is apparent that there will be some cost of acquisition, followed by the costs of whatever types and amounts of development are planned. The price for which the Island was sold in July 1970 was reported as \$5.5 million, including a mortgage taken by the seller. The additional direct costs of developing minimum facilities for educational or recreational use could range from \$70,000 to \$425,000 for the facilities together with a dock for access by ferry. Road access might add as much as \$1 million to these costs. In addition, there would be expenditures for operation and maintenance annually.

These costs are, of course, minimal, since additional basic units of recreation or educational facilities could be built if needed.

Costs of the uses are reported in dollars for development of various recreation or education facilities. For research, the range could be very large: from a temporary storage area for instruments and equipment, to a permanent laboratory and training facility complete with residences. It does not appear, however, that the latter is being sought by the research community, which would prefer to have its laboratories closer to its supporting facilities: libraries, computers, and permanent residences.

In any development, careful attention must be paid to alterations that would diminish the fisheries output of the marshes and estuaries around the Island. Any such effects would have to be considered as costs of using the Island.

Finally, in evaluating State uses of Smith Island, it is helpful to consider the incidence upon various groups of persons of the results of those uses. For the immediate users, it is clear that certain forms of recreation use could serve large numbers, but with experiences that are similar to those available elsewhere. Other forms of recreation or education would serve smaller numbers and more fully utilize the unique characteristics of the Island. Research uses of the Island, by their

nature, will involve small numbers of persons directly, although the benefits of knowledge gained by research could affect many persons indirectly. Insofar as uses of the Island promote tourism, economic benefits are likely to accrue to certain types of business in the area near the Island. On the other hand, if economic growth in that area were the primary concern, State use of Smith Island might not be the most effective means of inducing economic change.

Various aspects of the decision framework are summarized in the following table.

Table 1  
SUMMARY OF USES

	<u>Recreation</u>		<u>Education</u>	<u>Research</u>	<u>Ad Hoc Use</u>
	Picnic Swim	Camping	Nature Study		
No. potential users	Large	Medium	Small	Very Small	Very Small
Use of unique aspects of the area	Low	Medium	High	High-Medium	Medium-High
Ease of providing similar experience elsewhere	High	High	Low	Low-Medium	Low-Medium
Cost	Medium	Low	High	Low-High	Low
Effect on environment*	Medium	Medium	Low	Low	Low
Effect on Economic Growth*	Medium	Low	Low	Low-Medium	Nil

\* Assuming no destruction of fisheries habitat.

The evaluation must end with the several general objectives of decisionmakers and with the relative importance attached to each of them. Absolute concern for one or another objective can lead quickly to a particular use, but at the cost of foregoing any achievement of the other objectives. Along with the general objectives, decisionmakers need to consider the specific objectives to be achieved by particular programs of use and need to place the entire decision in a context of economic growth, community development, land use policy, and use of coastal zone resources, not only in southeastern North Carolina but all along North Carolina's coastal zone.



## II. INTRODUCTION

### A. Purpose of the Study

This study resulted from the request, made by Governor Robert W. Scott, that an investigation should be made of the alternative uses to which the State could put Smith Island if it were owned by the State. The purpose of the study, then, is to elaborate upon the consequences of alternative State uses of Smith Island with the aim of providing State decisionmakers with information for making effective decisions about this important natural resource.

This study is addressed to defining a range of such uses and to identifying their advantages and disadvantages. To the extent possible, those advantages and disadvantages will be expressed quantitatively.

### B. General Procedure of Study

The first task of this project and section is to describe the physical characteristics of Smith Island which is the subject of this study. The second task is to examine the objectives that might be attained by various State uses of Smith Island. The third task in this project combines a review of uses proposed for Smith Island during the past 50 years with a description of the several types of use that are considered further in this study. The fourth project task investigates some of the factors that would affect the feasibility of certain uses; these factors include stability of the land mass, climate, and water and sanitation. The fifth major task is evaluation of each alternative use in terms of the several objectives previously introduced. The final task is presentation of the findings of this research report.

In conducting this study, RTI project staff have been assisted in a variety of ways by numerous State personnel. At the beginning of the investigation interviews were conducted with a number of State administrators as well as with representatives of the academic community. Data were gathered from several State files and considerable work was done with the State Parks Division in estimating costs of developing and operating various types of facilities. A field trip was made to Smith

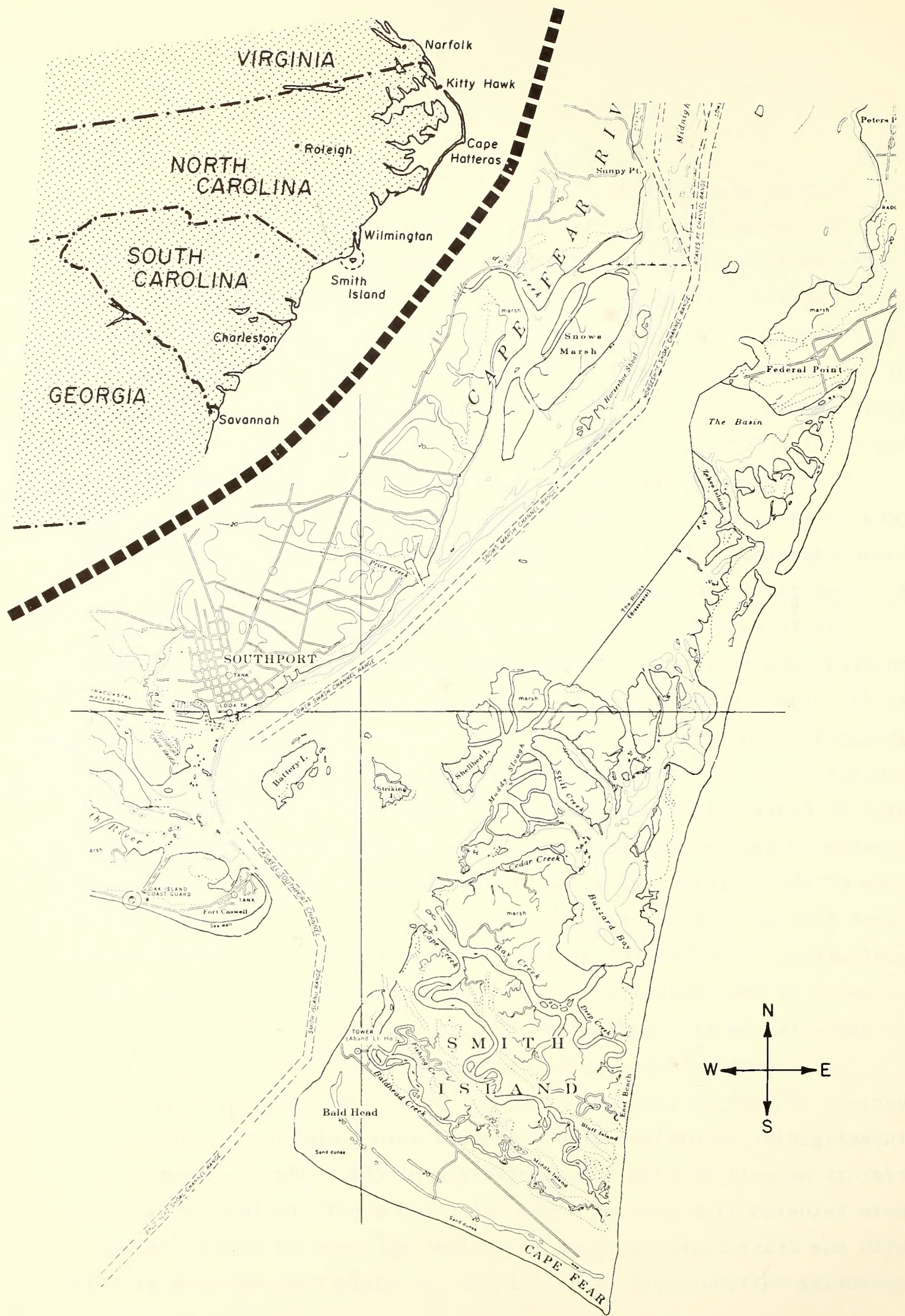


FIGURE 1 SMITH ISLAND AND VICINITY



Island with the recreation consultant for the project (see Appendix A) and one of the project technical monitors. Discussions have been held with the technical monitors at various points during the project.

C. Description of Smith Island

Smith Island is the southernmost point of North Carolina. Located in Brunswick County at the mouth of Cape Fear River, it is about 22 miles south of Wilmington and three miles east across the river from Southport. The Island is shaped somewhat like a thin triangle, getting its common name, Bald Head, from the exposed beach and dunes at the south-western corner. As shown in Figure 1, Smith Island is actually a complex of small islands, creeks, and marshes. Of the total of about 10,900 acres, some 2,580-2,700 acres are high land. The rest is submerged land and salt marsh, ownership of which is claimed by the State.

The southwest coast of Smith Island is paralleled by a high sand ridge, (the Great Ridge), approximately three miles long. The area behind this ridge and a strip behind the eastern beach, approximately six and one-half miles in length, comprises a marine forest. This forest, protected from the wind and ocean by the dune system, contains a stand of live oaks and sabal palmetto. In discussing Smith Island, the National Park Service (1955) seashore recreation study reported "In only a few limited areas [on the Atlantic coast] are there remnants of forests which . . . can be still recognized as parts of the primitive, native forests" (Quoted in Cooper and Satterthwaite, 1964:14). The Island is the northern limit for the sabal palmetto.

Smith Island plays an important part in the preservation of the Atlantic loggerhead turtle. These giant sea turtles have long used the Island's beaches to lay their eggs; as undisturbed coastal areas for nesting grow rare, the loggerhead is becoming uncommon. The Island has also been the home of the Florida wood rat. The nearest coastal population of this species is over two hundred miles south (Cooper and Satterthwaite, 1964:21) and its existence on Smith Island is unusual and deserves scientific study.

The salt marsh (3400 acres), creeks and bays (3250 acres), and shallow river water (1550 acres) provide a rich environment for marine life. These areas total 8200 acres and are mostly all below mean high water. Most of

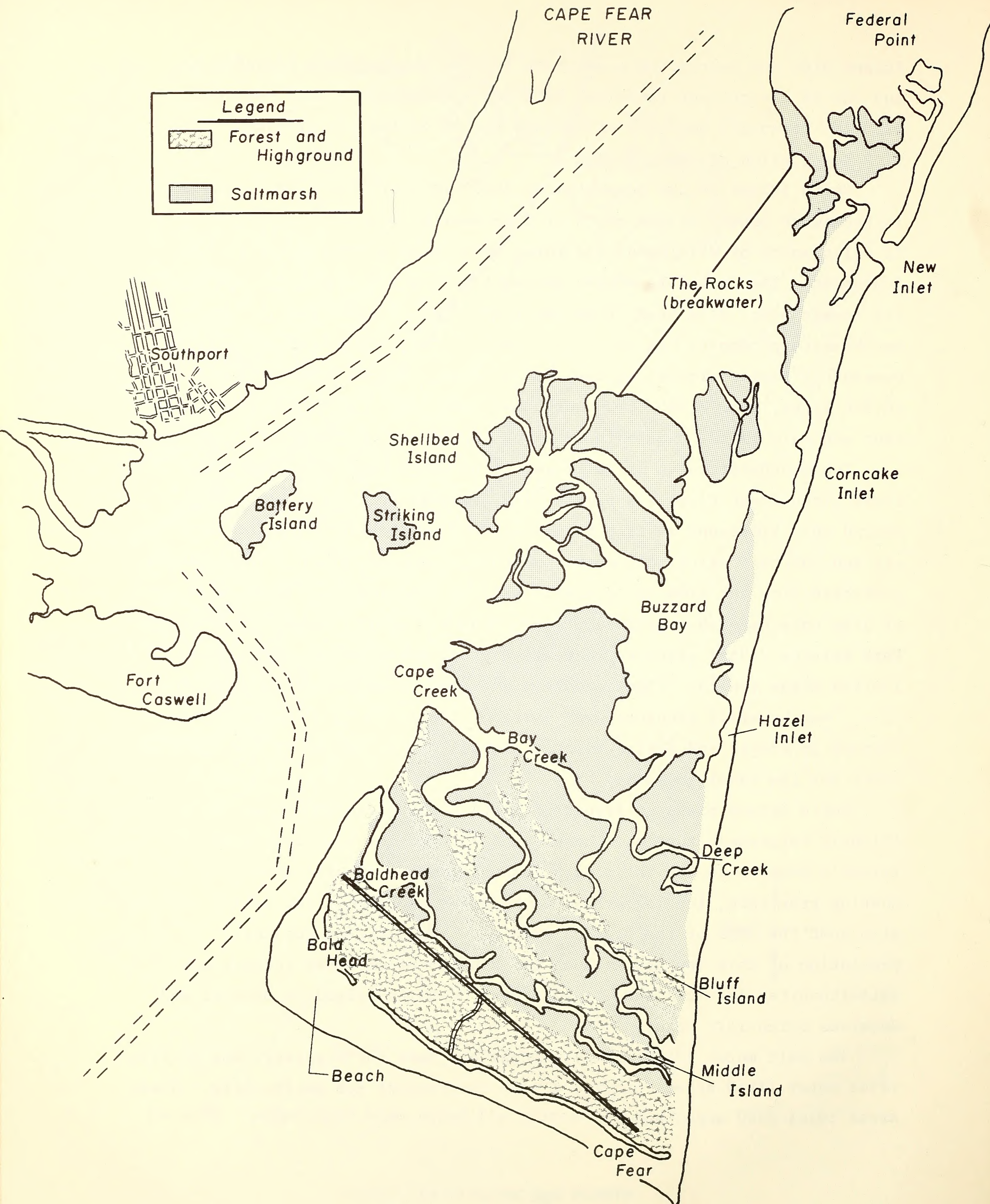


Fig. 2. Smith Island Land Types.

the seed oysters used on the North Carolina coast come from this area (Turner, 1969:4). The waters are also important spawning grounds for finfish and shellfish. The marsh areas are practically undisturbed by man, providing an ideal area for research in marine ecology.

The outlying islands, Battery, Shell Bank (or Shellbed), and Striking Islands, provide nesting grounds for several species of birds. Battery Island is now a large heron rookery, containing "thousands of individuals of ten species of wading birds . . . Probably no area of equal size in North Carolina supports so great a volume of such diverse bird life" (Cooper and Satterthwaite, 1964:23).

Inaccessibility has undoubtedly been a major factor in deterring developing of Smith Island. Since its first settlement the Cape Fear area has been recognized as extremely hazardous for ships. Southeast of Smith Island for twenty miles lie the Frying Pan Shoals, and even today passage up the Cape Fear River is only by carefully maintained river channels. Smith Island can be reached only by boat, and "a complex of sand bars, mud flats, and tidal creeks limits access to small boats in calm weather at high tide. Even the most experienced local boatmen approach the island with extreme care" (Cooper and Satterthwaite, 1964:3-4). Despite these hazards the Cape Fear area has too many natural advantages to be left alone. Fishing on and around Smith Island has always been a profitable enterprise, and the Cape Fear's location on the Atlantic coast makes it a natural trade route. Its importance as an ocean shipping route was well established by the 18th century, through trade from the colonies to England. The first lighthouse on Smith Island began operations in 1796, on the southwest shore of Bald Head. It was replaced in 1817 by a new lighthouse, "Old Baldy," which is now the oldest standing building on the Island. For many years river pilots lived on Smith Island in order to serve ships more readily.

During the Civil War the Cape Fear ports assumed major military importance to the South. Smith Island and the surrounding shoals prevented the North from maintaining a successful blockade, and shallow-draft boats called "blockade runners" kept trade open between the South and Europe. To protect this shipping lane the Confederacy built Fort Holmes on the southwest side of Bald Head. The portion of the earthwork

fort that is protected by the forest remains in good condition. The South held the river area until January 1865, just three months before the end of the war.

Despite the subsequent dredging of the river channels, the Cape Fear area remained a severe hazard to ships. The Coast Guard Life-Saving Service maintained a station on Smith Island from 1882 to 1937. A new lighthouse was built in 1903, this time at Cape Fear Point. "Old Baldy" was discontinued in 1935; the new lighthouse operated until 1956, and was dismantled in 1960. Since 1956 the Coast Guard services have operated from across the river, on Oak Island. Smith Island presently has no permanent human inhabitants.

### III. SPECIFIC OBJECTIVES TO BE ACHIEVED BY STATE USE OF SMITH ISLAND

This discussion presents the specific objectives to be achieved by the State in the use of Smith Island. Although these objectives have been placed in five groups, it is recognized that a particular use of Smith Island may contribute to the achievement of more than one objective. These specific objectives may be considered as being the direct effects of the various types of use discussed later in this report.

Underlying these specific objectives are certain general objectives or values that must be considered as important criteria in evaluating alternative uses that the State might make of Smith Island. These general objectives or values include freedom of the individual to seek self-fulfillment, physical security in a sometimes-dangerous environment, ordering of the environment to maintain or enhance its quality, and organization of the economy to increase economic well-being. These values will not be discussed further here, they are noted so that the reader can consider their relation to the specific objectives presented below. (The foregoing general objectives are derived from, and closely related to, the four postulates--primacy of the individual, social order, physical security, and personal well-being--presented by Scott and Banks in Horizon Concepts for North Carolina (1969:7).

#### A. Recreation

The most cursory inspection shows that some parts of the Island offer excellent opportunities for ocean swimming and other activities associated with beaches. The white sand beaches are generally wide and shelve off gently into the water in most places. (In some places, however, fast tidal currents make use dangerous at certain times of day.)

A second type of recreation use that may be made of Smith Island is that of a natural area. This use stresses not the activity of an individual, but his ability to observe and enjoy ongoing processes of nature: the ebb and flow of tides, the breaking of waves, the development of dunes and forests and the ongoing lives of marine plants and

animals, turtles, raccoons, and many species of shore and subtropical birds. All these things may now be observed in a natural setting on Smith Island relatively unaffected by human activities.

A third recreation objective that might be achieved through the use of Smith Island would be to add to and complement the complex of recreation sites presently available in Brunswick and New Hanover Counties. Already available in the area are historic-cultural sites such as Fort Fisher, Brunswick Town, a Civil War museum, and the battleship North Carolina; elaborate gardens such as those at Wilmington and Orton Plantation; and a number of public beaches. The area also provides golfing, marinas for boating and the services of charter and head boats for sports fishermen. Insofar as Smith Island might be developed to increase the variety of recreation experiences available in the Brunswick-New Hanover area, it would complement existing recreation activities, make the area more attractive to tourists and thus increase the length of their stays in the area.

#### B. Education

The potential educational objectives to be achieved by State use of Smith Island merge with recreational objectives but may be considered separately. Descriptions by naturalists of the plants and animals and natural processes underway on Smith Island and in the waters around it make it apparent that parts of the Island are well-suited (through the development of nature trails and other interpretive programs) to providing education in the natural history of an area relatively free from human intervention. Such programs might focus especially upon the processes affecting the ecology of various shellfish that contribute much to the economy of the area. Also worthy of note would be the maritime forest of live oaks, the bird life of the area, and the processes affecting the shoreline.

Although the study of nature may be one of the more important objectives to be served by State use of Smith Island it is appropriate to consider the Island as a focus for social and cultural history also. Cape Fear is a part of the Island; much of the history of this part of the coast since the time of its first settlement is bound up with Frying Pan Shoals, ships, ship wrecks, trading along the coast and overseas, the nature of Wilmington as a port, the Civil War and the blockade,

and the efforts, through lighthouses and coast guard rescue services, to prevent disaster in the treacherous shoals off Cape Fear. All of these topics lend themselves to imaginative interpretation to make citizens and visitors to the State alike more fully aware of our heritage from the past. As noted under recreation, above, such developments could enhance the capacity of the Brunswick-New Hanover area as a complex of tourist attractions.

C. Research

Smith Island represents an important potential site for research precisely because it has received relatively little use by man in the recent past. Therefore it can provide a basis of comparison and contrast with other areas that have undergone a greater degree of use by humans. A wide variety of biological and oceanographic research is conceivable in the Smith Island site. It may be considered as follows: first, research describing and explaining phenomena that are unique to Smith Island, such as the community of animals found there; second, research aimed at answering questions applicable to coastal environments in general and for which Smith Island would serve as a convenient example and site for studies; third, the Island might be the location of a laboratory or center conducting research there or at other locations on matters related or unrelated to Smith Island.

At present a project has been funded under the Sea Grant program for research of the first type. This project, proposed by Dr. J. F. Parnell, of the University of North Carolina at Wilmington, and Dr. David A. Adams, of the Coastal Zone Resources Corporation, calls in its abstract for developing "an integrated description of the biotic and physical systems of the area and their ability to support human use. Results of field surveys . . . will provide an understanding of existing conditions, indicate modifications which might result from more intensive human use, and form the foundation for a more detailed study leading to a recommended land use plan for the area" (Parnell and Adams, 1970:3). The overall purpose of this study is to establish the "capability of the area to support human use without ecological damage" (Parnell and Adams, 1970:4). The study will investigate land vertebrates, vegetation, estuarine life, shoreline stabilization, and include a reconnaissance of land forms and soils.

D. Economic

Another objective to be served by State use of Smith Island is the economic one of enhancing and of developing the economy of the area. It is apparent to even the casual observer that different uses of the Island will differ in their effects upon the local economy; these differences have been the occasion of considerable debate about the ownership and uses of Smith Island because their effects are very important to the local population. If State use, or indeed any use, of Smith Island is to enhance the economy it should raise the level of per capita income, increase the diversity of types of employment and occupation, and reduce unemployment and underemployment.

E. Environmental

The final potential objective to be achieved by State use of Smith Island is the protection and enhancement of the environment of the lower Cape Fear River. Included under this heading are the continued production of finfish and shellfish in the estuaries on the river side of Smith Island (and hopefully the elimination of pollution from the Cape Fear River so that shellfish may again be taken from Smith Island waters), protection of the channel for ocean-going vessels, protection of the mainland coast from severe storms, maintenance of the gene pool available in the biologic organisms of Smith Island, and recognition and preservation of the Island as the site of certain climatic and biologic extremes in the State. (Such a climatic and biologic extreme is presently preserved in the Mount Mitchell area, which was the first State Park in North Carolina.)



#### IV. TYPES OF USE AND THEIR CHARACTERISTICS

Before proceeding to the main topics of this section, note should be made of other works that provide background on aspects of Smith Island. Particular attention is called to the monograph by Arthur W. Cooper and Sheafe Satterthwaite (1964), Smith Island and the Cape Fear Peninsula: A Comprehensive Report on an Outstanding Natural Area. This document summarizes much material on the natural and social characteristics and values of the area. Since it deals in some detail with the history of Smith Island (including aboriginal settlements, early explorations, early and abortive settlements, piracy and Indian trading, permanent colonization, the Revolution, The Civil War, and the Coast Guard and river pilots) these topics will not be elaborated here. Merely to mention them indicates the substantial range of history that may be interpreted through Smith Island. Naturally, the Cooper and Satterthwaite publication contains an important bibliography.

A bibliography of selected recent publications appears at the end of this report.

##### A. Review of Prior Proposals for Development

###### 1. Palmetto Island Corporation

In 1916 Smith Island was bought by Thomas F. Boyd for \$45,000. Although Boyd later deeded out all land north of Bald Head Creek to satisfy a debt, he did plan, through the Palmetto Island Corporation, to develop a summer home resort on Bald Head. According to Margaret Hood (Satterthwaite, n.d.) when Boyd bought Smith Island, he cut three streets through the forest from the ocean to the river and built a hotel of about 40 rooms. Lots were laid out on sixty acres on the western side. Boyd raised fruits and vegetables on the Island and also brought in cattle. Overgrazing occurred on the southern part of the Island and left hardly any grass in that area.

Boyd was unable to carry out his plans for a resort and in 1933 he offered the land to the State for the creation of a State Park, if the State or Federal government would pay the back taxes. United States forester E. A. Sherwood wrote Boyd in 1933:

"Members of the Branch of Research felt, however, that the somewhat unique soil and forest types of the Island offered unusual forms of forest research . . . . The fact that the Island's greatest public value would seem to lie in its potentialities for forms of public outdoor recreation would seem to dictate state ownership and management as the preferable course of action." (Quoted in Cooper and Satterthwaite, 1964:56.)

Although the State could accept a donation of land, law prohibited paying the back taxes; Brunswick County took over Bald Head for unpaid taxes.

The Palmetto Island Corporation, represented by R. C. Boyd, bought back Smith Island in April 1936 for \$11,000. On March 23, 1937, the general assembly passed House Bill Number 1282, authorizing the Department of Conservation and Development to acquire the Island. No funds were appropriated, however, and on April 23, 1937, Bald Head again came under county ownership for nonpayment of taxes.

## 2. Ownership by Frank O. Sherrill

### a. Initial Acquisition

In March 1938, Frank O. Sherrill of Charlotte, North Carolina, bought Smith Island, Brunswick County. It was reported by the Associated Press from Wilmington on March 27, 1938:

"Sherrill said today it is his hope to make the island something like Bermuda, an island of beauty and pleasure without automobiles. He does not desire to make the place a haven for tin can tourists, he said, but added there will be development of the island." (Quoted in Cooper and Satterthwaite, 1964:57.)

Although few roads were built in the 1940's and some experimental farming attempted, the war interfered with development plans. Nothing was attempted in the 1950's by Sherrill. In September 1963, Sherrill completed his purchase of the Smith Island property by obtaining 30 acres of former Coast Guard property sold by the Federal Government as a surplus. The property consisted of 20 acres surrounding the Cape Fear lighthouse, built in 1903, 10 acres around the Bald Head Radio

Beacon Station, and a 30-foot right-of-way connecting them. Following publication of a development plan in September 1963, Sherrill offered the Island for sale to private firms for prices reported to be as much as \$5.5 million.

b. Henry von Oesen Report

In 1962-1963, Henry von Oesen, a consulting engineer in Wilmington, North Carolina, reported to Sherrill on land access to Smith Island. Two routes were recommended, both starting at Federal Point. The first went south along the west side of Barrier Island and Buzzard Bay, and required three bridges totaling approximately 1,500 feet of bridge. The alternative route ran along the east side of The Rocks and then over to the eastern shore and finally along the southern coast of Smith Island. This route required approximately 800 feet of bridging in one spot. Cost estimates for the work were \$300-500 thousand, and similar work today might cost about \$1 million. The proposed road would have been a "developers road" for low-density, moderate speed use. This is below the standard required for both State and Federal highways. Road construction would have required filling of marshes.

c. Rader Plan

In September 1963, Rader and Associates, a Florida architectural and engineering firm hired by Mr. Sherrill, published a feasibility study and development plan for Smith Island. This plan contained an analysis of the potential market for the project, estimates of development costs and cash flows, and a complete land use plan with proposed development divided into 5 stages over a 20-year period. Unlike other plans for Smith Island, the Rader Plan called for the creation of an entirely self-sustaining community, including industry, schools, a hospital and other public facilities. The overall project would create:

"a completely self-contained year-round residential community for 60,000 persons living under exceptionally favorable conditions, plus excellent resort and convention facilities for 15,000 visitors" (Rader and Associates, 1963:2).

i. Development

The early stages of the Rader development plan would concentrate on building a private airport on Battery Island (presently a rookery and nesting area for several species of subtropical birds) and on developing a residential area on the southwest corner of the Island. During this time Smith Island would be an exclusive residence and resort area. Commercial and industrial development would be emphasized in later stages. The completed project would have developed approximately 41 percent of the total 10,200 acres as single and multiple family residences, including "skypark" residences for plane owners adjacent to the airport. The plan called for 125 miles of canals to be built throughout the Island, creating 8,000 homesites with private backyard docks. Area would be allocated for ten small public beaches and one large public beach and the property lines on the remaining 13 miles of beach would extend to the water, insuring private use of beach-front area. Public accommodations would be concentrated along the east coast strip below Fort Fisher and on the Cape Fear Point.

Two shopping centers would be located near the north and south ends of the Island along its eastern shore. Land was allocated for thirteen public schools, one private school and for a future higher education center. Although land was designated as "Public and Ouasi-Public" for development of necessary public facilities, such facilities were not specified.

Recreation facilities, other than the public beaches, would include two yacht clubs, two golf courses--located on the east coast of Bluff Island and the southwest side of Bald Head--a riding club, a gun club, several marinas, parks and picnic areas, and a large amusement park and Marine Land area in the north of Smith Island below Fort

Fisher. The large public beach would be east of this amusement park, and would be developed with a boardwalk, parking areas, and beachfront motels.

Industry would be located on Battery and Striking Islands. Suggested industry to be encouraged included biological products, dental, surgical and optical equipment, electrical and mechanical components, games and toys, signs and advertising, and similar labor-oriented light industry.

Access to Smith Island would be by a State-built highway south from Fort Fisher and a State ferry to Battery Island, which would be connected by bridge to Striking Island and then to Smith Island. The private airport on Battery Island was intended to be an inducement to industry.

ii. Construction

The Rader plan had no provision for preserving any of the existing environment of Smith Island. The value of the Island was that no previous development had occurred and, given its ideal location "within 500 miles of one-third of the country's population," (Rader and Associates, 1963:2) completely planned development could create an "ideal" community. Development, therefore, concentrated on construction and design and did not discuss preservation or the value of the estuaries as breeding areas for shellfish and finfish.

The project proposed creating a uniform elevation on Smith Island of 8 feet above "Mean Low Water, which is defined as elevation 0.0" (Rader and Associates, 1963:24). This would involve leveling the dunes and filling the marshes to create a uniform height for the Island of 8 feet. "The controlling factor governing this decision [was] the tide history at Baldhead" (Rader and Associates, 1963:8). Mean High Water was judged to be 4.3 feet and equinox tide 6.0 feet. Storms

and storm tides were not mentioned, nor was there discussion of the effect of dune leveling on wind velocity and capacity to do damage.

A second major aspect of the plan was the construction of 125 miles of canals. This would involve continuous bulkheading, and accounted for over 30 percent of total estimated cost. The sea wall surrounding the canals would have a height of 6.5 feet above mean low water. Surrounding land would rise gradually from that height to the 8 foot maximum elevation.

Fill material for the marsh land was to come from the excavation of the canals. The report stated "Large areas of marshland will be reclaimed by fill, but that is neither especially difficult or undesirable" (Rader and Associates, 1963:77).

No provision was made for sanitary services. The plan called for sewerage and utilities to be provided by private for-profit organizations.

The only mention of the plant life of Smith Island was the realization that the existence of the semi-tropical and exotic plants would insure the successful cultivation of similar plants, "providing the ultimate in landscaping" (Rader and Associates, 1963:9).

### 3. National Interest

In the early 1930's State forester J. S. Holmes, working with Thomas Boyd who then owned Bald Head, attempted to obtain Federal aid for State acquisition of the Island. The project was evidently deemed too large and too expensive; thus in April 1937, the land reverted to county ownership for unpaid taxes. The next month the first report on Smith Island by the National Park Service was written by L. A. Sharpe, State Supervisor for the Service. Sharpe's opinion was that the Island was not of national importance and such factors as inaccessability and discomfort from insects prohibited recreation use (Sharpe, 1937).

Two decades later, however, the Seashore Recreation Area Survey by the National Park Service stated "Smith Island is believed . . . to be among the first five most outstanding undeveloped areas for recreation opportunities along the Atlantic Coast" (National Park Service, 1955:1). The Park Service advocated public acquisition because of the high recreation potential of the Island, the fact that its natural beauty should not be disturbed, and its important geographical location which "would fill the void for those seeking day-use recreation with a minimum amount of travel" (National Park Service, 1955). A main concern of the Park Service was the rapidly decreasing beach area for public use.

In 1957 the National Park Service attempted to interest private agencies in acquiring nine or ten unique areas. The Service encouraged private clubs such as the Izaak Walton League and the Wilderness Club of North Carolina to acquire Smith Island. The Park Service considered massive recreation unwise on the Island, and wanted it preserved as a wilderness area.

In 1964 the National Park Service released Parks for America, a summary of existing and potential park areas in all States. In North Carolina "ocean beach reservation for public use is a major concern" (National Park Service, 1964:158). Acquisition of Smith Island was recommended to help fill this need. "Day and weekend" and "vacation" use were suggested, and it stated that the Island was suitable for picnicking, hiking and riding, camping, boating, swimming, fishing, nature study and wilderness experience activities.

An island survey in 1967 by the Bureau of Outdoor Recreation, U.S. Department of the Interior, provided information on the geography and recreation potential of Smith Island. The Island Inventory Worksheet stated that 5,000 acres of the 11,000 acres of beach, woods, and marshes on Smith Island are considered suitable for recreation. The State is considered the "sector which would most appropriately protect and manage the island" (Bureau of Outdoor Recreation, 1967). The scenic beauty of the area is listed as its best quality with its swimming beaches listed second. Other important qualities are fish and wildlife habitat, historical value,

significant plant and animal communities, and natural wilderness. It was believed that Smith Island could be of regional importance as a recreation area offering swimming, picknicking, camping, boating, water skiing, hiking and nature study. A potable water supply was indicated as potentially available. This Island Inventory is to be published in 1970.

In sum, the national interest in Smith Island as represented by the actions and recommendations of Federal agencies, is that the Island ought to be in public ownership but that it is not important enough to receive direct Federal attention. There is possible inconsistency in the use recommendations between maintaining it as a wilderness area and its development for potentially intensive day-use activities, such as swimming. These inconsistencies would need resolution before a development plan could be prepared.

#### 4. State and Local Use Proposals

Interest by the State of North Carolina in the use of Smith Island as a State Park dates to at least the mid-1930's at which time the then State forester, J. S. Holmes (who was also then responsible for State Parks) was actively advocating acquisition of the area by either the State or Federal government for park purposes. Although a bill authorizing such acquisition passed the general assembly in 1937 the Island did not become State property then because no funds were appropriated for its purchase.

The Superintendent of the Division of State Parks described the facilities of a possible State Park on Smith Island as including a boat dock, trails, interpretive devices, swimming, picknicking, and camping, fishing and the study of natural history. He suggested that a ferry be the means of access to the Island and that even with a ferry, the number of visits might reach several hundreds of thousands in a short period of time (Ellis, 1965).

The Division stressed the advantages of the Island being administered as a State Park in a subsequent document that called attention to Divisional policies for preservation and protection of areas administered by the Division of State Parks. The document noted that administration by the Division would make research and



educational opportunity more readily available to other agencies and organizations than could be done by any other agency of State government (Ellis, 1969).

It is difficult to characterize local use proposals because there have been several of them and because they have been somewhat less formalized than some of the others discussed herein. Residents of the Smith Island vicinity appear as divided about the best use of that island as are persons from outside. On the one hand are persons whose major value orientation is toward economic development. Their statements imply that commercial development of Smith Island would be a gain for the local economy and they do not discuss the possible costs that might offset such gains. On the other hand are those persons who see Smith Island as a place to be experienced individually and in its natural state. These persons see "development" as foreclosing such experiences and they talk little about the possible disadvantage of continuing the present mode of unplanned use.

#### 5. Fraser Plan

In 1969 Charles E. Fraser, developer of the Hilton Head Island resort on the South Carolina coast, negotiated with Sherrill for the purchase of Smith Island and created a development plan for the Island similar to that of Hilton Head. Fraser abandoned his plans after it appeared that the State would block any commercial development, but the Fraser Plan involved some consideration of the preservation of the natural state of the Island. Fraser states a planning policy that would "prepare for the recreational use of the Atlantic coastal islands by man in such a way that their essential beauty will be maintained" (Fraser and Lochner, 1969). The plan for Smith Island intended to follow this principle.

##### a. Development

The Fraser Plan for development of Smith Island involved only the 3,000 acres of land area. The 9,000 acres of salt marsh were to be given by a "quit claim" deed to the State, with the understanding that they would be preserved with no dredging and filling and with the requirement that the State

build on the salt marsh a Marshbank Interpretive Center for public education in ecology. The rookery islands (Striking Island, Shell Bank Island, and Battery Island) would also be given to the State, to be used as a wildlife sanctuary. Different versions of the Fraser Plan call for either 2 miles of the north beach adjacent to Fort Fisher, or one mile of this beach and one mile of beach northeast of the Cape Fear Point, to be reserved for five years for purchase by the State as a public beach. Thus, development plans concentrated on the Bald Head Island portion of Smith Island.

Building was to take place mainly in the marine forest, which, it was felt, could support extensive use "without upsetting the balance of ecological forces" (Fraser, 1969a). Planned development called for individual residences in this area, while public accommodations would follow the Bay Beach on the eastern side of the Island. Buildings on the southwest portion of Bald Head were planned as multi-family condominiums, "to preserve the maximum amount of open space" (Fraser, 1969b). The Plan mentions this area as the location of the major inn, built as a series of small units, and of the "airport-town center," although details are not specified. Buildings, particularly those along the eastern coast and those immediately inland from the dunes, were to be of the "raised architecture" type, both for protection from hurricane damage and so that they might "peep over" the dunes. All buildings would be strictly regulated against possible damage to the Island, and "restricted as to architecture, [with] exterior materials . . . limited to landscape blending materials" (Fraser, 1969a).

Planned recreational facilities included two golf courses. It was felt that "with careful irrigation and stabilization, a portion of each . . . may have fairways in front of the Great Ridge," and others (perhaps half of the fairways) in the marine forest behind the Great Ridge" (Fraser, 1969b). Other facilities, such as "tennis courts, swimming pools,

boat marinas, a town center, activity points, etc. [would] be placed in accordance with good relationships with residential and multi-family areas". (Fraser, 1969b). A campsite was tentatively scheduled for the Buzzard Bay area, but the Plan was not specific as to location or development.

Restoration was planned for all existing major structures on Smith Island; Historical Interpretive Centers were to be created.

b. Preservation

Development was to be conducted with minimum disturbance to the ecosystem of the Island. Preserving the dune system was a major concern, particularly the Great Ridge running along the southern end of the Island; this ridge was felt to be vital to the preservation of the marine forest. Although the actual beach was believed stable and able to support heavy use, Fraser asserted that the dunes must not be disturbed in any way. The Plan called for irrigation of the dune/dune grass area to promote vegetation growth as protection against wind erosion.

A toll highway, built by the State, was to run along the eastern shore of the Island. Although the highway itself would be no closer than 500 feet from the front dune line, 450 feet east from the road a protective sand dune was to be created. This dune would be reinforced by vegetation, thus creating a new small forest between the dune and the road. Portions of this would be developed as "pocket parks" between the buildings along the shore.

The Fraser Plan called for a backup sewerage system to ensure pollution prevention.

The Plan recognized the importance of preserving the animal life presently existing on Smith Island. No large domestic animals would be allowed on the Island, and a special security patrol would ensure protection of the nesting of the Atlantic Loggerhead Turtle.

c. Research

The Plan stated that after obtaining the option on the property, the North Carolina Academy of Science, the Conservation Foundation, and other such organizations would be urged to "make an intensive, one-year 'base line' study of the ecology of the Island in its present state, and to jointly staff a research center on Environmental Studies to operate on Smith Island for at least ten years, to study the effects of man's inter-action with nature on the Island" (Fraser, 1969b).

6. Carolina Cape Fear Corporation (CCFC) Proposal

The Carolina Cape Fear Corporation under the leadership of William R. Henderson obtained an option on Smith Island in the spring of 1970, ending in July. The Corporation announced July 17, 1970, that it had bought the Island from Frank O. Sherrill for \$5.5 million. Reports indicate that the sale involved two mortgage notes for \$5.2 million and about \$196,000, respectively, and that cash payments amounted to some \$104,000 (Durham Morning Herald, 1970). The Corporation, in assuming that Sherrill held clear title to the marshes, has proposed development of the entire Island south of Fort Fisher. The overall development plan is for a resort and retirement community, with an ultimate population of 50,000-60,000 persons (Raleigh News and Observer, 1970a). The climate of Smith Island allows year-round recreation and the Corporation is encouraging building of "second home" residences for vacation purposes.

The Carolina Cape Fear Corporation has offered lots for commercial accommodations and private residences. In a brochure for potential buyers entitled Bald Head Island the Corporation deals with proposed development of these areas. No other type of commercial development is considered in this brochure. The Corporation is offering three types of alternatives.

- a) One ocean-front lot of 40,000 square feet for commercial housing.
- b) One ocean-front lot of 17,000 square feet and two lots of 12,750 square feet on the inland parkway along Bald Head Creek, restricted to single-family housing.

- c) Two lots of 12,750 square feet along the proposed east coast boulevard and two parkway lots of the same size, restricted to single-family housing.

The price of any of the three alternatives is \$25,000. Although the brochure states "The Carolina Cape Fear Corporation was conceived for the dual purpose of developing and conserving Bald Head Island" (CCFC, 1970) plans concentrate on development without specifying proposed methods of conserving the natural environment of Smith Island.

- a. Residential Developing

"Bald Head will be a place of space. Buildings will be low and long, hugging the Island; their materials will harmonize with the colors of driftwood, sun-bleached and water-washed, and the infinite number of greens, year-round, yet ever-changing" (CCFC, 1970).

The Carolina Cape Fear Corporation development plan concentrates on proposed building restrictions. No building or structure of any type in a residential area "shall be erected, placed or altered . . . until the proposed building plans, specifications, exterior color or finish, plot plan . . . and construction schedule shall have been approved in writing by Carolina Cape Fear Corporation, its successors or assigns" (CCFC, 1970). The Corporation may refuse approval on any grounds, "including purely aesthetic considerations." Reasons for non-approval other than not conforming to the listed restrictions are not specified. Some of the specific building restrictions for residential areas include the following:

- 1) Buildings will have a maximum height of two and one-half stories.
- 2) Houses "will have a minimum of 1500 square feet of enclosed dwelling area." This area does not include garages, open porches, and similar structures.
- 3) The first floor of houses on beach front lots must be raised 10 feet above the beach elevation of the lot, unless the Corporation approves otherwise.

- 4). Structures must be 10 feet from the side lines of the lot and 35 feet from the front property line; beach lot structures must be 40 feet from the front line.

Many of the listed restrictions may be altered with the permission of the Corporation. Occasions for such alteration are not given.

Hotels, motels and two-story condominiums are planned for the southwest side of Bald Head, the southeast Cape Fear Point, and the eastern Bay Beach area. All other housing will be single family residential.

b. Recreation Facilities

The development plan includes two golf course-country club; one on the west side of Bald Head, north of Bald Head creek; one running north-south below Fort Fisher. The entrance to Bald Head creek would be used as a yacht basin with a Yacht Club on the adjoining land. A sailing marina would be developed nearby, and public and commercial marinas are planned farther north. Tennis courts would be "conveniently at hand for residents and visitors" (CCFC, 1970), but emphasis is placed on water-based recreation. The tip of Cape Fear Point, at the southeast corner of the Island, is the location planned for a Beach Club with a "luxury motel and a major convention center" in the surrounding area. "With dining rooms, game rooms and club rooms, the Yacht Club and the Beach Club will be two of the Island's centers of social life for resident or visiting members" (CCFC, 1970).

Commercial development such as shopping centers is not mentioned in the brochure.

c. Preservation

A few building restrictions relate to preservation of the area. No lowering of the dunes will be allowed without permission from the Corporation. No trees over four inches in diameter at ground level may be cut without permission of the Corporation. No sewage disposal will be allowed into water or the shoreline. No motor vehicles, including bicycles and carts, will be allowed

on the beach after six months from the opening of the main Boulevard along the east coast. No overall plan is mentioned for preservation of the dunes, beach, forest, marsh areas or existing animal and plant life.

d. Research

According to news reports the Carolina Cape Fear Corporation is prepared to "give the State, at no cost, land for research use, plus state park use" (Raleigh News and Observer, 1970b).

This is not mentioned in the sales brochure.

B. Description of the Types of Use Considered in This Study

This discussion proceeds in two parts: first, a description of single-purpose uses; second, a commentary on the manner in which these uses might be grouped to provide the sorts of services associated with conventional administrative units, such as State Parks.

1. Ad Hoc Use

Nonuse or, more correctly, continuation of the system of ad hoc use prevailing in recent years, is one possible use. It is reported that fishing, hiking, swimming, picnicking, nature study, and camping have all occurred on Smith Island. Much of this use has been unstructured and unsupervised; some of it has been destructive. Some vandalism has occurred in the Coast Guard buildings and in the old lighthouse at the west edge of the Island. Instances of littering can be found throughout the Island. The vegetation and dunes in some parts of the Island are being damaged by the pigs that have reverted to a wild state. In the absence of a program to prevent ad hoc use, such use and its consequences will undoubtedly persist.

An important aspect of ad hoc use is the continued output of finfish and shellfish from their breeding and feeding grounds in the estuaries next to Smith Island. While it is possible that programs can be devised to enhance the yield of these areas for commercial and sports fishing, it is certain that development plans involving dredging, filling, and siltation would be detrimental to fisheries output.

## 2. Recreation

The recreational uses described below are intended as the basic elements out of which an administrative unit, such as a State Park, could be built, consistent with the size and quality standards now used by the Division of State Parks.

### a. Picnic Area

A fully-developed picnic area consists of 60 to 80 tables, a shelter, sanitary facilities, fireplaces, drinking fountains, trash and garbage cans, and a parking area. Picnic areas have 12 to 18 fireplaces. Five or six tables are then grouped around each fireplace. In addition, there are usually a number of individual tables without fireplaces scattered around. Water is provided at several locations in the area by fountains that usually also have spigots.

In the past each area had one large shelter with a fireplace and 10 or 15 tables for the use of large groups. Because of changes in demand (do not seem to have as many large groups) and because the entire shelter is often occupied by only one or two families, several small shelters will probably be built in place of one large one in new picnic areas.

The Division of State Parks feels that 35 to 40 thousand picnic days per area per year is the maximum desirable usage. At higher use rates, site quality begins to deteriorate rapidly. Usage of picnic areas in State Parks ranged from 2,000 to 86,000 user days in 1969.

### b. Family Camping Units

Family camping units consist of a central wash house surrounded by approximately 35 campsites with associated roads, parking spurs and utilities to serve the area. The central wash house is designed to Department of Public Health standards to serve 150 people with flush toilets, hot showers, and laundry tubs. Consideration is being given to replacing the laundry tubs in future designs with coin operated washers and dryers.



The current design for family camping units includes a dump station and fill stand for the sewage holding tanks and water tanks, respectively, of trailers and pickup truck camper units.

Individual campsites consist of a parking spur, fireplace, picnic table, garbage can, and a tent space, which often will also accommodate a trailer or pickup camper. No sites have utility hook-ups for trailers, nor are utility hook-ups planned.

Water is available at several locations in the unit with combination fountains and spigots.

A unit provides approximately 10,000 camper days per year. Additional units are considered when the occupancy rate exceeds 70 percent during week days. Planning is based on a family size of four persons. At least 15 to 20 acres of land are required for a family camp unit, depending on terrain.

c. Seashore Swimming Area

Seashore swimming areas are operated by the State Park System at Fort Macon and Hammocks Beach State Parks. The only major difference between the two in the facilities is that Fort Macon has an auto parking area while Hammocks Beach does not; access to Hammocks Beach is by passenger boat only. Design and construction of the bath houses are practically identical.

The parking area at the Fort Macon bath house accommodates approximately 450 cars, and occupies approximately 5.5 acres of land.

Seashore swimming facilities consist of a combination bath house and refreshment stand. Services offered include flush toilets, showers, clothing check and towel for each swimmer. Design capacity provides checking space for 1,000 but at present approximately 600 spaces are used at Fort Macon and even less at Hammocks Beach.

Life guards are provided from 10 a.m. to 6 p.m., June 1st through Labor Day weekend. Swimming at other times and outside designated areas is discouraged and use of the bath house encouraged, but these are extremely difficult to control. Many persons come to the beach attired in swimwear, even at

Hammocks Beach; it is estimated that only one in six or seven swimmers uses the check service (for which a fee is charged and accurate use figures are available). From this count, utilization in 1968 is estimated as 158,000 user-days at Fort Macon and 2,000 user-days at Hammocks Beach. The beach area protected by life guards is expanded and contracted depending on the number of swimmers.

Since access to Hammocks Beach is by boat only, use estimates are quite accurate although on one weekend 37 boats were observed pulled up in a small cove near the ferry dock on the sound side. Use is estimated as 10,000 visitor-days in 1968.

### 3. Education

It is somewhat arbitrary to separate the following uses from the recreation category above; it may be justified, however, on the basis that participation in these activities has a long-run social benefit in terms of understanding of the environment that transcends the short-run recreational benefit of the outdoor activity. Moreover, these activities may be structured as part of a formal curriculum at any level of education, and thus be primarily educational rather than recreational. The analogy here might be to recreational vs. educational use of the North Carolina Art Museum.

#### a. Interpretive Center

Weymouth Woods Sandhills Nature Preserve has the most elaborate interpretive center. As the only building on the area, it serves as a combination interpretive center, museum, office, and workshop. It consists of a two-story central unit with two wings attached by porches.

The ground floor of the central unit contains a lobby, reception area, ranger's office, sanitary facilities, storage closet, janitor closet, mechanical room, and stairs, in 2,375 square feet of floor space. The second floor has a library, book storage room, seminar room, work room, and storage room for a total of 1,821 square feet. In addition, there are two floored, but otherwise unfinished areas that can be used for storage.

Each wing contains 1,280 square feet of space. One is a museum; the other is a 100-seat auditorium with projection and storage rooms. Connecting each wing to the central unit is a porch of 444 square feet. Total area of the building is 7,044 square feet.

With respect to Smith Island, an interpretive center might stress either the natural history or the social history of the area, or both. In his plan for developing Smith Island, Charles Fraser (1969) proposed that such a center emphasize the plant and animal communities of the marshes and estuaries.

b. Nature Trails

Nature trails take the participant to the more interesting and significant places within a given natural area. They emphasize particular plant species, geological processes, the results of certain animal activity, and the relations among the denizens of a particular natural community. They are cleared of brush and briars to permit unimpeded walking and are marked in varying degrees of elaborateness from numbered posts (keyed to a guide leaflet) to metal signs with incised lettering and drawings. Some trails may be paved to avoid damage to the site from heavy use. Trails may be self-guiding, with signs or leaflets, and may also be used by ranger-naturalists to conduct groups on tours.

4. Research

Scientific research is an endeavor involving the interaction between an investigator, his colleagues, and the resources available to him, including sites for conducting observations or experiments. The research process is uncertain; it may not yield the expected results and sometimes it may produce unintended results in a matter that was not directly under investigation.

Much research with an ecological orientation today is focused upon the interactions of man with his environment. An important part of much of this research is a capability for establishing the nature and extent of environmental processes in the absence of human intervention; such data provide the "control" against which

the effects of human actions may be compared. There are few places totally unaffected by human forces. Smith Island has already been significantly altered by human contact. (For example, by construction on The Rocks, a dike separating the northern parts of the area from the lower Cape Fear River, and by cutting of certain species of trees for timber.) Nevertheless, Smith Island is relatively unaffected by human actions with respect to many of the natural processes underway there. For this reason it has utility as a research site if suitable areas there are maintained free from additional human influence.

The variety of research that might be conducted at Smith Island has been described by Cooper and Satterthwaite (1964:25-34). The general topics they identify include:

- Energy flow and feeding relationships
- Mineral cycling
- Behavior of radioactive materials
- Shoreline process and coastal shoreline stabilization
- Life history studies of plants and animals
- Taxonomic, geographical, and evolutionary studies
- Constructive processes and reservoirs of germ plasm
- Archaeology-geology.

Without elaboration it is difficult to give meaning to those general topics; they do, however, suggest the range of types of research that might attract investigators.

Researchers have not ignored the possibilities of Smith Island as a research site: as of 1964 some 30 papers and theses had been published dealing with the natural history of the Island and its vicinity (Cooper and Satterthwaite, 1964:75-78). As indicated above, a variety of research projects are possible in the Smith Island vicinity. Perhaps one of the most useful of those, in terms of the State's use of Smith Island, is a resource capability study of the area being initiated by Drs. J. F. Parnell and D. A. Adams (1970).

## V. SELECTED ENVIRONMENTAL FACTORS

### A. Stability of Land Mass

#### 1. Beaches

Even a cursory examination of reports dealing with the interface between the sea and the land indicates that this interface is dynamic and ever-changing. Beaches grow and erode, inlets open and close or migrate from one side to the other; dunes rise and fall, seawalls are built to protect facilities threatened by the sea--some survive others do not. The general conclusions of a study of the entire North Carolina coast by Langfelder, et al. (1968, pp. 124-125) were that erosion is the general trend on the North Carolina coast, major storms cause an important part of all the erosion experienced, inlets tend to migrate and change size and direction, and that drift of waters along the coast is generally south for eastward-facing sections.

The Langfelder study reports certain measurements of erosion and accretion on the Smith Island coast but did not include a visit to the Island. The importance of studies such as this one for the future development of Smith Island lies in the recognition that coastal areas are changing, not permanent, and that human use of them should be consistent with this reality. Inspection of maps dating from the last century and of aerial photographs taken at different times confirms that shoreline changes are occurring on Smith Island.

It is also reported (National Park Service, 1955) that during storms the low beach at the north end of the South Island complex is sometimes completely under water.

#### 2. Dunes

Sand dunes raised by the wind and stabilized by beach grasses and other vegetation are the backbone of barrier beaches, such as Smith Island. Even such minimal use as walking on the

dunes may destroy the grasses vital to their stability. While the beach area of Smith Island would be extremely tolerant of human use, the primary dunes, especially on the eastern side of the Island, as on any shoreline, must be protected. Access of any significant number of persons to the beach area over the dunes must therefore be made on some manner of bridge or crossway that protects the vegetation.

The croft inland from the primary dune is slightly more tolerant of human use; here the problem is ground water. The vegetation depends on fresh water and the water level cannot be lowered significantly without affecting the vegetation.

A useful discussion of the precarious ecological balance existing between the sea and the land and an exposition of the principles for use of these areas may be found in Design with Nature by Ian McHarg (1969).

#### B. Smith Island Climate

Smith Island has a generally mild, sometimes sub-tropical climate. It lies completely exposed on its south and east sides to the Atlantic Ocean. This marine environment is the major climatic force on the Island: the surrounding water curbs extremes in temperature in both winter and summer; waves and wind continuously reshape beaches and shores; tides move plant materials back and forth in the estuaries and help produce the varying degrees of salinity that provide habitats for plants and animals requiring differing conditions; and the sea is the source of water for the waves and surges associated with major storm systems that pass through the area from time to time.

Winds are generally south-westerly or north-westerly in nearby Southport. Temperatures average 64° and have mean lows and highs of 56° and 72° for the year. Winter weather is warmer than most of South Carolina and parts of Georgia and Alabama, yet summer temperatures are generally lower than in those states. Rainfall at Southport averages nearly 51 inches a year.

At Southport tides generally rise and fall about four feet. Major storms, however, have produced tidal surges on the order of 7 to 14 feet and possibly higher; these can vary widely from one area to

another. It is reported that during Hurricane Hazel all of Smith Island except the Great Ridge was under water (Cooper, 1969:3). In addition to storm surges, there may be breakers, which add to the destructive power of the water.

The North Carolina coast has experienced an average of 1.05 storms per year causing some damage during the 44-year period ending in 1964. Approximately one-fifth of these storms produced severe damage and half resulted in moderate damage. Storms of these two types occur each 1.4 years, on the average.

While there are a number of measures that may be taken to minimize damage by appropriate design, materials, and construction, it should also be recognized that as a part of the North Carolina coast, Smith Island is exposed to certain environmental risks that the remainder of the State faces neither as frequently nor with as much damage.

A more detailed review of climate and storms is included in this report as Appendix B.

#### C. Water, Sanitation, and Insects

##### 1. Water Supply

During the study of Smith Island by Rader and Associates, a test well for water was drilled on the western end of the main island close to the south shore. "This well successfully located a water-bearing aquifer at a depth of 165 feet" (Rader and Associates, 1963:27). The engineers believed that in this area a well capable of supplying potable water for 3,000 permanent residents could be developed. It is also reported that the Army, at one time, drilled wells on the Island for use by troops on training missions. Careful study would be necessary to establish the amount of use that might be tolerated without lowering the fresh water level too far, and causing damaging salt water intrusion.

##### 2. Sewage Disposal

In order to prevent pollution of the shellfish breeding areas, sewage would have to receive at least primary and secondary treatment. This could best be done through a central treatment facility to ensure compliance with regulations. Moreover, chlorination might be necessary to prevent pollution of the estuarine areas.

Solid waste disposal for a large population on the Island would involve further study, as it is not known if conventional land-fill techniques would appropriate in this area.

3. Insects

Insect life on Smith Island is reputed to be vigorous. Organized use of Smith Island is likely to result in efforts to control annoying insects. Insect control involves use of pesticides, which may harm other life forms. Consideration must be given to possible results from the use of any such methods.



## VI. EVALUATION OF POSSIBLE STATE USES

### A. Objective of This Section

The final phase of this study cannot proceed without introducing the values held by North Carolinians, and by their governmental decision-makers. Indeed there are few, if any, areas of life in which decisions can be made without values. This being the case, the major function of this section is to focus debate on the issues that are most germane to decisions about the use of Smith Island.

In the remainder of this section discussion will move first to a description of the criteria for evaluating alternative uses. Next the benefits and costs of alternative uses will be described to the extent possible with limited data and with recognition of certain benefits and costs which it is difficult to measure. Then, to put these benefits and costs in perspective, the incidence of the benefits and costs upon various groups will be described.

### B. Criteria for Evaluating Alternative Uses

One of the important functions of this section is to make as concrete and explicit as possible the criteria that are believed to be relevant for making a decision about the State use of Smith Island. Although these criteria will, in general, be similar to those applied to other public decisions, it is especially important to identify them in the case of a public decision about natural resources because in the past the criteria for this area of decisions have been especially vulnerable to vagueness and incomplete description.

#### 1. General Objectives or Values

At this point we should reiterate the general objectives, or values, mentioned above. These include:

- a) Freedom of the individual to seek self-fulfillment.
- b) Physical security--in a sometimes-dangerous environment.
- c) Organization of the economy--to increase economic well-being.
- d) Environmental preservation--to maintain or increase the material and non-material benefits it provides.

Obviously, these general objectives may, by their nature, become inconsistent with one another in specific situations, thus complicating decisionmaking.

Two other principles enter the decisionmaking process:

- e) More is preferred to less.
- f) Uncertainty is to be reduced.

Whenever an action will increase the well-being of one or more persons without lowering the well-being of others, it is desirable. When the consequences of one alternative are less fully known than those of another alternative, the second may be preferred to the first, and all the more so if any of the unknown consequences might be irreversible. This concept might be expressed alternatively as attaching value to not foreclosing options for future actions, especially if it is not apparent which future actions may be foreclosed.

## 2. Specific Objectives

The specific objectives given in Section III were phrased in the context of governmental programs. A somewhat broader, less programmatic context is provided in Horizon Concepts for North Carolina (Scott and Banks, 1969). Especially relevant items include:

- a) Cultural heritage--to transmit our experiences to succeeding generations.
- b) Recreation--to provide variety and enrichment to life.
- c) Esthetic environment--to satisfy our appreciation of beauty.
- d) Land utilization--to seek the best relationship between resources, social and economic needs.
- e) Natural resources--"to maintain a balance between man and his natural environment that will yield the greatest net benefits for present and future generations."

Further discussion of these and related concepts occurs in Fundamental Approaches to Government in North Carolina (Stallings, 1970).

## C. Benefits of Alternative Uses

The use of benefit-cost analysis as a tool has become increasingly common in decisionmaking about governmental programs. Like any specialized tool, it does certain jobs well--but is less useful for other tasks. Benefit-cost analysis is most useful when comparisons and contrasts are to be made among alternative projects within a given program: e.g., this dam

versus that dam; this park versus that park. The technique becomes much more difficult to manage when the desired comparisons are of health care versus law enforcement, etc.

A warning about this difficulty with respect to outdoor recreation has been expressed by Mack and Myers (1965:71) as follows:

"The benefit-cost calculation for this field [outdoor recreation] is particularly intractable. The benefits are complex and abound in non-commensurable aspects that sharply limit the theoretical and actual possibilities of measuring them on the basis of either free market prices or any other system purporting to express their value to the user and the state."

The conclusions reached by these authors are that dollar values applied to recreation benefits may be quite misleading but that until refinements of dollar measures are devised, benefits of recreation may be realistically measured in terms of the user-days received by various groups within the population. It is this general approach that has shaped the remainder of this section.

1. Recreation and Education

a. Benefits to Users

Recreation and education may be measured in a variety of units, some of which may, by various methods, be converted into ostensible dollar values. One of the more direct measures, however, is simply capacity of an area or facility in user-days of services it provides. Given the units of several types of recreation and education described above, the output of services in user days may range up to the capacities given in Table 2.

b. Benefits to the Economy of the Area

Establishing recreational or educational facilities on Smith Island would entail **construction** costs, just as any other form of development would. This would result in some employment during the period of development. Operation of such facilities would likewise increase employment in the area, more permanently though in a small amount, than in the construction phase. Both types of employment are to be counted as benefits of any program of State use of Smith Island.

Table 2  
CAPACITIES OF SELECTED FACILITIES

Area Type	Unit Definition	Capacity per Unit
		User-Days
<u>Recreation</u>		
Picnicking*	60-80 tables/area	37,500
Camping*	35 camp sites/area	10,000
Seashore Swimming*	Bath house, refreshment stand	297,500
<u>Education</u>		
Nature Study		
Interpretive Center	One	48,000
Nature Trail	Mile	27,000

Source: N. C. Division of State Parks.

\* Sanitary facilities, water, and parking area included in site.

Travel and tourism associated with the use of recreational or educational facilities on Smith Island would benefit the economy of areas adjacent to Smith Island. Lodging, eating, recreation, automotive service, and passenger transportation businesses might expect to benefit from greater tourism. In 1969, these businesses were reported to involve 387 and 1,884 employees and proprietors in Brunswick and New Hanover Counties, respectively. Total sales (to travellers and local customers) of these travel-related businesses are shown in Table 3.

When Brunswick and New Hanover Counties are compared in terms of sales of travel-related businesses, after taking into account their population sizes, it is evident that Brunswick receives slightly less than its per capita share of travel trade while New Hanover receives somewhat more than its relative share.

Table 3

## TRAVEL-RELATED STATISTICS, 1968

	North Carolina	Brunswick County	New Hanover County
Population, Percent of State	100.00	0.44	1.60
Travel Expenditures 1969 (million)	\$752.0	\$2.4	\$16.8
Percent of State	100.00	.32	2.24
Percent Increase Since 1958	109	134	80
Travel-Related Sales (million)	\$1,690.0	\$5.9	\$28.9
Percent of State	100.00	.35	1.70
Number of Businesses	23,800	186	557

Source: Travel: Copeland, 1970.

Population: Hamilton & Ramsey, 1970.

To make quantitative estimates of the effects on travel-related businesses of various developments on Smith Island would require estimates of the use of those developments and assumptions about the nature of access to Smith Island (whether by passenger or car ferry or highway and bridge). Depending upon the assumptions, Brunswick or New Hanover County might be the major beneficiary, or the benefits might be split.

## 2. Fisheries Output

The marshes and estuaries adjacent to Smith Island convert solar energy into plant material; this in turn, furnishes food for marine life, both in the estuarine areas and down the river and out to sea, as the tides wash it into those areas. The estuaries are the permanent habitat of some species, such as oysters, and the breeding and nursery area for other species that ultimately make their homes in deeper waters.

Brunswick County contributes a significant amount to North Carolina's production of finfish and shellfish. (See Table 4.) Brunswick supplies from one-quarter to one-third of the total

oysters and hard shell clams for the State, and seven percent of total fisheries production. Production of finfish in Brunswick is increasing, rising from 8 percent to 12 percent of the State total from 1967 to 1969. During this period the value of fisheries rose 31 percent within the County.

Table 4

VALUE OF FISHERIES PRODUCTION, BRUNSWICK COUNTY  
AND NORTH CAROLINA, 1969

Type of Fish	State	Brunswick County	
		1969 Value	% of State
	(Thousands of dollars)		
Finfish	4,578	528	12
Shellfish			
Shrimp	4,915	192	4
Oysters	481	144	30
Hard Clams	128	31	24
Hard Crabs	2,238	9	*
Other	966	-	-
Total	13,306	904	7

Source: N. C. Division of Commercial and Sports Fisheries, 1970.

\* Less than 0.5 percent.

3. Protection of River Channel and Shore

Another form of benefit derived from Smith Island is the protection it provides to the mainland and to passing ships from wind and water during storms. Although the Cape Fear River is some three miles wide in the vicinity of Smith Island it is nevertheless a calmer passage during bad weather than it might otherwise be. The development plan by Rader and Associates proposed leveling of the Island to a uniform height of eight feet above mean low water. Any such step could be expected to increase wind velocities in the adjacent river channel.

#### 4. Option Demand

One further benefit of Smith Island is the value attached to it by persons who, while not entering upon it physically, nevertheless feel that they derive benefit from it: knowing that it is there if they wish to, and are able to, use it, knowing that it is providing certain benefits and pleasures for other persons, knowing that its environment nurtures certain other forms of life. This type of demand for a natural area is known as option demand. Conceptually, it appears possible to measure, but by means that appear quite indirect when compared to those used for conventional goods in the marketplace. Tombaugh (1970) is embarking upon such an effort with respect to forest resources. It may be inferred that his procedures might be applicable to Smith Island, but only with much effort. The types of measures that might be used are the expenditures of citizens to purchase bumper stickers or to employ lobbyists, or the value of their time devoted to writing officials--all in support of some particular alternative government action.

#### 5. Research

The outcome of research is inherently uncertain; some research findings will be trivial, others momentous. It is risky to judge in advance the category into which a project will fall. But research is well-established as the most effective way to increase understanding of, and capability for working with, our environment. Thus, it is sensible to fund research and to make available sites at which meaningful studies can be made.

### D. Costs of Alternative Uses

#### 1. Capital Costs

##### a. Acquisition

A major capital cost is, of course, that of acquiring Smith Island. This cost has been the object of much discussion and comment during 1970. The Island is reported to have been sold to the Carolina Cape Fear Corporation as of 17 July for a total price of \$5.5 million, composed of a reported option fee of \$100,000, cash of \$3831, and two mortgage notes totaling \$5,396,169 (Durham Morning Herald, 1970).

In 1955 the National Park Service (1955:7), in the Seashore Recreation Area Survey, estimated the value of Smith Island to be \$342,700. This estimate assumed that if the entire Island were sold, the price would be based on its value if subdivided into lots. The estimate is comparable to the price at that time of subdivision lots on Cedar Island, off the Virginia coast. At this time Smith Island was assessed for tax purposes by Brunswick County at \$21,500, considered by the tax collector to be about one-fourth of its value as unimproved land.

In 1964-65 Smith Island was assessed by Brunswick County at \$381,500. This brought a revenue of \$3,433.50 to the County in 1969 (Turner, 1969). Although commercial development would increase the tax resource, the overall advantage to the public sector would depend upon the amount of police and fire protection, education, and other services required from the public sector as a result of such development.

b. Access

Difficulty in achieving access to Smith Island has undoubtedly deterred development and intensive use of the area throughout many years of its history. A glance at the map shows that land access is most plausible from Federal Point, to the north of Smith Island. This route was recommended by a consulting engineer to Mr. Sherrill in the early 1960's. At that time a road suitable for use in developing the Island, but not meeting Federal or State standards was estimated to have cost \$300,000-500,000; in 1970 a comparable structure is expected to cost up to as much as \$1 million.

The next alternative, water access by ferry, would involve construction of a dock on the shore of the Island or the bank of Baldhead Creek. If the newly constructed dock for the Southport-Fort Fisher ferry, which carries both vehicles and passengers, could also be used by a ferry to Smith Island, only one dock would be needed. According to Brinkley (1970) the cost of four new ferry docks in the Hatteras area is expected to average about \$63,000; these docks will serve vehicles. The cost includes docks, bulkheading and dolphins, but not dredging and filling behind the bulkhead.



The third alternative for access is by air. Airstrips on or near Smith Island have been mentioned in various plans for developing the Island. Access to Smith Island directly by air could be obtained with a cleared and graded strip of land at least 900 feet long. With clear approaches this would be suitable for occasional use in good weather with favorable winds by light, single-engine aircraft of the two- and four-place variety. Because of the sandy soil, such a strip would probably be hazardous without soil stabilization. More elaborate facilities are possible. Air transport is not, however, a substitute for other means of access unless the numbers of persons and trips are relatively small, so it will not be considered further here.

c. Recreation and Education Facilities

Each of the various recreation and education facilities requires outlay to build the basic unit and its supporting facilities, such as sanitation and parking. The costs shown in Table 5 represent the recent experience of the Division of State Parks. When the special conditions affecting construction on Smith Island, such as transportation of labor and materials, are considered, these estimates are probably minimal.

Table 5

CAPITAL AND OPERATING COSTS OF RECREATION AND  
EDUCATION FACILITIES

	Unit Definition	Unit Costs	
		Capital	Annual Operating
Picknicking*	60-80 tables/area	\$ 53,000+	\$ 3,600
Camping*	35 camp sites/area	80,000	4,900
Seashore Swimming*	Bath house, refreshment stand	85,000	17,000
Interpretive Center		135,000	19,200
Nature Trail	Mile	1,400	-

Source: N. C. Division of State Parks.

\* Sanitary facilities, water, parking area included in sites.

Roads associated with such facilities are estimated to cost \$10 per lineal foot (18 feet wide) for construction in sandy soil. This includes grading and drainage, a stabilized sub-base, base of asphalt and aggregate and 1.5 inch wearing course of asphalt and sand.

d. Research Facilities

The position of the research community regarding on-site facilities at Smith Island, as discussed above, leads to the conclusion that any facilities placed there would be quite simple-possibly even only semipermanent. Specific needs for facilities not being available, capital costs cannot be set for research facilities, but costs obviously could run from a minimal \$1000 for a storage area to millions of dollars if a major laboratory and associated residences were placed on the Island.

2. Cost of Reproducing Fisheries Output

The output of the marshes and estuaries of Smith Island may be considered also in terms of their transformation of energy. This approach has been pioneered by Howard Thomas Odum, Professor of Ecology in the Department of Environmental Sciences and Engineering at the University of North Carolina, Chapel Hill. Dr. Odum's system involves measurement of the work done by natural forces in an ecosystem and the subsequent valuation of that work, which represents energy, in terms of the cost of an equal amount of energy obtained from fossil fuels. The measures of work are made in units of gross production of organic matter: grams per square meter per day. These are translated into kilocalories per acre per year and then, at the rate of one dollar per 10,000 kilocalories, into dollars per acre per year. The results may be interpreted as the dollar cost of fossil energy sufficient to produce output equivalent to that yielded by natural forces in the ecosystem being considered. Put another way, it is the cost that may be imputed to what natural forces accomplish by themselves.

The results of these calculations are summarized in Table 6.

Table 6

## OUTPUT OF SELECTED ECOSYSTEMS OF THE SMITH ISLAND AREA

System	Acres	\$/Acre/Yr.	\$Million /Year
Salt Marsh			
Tide energy	4,500	2.10	0.090
Photosynthesis	4,500	5,900.00	26.600
Nursery Waters			
Biological Production	3,500	4,400.00	15.400
Tide Energy	3,500	165.00	0.580
Oyster Reef	90	23.00	0.002
Total			42.591

Source: Odum, 1970.

The resulting figure of \$43 million is Odum's estimate of the cost of creating with fossil fuels outputs of organic matter equivalent to those of the Smith Island ecosystems. Those systems now nourish the wide variety of marine life that forms the basis of the commercial and sports fishing industries in this part of North Carolina.

The foregoing argument may be carried a step further, ending with an estimate of replacement cost rather than of annual output:

"Each of the ecological systems now in quasi-steady state has developed its own capital investment of its own structure such as trees, oyster reef, dune development, etc. The stored value of these may be evaluated by the replacement cost. Again using energies, we multiply energy per year times the estimated years it would take the natural processes to redevelop structures should they be destroyed" (Odum, 1970).

The cost of replacing the salt marsh (10 years) and the nursery waters and oyster reef (three years each) totals \$733 million. Replacing the live oak forest is estimated at 100 years, with a value of \$590 million.

Figures such as these are difficult to place in perspective against the usual measures of value attributed to natural areas, such as the present value of a stream of income generated through time.

One factor in favor of this mode of looking at costs and values is that it is internally consistent and could be applied equally well to measure replacement values for Mount Mitchell or a commercially developed beach. Perhaps the greatest use of such numbers is to make the decisionmaker aware that important and valuable events and processes do occur in natural environments in which man is not taking any active role.

### 3. Operating Costs

In addition to building facilities to suit any uses chosen, it will also be necessary to pay the annual cost of operating such facilities. Estimates of these costs have been prepared and included in Table 6. The estimates are based upon the costs of the several levels of personnel, which are used in different amounts in the different facilities, plus costs of supplies for maintenance and operation.

### 4. Induced Governmental Expenditures

Assuming some State development of Smith Island, some increases in costs to local government can be expected. Insofar as State uses result in visits to the Island by day-users, the additional costs to local government would be for traffic control and possibly for additional parking to serve central business district shopping and eating facilities. If State uses brought permanent residents to the Island, then local government could expect expenses for education, police protection, and possibly for fire protection. Should a permanent community be established on the Island, costs of these services could be significant, especially if access to the Island were from New Hanover County although the Island is now a part of Brunswick County.

### E. Incidence of Benefits and Costs

The sizes of benefits and costs are important influences on decisions about alternative programs, but in a full consideration of an issue, they should be supplemented by information about their distribution among segments of the population.

The population segments that have been identified include:

- 1) Present residents of the Smith Island locale: parts of Brunswick and New Hanover Counties.
- 2) Recreationers, local, rest-of-state, out-of-state (swim, picnic, camp, etc.).

- 3) Students of nature.
- 4) Commercial and sports fishermen.
- 5) Other citizens and non-residents.

The general and specific objectives that may be sought by each of these groups were presented in Section B, above.

Precise quantification of the benefits and costs to each group would be extremely difficult, if not impossible. It is feasible, however, to identify the direction and probable relative size of benefits and costs.

1. Benefits

- a. Present Residents

Present residents of the Smith Island locale may take on the attributes of other broader groups, such as recreationers or citizens of the State, but are, nevertheless, distinguished by one characteristic from such other groups: they have a particular concern for uses of Smith Island that would alter the organization of the economy to increase employment, business, and tax revenues. Although certain development of Smith Island may benefit the economy of the entire State, the largest effects will be local. Being the group on the scene, they stand to benefit most directly from such changes. How these changes might affect Brunswick and New Hanover Counties, respectively, depends upon the type of access that is chosen and upon the availability in the labor force of each county of persons with the skills required to build and operate various facilities on the Island. Economic benefits will also depend upon the ability of the local economy to supply the needs of users of Smith Island with goods made locally as opposed to goods that are brought from outside the area.

- b. Recreationers

Benefits to recreationers will vary among groups depending upon the types of recreation uses chosen for Smith Island. For example, swimming and picnic areas are most likely to be frequented by day-users within range of a one-day outing, by local residents, and by tourists staying in local accommodations.

Used for swimming or picnicking, Smith Island provides benefits quite comparable to those of other State Parks and public beaches but probably of higher overall quality because of the freedom from sight and sound intrusions from adjacent development.

Camping and particularly cabins may be expected to serve persons on week-end outings or vacations, possibly coming from more distant points than those who are primarily swimmers and picnickers. Campers and cabin users, being likely to spend more time on the Island, are more likely to engage in more activities than the day-users. Through this increased exposure they may come to understand and appreciate the unique characteristics of Smith Island more fully than those whose visits are more casual.

c. Students of Nature

"Students" is used here to denote all persons interested in their natural environment and a better understanding of the processes of which it is composed. This include bird watchers and "conservationists" as well as sportsmen and families merely looking for something to do on an outing. These different types of persons may all use an interpretive center or natural trail, but what each takes away from this experience may vary widely. The function of the interpretive program is to expand the portion of the population that experiences nature and its processes and is thereby made more completely aware of the interrelation between man and nature.

d. Fishermen

Fishermen, both sports and commercial, are concerned that uses of the Island enhance or do not reduce their respective catches. They are different in that for the sports fisherman a good catch merely makes the outing successful; for the commercial fisherman a good catch means economic security and long term growth of the local economy. Neither group is likely to benefit greatly from the proposed development of the Island either by State or private groups, but both groups could suffer significantly from any alterations of the Island's ecology that reduced output of the fisheries.

e. Other Citizens and Nonresidents

Statewide, citizens may benefit from State use by having Smith Island available as a part of the public domain instead of as a private landholding, and the consequent enhancement of the State in terms of public recreation areas and the maintenance of environmental diversity. They have the general benefit of option demand: the Island is still there if they choose to use it. And they receive benefits from whatever research a site on Smith Island makes possible.

2. Costs

a. Present Residents

The costs of any given use of Smith Island are measured in terms of presently available opportunities that must be foregone to achieve that use. Continuation of present ad hoc use would maintain the individual freedom of present residents of the vicinity to visit the Island but would not yield the improved level of living that is desired from development of the Island. Recreational and educational uses would cost little in terms of freedom to use the Island.

b. Recreationers

As a group, recreationers would incur little cost from State use of the Island unless that use precluded any recreation at all. Of course, depending upon the particular selection of recreation facilities and activities, some types of recreationers may benefit more than others. It is apparent that recreation development on Smith Island will only be experienced by persons with the time and money to go there.

c. Fishermen

The cost to fishermen, of both types, would come from alteration of the Island habitat in a manner reducing fisheries output. There is little evidence that habitat reduction is inevitable in the absence of man because such areas have existed for hundreds of years, but considerable change is likely unless careful plans are made to avoid it.

d. Other Citizens and Nonresidents

The cost to the citizens of the State will be measured in public expenditures used to acquire and develop Smith Island versus alternative uses of those same funds to develop other shorelines for recreation, education, or research or for some other public purpose, such as education, health, or corrections.

Nonresidents would have no tax cost for Smith Island; their costs would be those of visiting the Island.



## VII. CONCLUSIONS

### A. Decision Context

There are several contexts within which decisions about State uses of Smith Island may be made. The most relevant ones include:

- 1) Technical feasibility; can program X be instituted at Smith Island?
- 2) Economic feasibility; is this program efficient at Smith Island compared with alternative locations?
- 3) Type of decision; is the decision about the uses of Smith Island a fundamental or an incremental decision?

In addition, the emphasis placed upon general objectives the State wishes to achieve for its citizens will also affect the decision context. Those general objectives are taken to be:

- 1) Individual freedom to seek self-fulfillment.
- 2) Physical security.
- 3) Preservation of environmental quality.
- 4) Organization of the economy for growth and development.

If primary stress is placed upon individual freedom, this leads to considering the incidence of benefits--whether that freedom will be for all persons or for particular groups. On the other hand, if economic growth is the primary reason for the program, then a program involving Smith Island **must** be weighed against alternative ways of expanding the economy of the area. These comments suggest the nature of interrelations among general objectives and the contexts in which a decision about Smith Island must be considered.

A further comment should be made about the type of decision, however. Most governmental decisions are incremental; they involve the allocation of a small additional amount of resources to some program, say mental health, that is already underway. By contrast, a few decisions are fundamental; they mark the beginning of a basically different approach to a given program, for example, when treatment is substituted for punishment in the case of chronic alcoholics. Although the extreme decision types are clear-cut, a particular decision may partake of both. This appears to be the case with Smith Island. Making more recreation facilities is incremental but establishing principles

about the appropriate use of the coastal zone could be fundamental. Likewise, a decision to set aside part or all of Smith Island as a research site could be fundamental in the emphasis it would give to preserving areas for further use in producing new knowledge.

B. Feasibility of Developing Smith Island

Technically, it appears that Smith Island can be developed for any of several uses the State might make of it. Land and water access routes are feasible, water is available in some locations, electric power can be brought in along a road. On the other hand development of the Island for State uses must be done with considerable care in order to avoid damage to the marshes and estuaries that provide major support for the area's fishing industry.

An additional consideration for development of State facilities on Smith Island, as in many other coastal areas, is the physical security of the investment. The section on climate shows that each year North Carolina coastal areas experience an average of 1.05 storms causing some damage to the coast. Storms producing moderate to severe damage have occurred approximately every 1.4 years. Some of these storms may be hurricanes, but other types of storms can also cause substantial damage. Because of the uncertainty of this climate, an investment made in Smith Island may not have as long a period of service as a comparable investment in a location less subject to bad storms. This may lead to a decision to make facilities less extensive or elaborate than they might be in some other environment.

In sum, it is technically feasible to build certain facilities and make additional uses of Smith Island, but in so doing, it is important to avoid damaging the fisheries resource and to make the nature of the investments practical and consistent with the degree of physical security found in that location. It should be remembered, however, that development of the island has not yet been accomplished even though it has been proposed by one group or another for more than 50 years.

C. Benefits of Developing Smith Island

The largest number of persons would benefit directly from development of Smith Island for picnicking and swimming. This benefit would be offset by the somewhat higher costs of building and operating such recreation areas at a relatively inaccessible location, such as Smith Island, compared to another

site. If areas for camping and/or cabins are created, the number of users will be smaller, but the experiences will be more extended and perhaps have greater impact upon the individuals in terms of **their perception** of a natural area. Such uses of Smith Island would more fully utilize its special characteristics: isolation, lack of previous development, direct exposure to the ocean, habitat for species not found in more developed areas, a wilderness experience.

Utilization of the Island for education experiences centered on the understanding of natural processes would most thoroughly employ the unique assets of the Island for sizable numbers of persons directly. Compared to some of the recreation programs, such a program would cost more per user because of the higher ratio of staff to users, but that is what makes its impact greater than a day of swimming, for example.

Researchers could also make use of the unique features of Smith Island, especially the relatively small extent of human intervention in natural processes there compared to other coastal areas. The number of researchers who benefit directly would be small at any one time. The number of persons who might indirectly benefit from their studies, could, however, extend to include residents all along the coast and possibly throughout the State.

#### D. Combination of Uses

The various uses that the State might make of Smith Island have been discussed above as though they were independent of, and isolated from, one another; this was done for clarity. It should be recognized, however, that for both administrative and programmatic reasons, it is likely that the State would combine two or more uses. With suitable planning this is not only possible but also desirable since uses may complement one another. For example a swimming area makes a camping area more desirable. It is not necessary that the Island be given over exclusively to one use; it is only required that the uses be developed so that the side effects of one do not impair another (as in the case of development interfering with fisheries).

One possible method of combining several recreational and educational uses is suggested in the report of Gardner Gidley, who visited the Island as a consultant with project staff. This report appears as Appendix A. Another program for using Smith Island has been suggested by Sheafe Satterthwaite who was coauthor of the most extensive monograph to date on Smith Island (Cooper and Satterthwaite, 1964). Satterthwaite's program is detailed in Smith Island as a Park--Stray Notes, an unpublished manuscript.

#### E. Costs of Developing Smith Island

The direct costs of developing a minimum amount of recreation and educational facilities on Smith Island could range from about \$70,000 for a ferry dock and a couple of miles of nature trail to around \$425,000 for a recreation-education area with one each of areas for swimming, picnicking, camping, interpretive center, and nature trail at the upper bound. To provide road access in addition to ferry access could raise these costs by as much as \$1 million, depending on the route and type of road. These costs do not include the costs of acquiring Smith Island itself, which would have to be considered in overall decisions about the use of Smith Island.

As noted in the chapter on evaluating uses, development of Smith Island in a way that diminishes fisheries output from the marshes and estuaries around the Island could result in costs up to \$904,000 per year in value of fish caught commercially, to which should be added the economic activity associated with sports fishing and the induced loss to the economy of the community of spending associated with the fishing industry.

An alternative mode of looking at the cost of uses of Smith Island that destroyed the fisheries associated with its marshes and estuaries is to examine the cost of replacing those areas. This cost may be measured in terms of the energy required to replace them. It has been estimated at some \$42.6 million. This figure is a rough measure of cost of energy that would have to be applied to a site by men, to achieve the same results achieved by natural processes at no cost to society. It indicates that substantial amounts of work are being performed at Smith Island by natural processes without human intervention.

#### F. Final Remarks

It is apparent that the question of State uses of Smith Island has many sides and that each individual use will have benefits and costs that differ from one group to another. Moreover, development by the State of some use on Smith Island is only one of several ways in which certain objectives, such as economic growth, might be achieved. The reader may be unsatisfied with this report because it does not end with one, clear statement for use. The primary reason for this is that choices among uses are specifically reserved to State decisionmakers because it is

they who must ultimately rank the objectives they wish to further for the citizens of North Carolina through use of Smith Island.

In its most concise form, the decision about State uses of Smith Island must still be seen in three dimensions:

- 1) The general objectives of individual freedom, physical security, economic growth, and environmental preservation.
- 2) The program for moving toward one or more of those objectives at Smith Island, such as some form of research, recreational or educational use, or nonuse.
- 3) The alternative programs at other locations that might promote attainment of those objectives.

In making those decisions it is, however, strongly recommended that uses of Smith Island be evaluated not only on their own merits, but in the context of economic growth, community development, land use policy, and use of coastal zone resources, not only in southeastern North Carolina but all along North Carolina's coastal zone.



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Appendix A

Smith Island Preliminary Use  
Plan--A Consultant's Report

by

Gardner Gidley

Gardner Gidley and Associates  
Winston-Salem, North Carolina



Appendix A

Smith Island Preliminary Use  
Plan--A Consultant's Report

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I. INTRODUCTION

This report summarizes findings and recommendations based upon a one-day site visit together with reference to previously published material on Smith Island. The program proposed represents but one of many possible ways of developing the recreational, educational, and research resources of Smith Island. The program is based upon professional judgment about what is feasible. One important purpose of setting forth a specific program, such as this one, is that it provides a basis against which alternative developments may be compared.

II. PLANNING OBJECTIVES

The basic planning objective is to make the Island and its environs accessible to botanists, marine biologists, ecologists, ornithologists, archaeologists, and other scientists, as well as to the general public, who would seek out the area in order to observe natural conditions and participate in a wilderness experience. This objective is consistent with the preservation objective proposed for the North Carolina State Park System:

"In order that the present and future generations may use and enjoy the natural outdoor features with which the State of North Carolina is so liberally endowed, it is the objective of the State that adequate examples of such areas shall be acquired, preserved in as close to natural state as feasible, and made accessible to users for the purpose of outdoor recreation. In particular, it is the objective of the State that such examples should represent the unique or distinctive plant or animal communities found in the State as well as other natural and scenic features.\*"

\* Planning for State Parks and State Forests in North Carolina, TR AN 398  
Research Triangle Institute, Dec. 1968, p. 2.

This preservation objective may appear to be somewhat in conflict with the objective of preserving the Island in a natural state, but man's intrusions can be held to a minimum and can be limited to areas that have previously felt the hand of man. Basic to the preservation concept is the idea that no attempt should be made to stabilize the beaches or to interfere in any way with natural processes. Shifting sand dunes should be permitted to continue encroaching upon the wooded areas, tidal marshes should continue supporting their existing flora and fauna, and man should make no effort to control the opening and closing of inlets along the beach strand. Figure A-1 shows the location of proposed areas and facilities.

### III. ACHIEVING THE GOAL

Assuming that the goals and objectives outlined above have been accepted, the following management and physical development plan is suggested.

#### A. Management

Since the Island represents an opportunity for intensive scientific investigation, it is suggested that a special advisory council consisting of members of various scientific disciplines be created for the purpose of advising the North Carolina State Park System as to the appropriateness of development plans and operating procedures for Smith Island.

#### B. Physical Development and Use

It is not recommended that Smith Island be intensively developed or that it be made accessible to great numbers of people at a given time. It is my opinion, however, that Smith Island can be used, studied, and enjoyed by a few hundred visitors at one time without detrimental effect on the ecology. This number would be regulated by the method of access to the Island. Some of these visitors would be day users; others would be staying for longer periods. For all visitors the following plan is recommended.



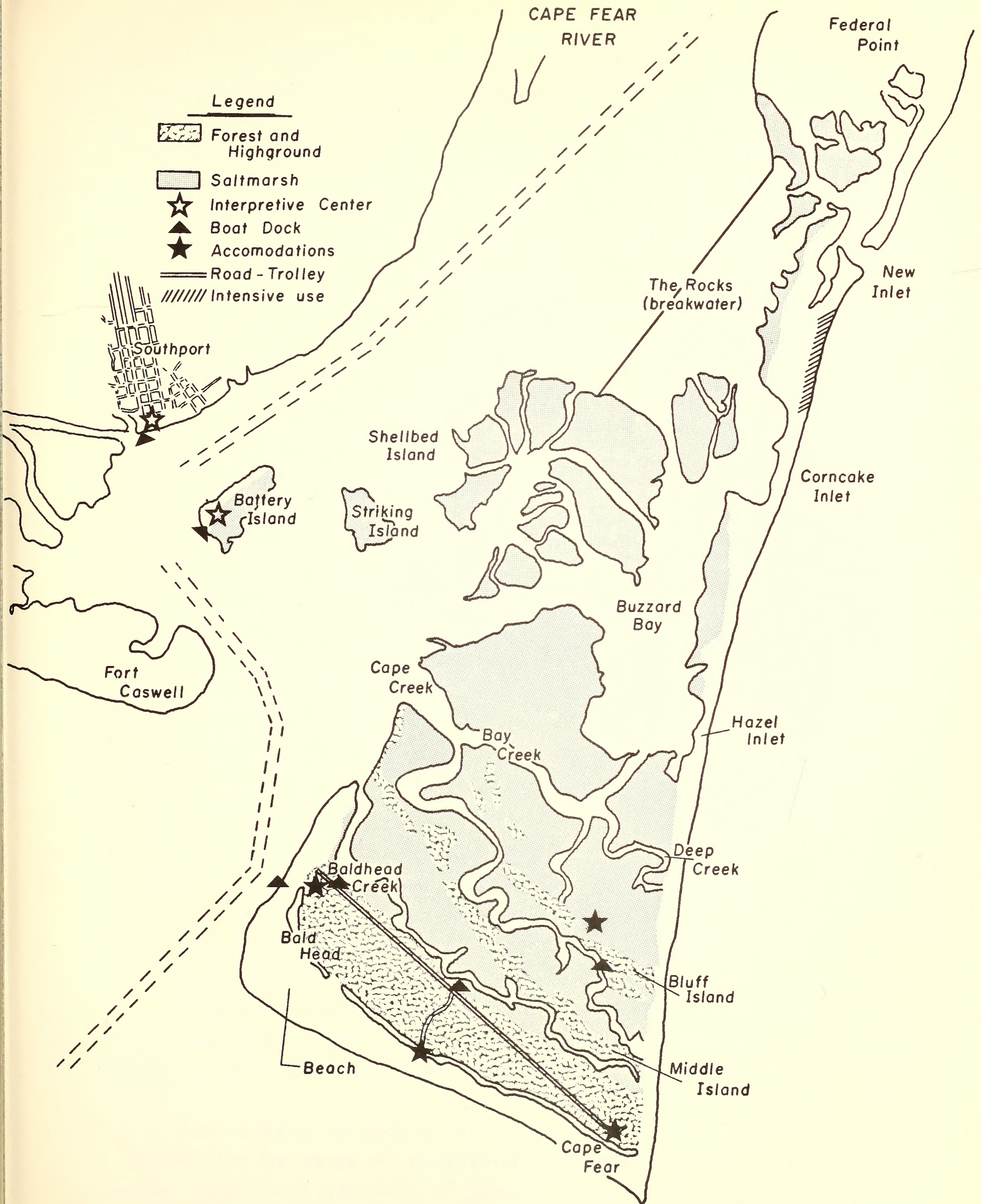


Fig. A-1. Location of Possible Recreation Facilities.

1. Access

Access to Smith Island and its environs should be only by ferry boat from Southport twice a day during high tide, when the channel up Bald Head Creek is sufficiently deep to allow boats to reach the pier behind Bald Head Lighthouse; an additional pier could be constructed on the beach in the vicinity of Bald Head Lighthouse as an alternate disembarking point. An alternate access point would be the dock used by the Southport-Fort Fisher ferry at the other end of the Smith Island complex.

2. Interpretive Center

An interpretive center should be established near the ferry dock at Southport. This will require the acquisition of several acres of land for parking (and possibly the construction of a ferry dock). Provisions should be made for an appropriate organization to operate various guided tours from the interpretive center. These tours would cover the Battery Island rookery, the marshes, and portions of Smith Island, including restored existing structures. A wild fowl observation platform and a landing pier could be constructed on Battery Island. Tours would be conducted by reservation only, and a fee would be charged. Those who do not wish to join a specific tour group should still be permitted to visit the Island. However, all visitors should be required to register at the interpretive center, where they would receive a copy of regulations, a map of the Island, and would make camping reservations if necessary.

3. Accommodations

Accommodations for those who wish to stay on Smith Island for an extended time should be constructed but spaces should be limited to, say, less than 150 visitors per night. Such accommodations should not be located obtrusively, should carry an architectural theme appropriate to the environment, and should create minimum environmental disturbance. It is recommended that none of these accommodations be built on the beaches; they should all be located behind the dune line as indicated in Figure A-1. The following functions are suggested for housing:

- a) Staff--It will be necessary to house a permanent staff on the Island for protection of the resources, maintenance of the area, and possibly for conducting interpretive programs.

- b) Camping--A camping area should be constructed in the vicinity of the Bald Head Lighthouse for those who are particularly interested in studying the Island and who are willing to bring their own camping gear. Back packing only should be allowed. It is suggested that 25 or 30 camp sites be constructed initially, with tent platforms and sanitation facilities.
- c) Other Accommodations--For those scientific study groups who wish a prolonged stay on the Island, permanent housing facilities should be built. Three locations are recommended: at the center of Bald Head Island near the abandoned Coast Guard station, near Cape Fear in the vicinity of the 1905 Cape Fear Lighthouse, and farther north, on Bluff Island. The Bluff Island and Coast Guard station installations can be reached by constructing docks on Bald Head Creek and Cape Creek. These accommodations should provide private rooms, common toilet and shower facilities, and food services. To assure orderly use, these facilities would be available by reservation only, and a fee adequate to cover the cost of operation would be charged. The Cape Fear location would be accessible as indicated in the following paragraph.

4. Transportation on the Island

Transportation on Bald Head Island presents a problem since some rapid mobility for those who are in residence is desirable. It is recommended that a railbed be constructed along the old tramway, which runs the length of Bald Head Island, and that an electric trolley be operated along its length, making several round trips each day. Corncake and New Inlets may be reached by walking along the Onslow Bay Beach from Bald Head Island or along the Carolina Shoal Beach from Fort Fisher.

5. Restoration of Existing Structures

The structures that remain on Smith Island and its environs represent an interesting period in the history of our country and should be restored. The 1817 Bald Head Lighthouse is of particular interest, as are the old Coast Guard buildings. In addition, the foundations for Fort Holmes and the 1905 Cape Fear Lighthouse should be restored, and appropriate interpretive signs and markers established.

6. Maintenance

The orderly maintenance of the Island and its resources will require that some vehicles be operated for the purpose of supplying the various facilities, disposing of rubbish, etc. The use of vehicles should be limited to such necessary purposes. Other vehicles should not be permitted on the Island, except possibly in the area above Corncake Inlet. Measures must also be taken to provide adequate water supplies, electricity, and protection from forest and other fires on the Island. A resident staff on the Island would help to minimize vandalism and other destructive behavior.

7. Other Uses

It is anticipated that the Island will continue to be used for such purposes as marsh hen hunting, shrimping, fishing, crabbing, etc. These uses are appropriate and should be encouraged.

#### IV. INTENSIVE USE

There is little question that there is a need for public, intensive use areas in the Brunswick-New Hanover area. Aesthetically, Smith Island ends at the site of the Old Corncake Inlet. The area between Corncake Inlet and the current New Inlet could be made accessible (with or without automobiles) for day use for such purposes as picnicking, fishing, swimming, (assuming that a beach safe from dangerous tidal currents and other underwater hazards can be located there).

## V. COST

No detailed estimates of the cost of this development program have been prepared, but a general range of \$500,000 to \$700,000 is suggested. These figures do not include any estimates for the development of intensive use areas.

## VI. SUMMARY

Smith Island is a fragile resource. Its ecology has already felt the hand of man, and development should be very carefully planned. At the same time, a resource such as Smith Island can be of more pleasure and use to a larger number of people than are presently enjoying it. The plan above is presented as a possible solution to the vexing problem of preserving this resource while making it accessible to those who care to take the time and trouble to learn more at first-hand about our environment.



Appendix B

Climate and Storms in the Smith Island Area

by

Alex B. Cole





## Appendix B

### Climate and Storms in the Smith Island Area

by Alex B. Cole

#### A. Climate

##### 1. Introduction

The climate of Smith Island is undoubtedly very much influenced by location. It is completely exposed to the full expanse of the Atlantic to both the south and east. While exact measurements of climatic factors are not available because there is no weather station on the island, general conclusions about the climate can be reached using data available from nearby communities. Southport, located approximately three miles west of Smith Island and six miles from Cape Fear, has the longest period of weather records in North Carolina, dating to 1822 for temperature. There are some breaks in the mid-1800's but both temperature and precipitation records are continuous since 1876 (U.S. Weather Bureau, 1965). Additional data are available from the Wilmington Airport Station of the U.S. Weather Bureau, which is located less than 20 miles to the north.

##### 2. Wind

One climatic force prevails over all others in a coastal location such as Smith Island. That is the wind. Prevailing winds at Southport are from a south-westerly direction during the Spring and Summer (March through August). At other times winds are from a northwesterly direction. Winds quite commonly shift directions several times during the day (U.S. Weather Bureau, 1965). A similar pattern occurs at Wilmington where the prevailing wind is from the south-southwest March through August and from the north September through February. At this station the mean hourly speed is 9.6 miles per hour with

speeds above 46 miles per hour reported in every month (U.S. Weather Bureau, 1964). However, winds exceed 25 miles per hour only about one percent of the time.

Contrary to common belief, the prevailing winds do not bring to land the warm Gulf Stream air: Seasonal shifts of the Gulf Stream bring its near edge no closer than 40 to 50 miles to the east, whereas prevailing winds are from the north or southwest.

All sea breezes, however, have some moderating effect on temperatures throughout the year, as the ocean is warm in winter and cool in summer relative to the land.

### 3. Temperature

Smith Island is the southernmost part of North Carolina and even lies at a latitude south of all the larger cities of South Carolina except Charleston. Southport is also south of Los Angeles, and the average annual temperatures of the two places are almost identical. The highest temperature recorded is 103° and the lowest is 10°. The moderating effect of the Atlantic reduces both the extremes of high and low temperature. Averages are summarized in the table below:

<u>Southport, N. C.</u>	
Temperature (°F)	
Mean Low	56.2
Average	64.0
Mean High	71.8
Precipitation (inches)	
Average/year	50.85

Southport's winter weather is warmer than most of South Carolina and about half of Georgia, Alabama and Mississippi. Yet summer temperatures are lower than most locations in the Southeast.

The range in temperature from day to night and from summer to winter is much smaller than that for most interior locations in the Eastern States. Summer temperatures reach 90° on an average of 11 days per year. This is only one-third to one-fourth as often as at typical inland locations. Freezing weather

occurs an average of 32 days per year and there is no record of zero or below temperatures in more than 100 years of weather observations. Interior locations typically report freezing weather twice as often.

The heating season runs from late October through early April. Many days of November and March are warm enough so that artificial heat is not required. Fuel requirements at Southport are approximately two-thirds those of the average inland location in North Carolina.

#### 4. Precipitation

Precipitation in this area is almost all rain with only occasional snow in about half the years and measurable amounts in only one winter out of five. Sleet and hail are even less common.

Rainfall in this area averages 50.85 inches per year, well distributed throughout the year. It averages about three and a half inches October through May and about six inches during the June through September portion of the growing season. April is the driest month and July to September the wettest.

#### 5. Humidity and Comfort Index

Average around-the-clock relative humidity is about 75 percent. The one p.m. relative humidity averages 54 percent for the year with an average of 61 percent for the summer months of June, July, August and September and 51 percent for the remainder of the year.

#### 6. Cloud Cover

The only record indicating the amount of sunshine at Southport is the number of days when at least 0.10 inch of rain fell. This averages 75 days a year. The Wilmington weather station reports the percent of possible sunshine. This average ranges from a minimum of 58 percent for January and February to 70 percent for April. The average for the year is 64 percent.

B. Storms

1. Tides and Storm Surges

On the bar of the Cape Fear River mean range of tide is about 4.7 feet. At Southport tides range from a mean low water of 0.0 feet to a mean high water of 4.1 feet. The mean range is about 4.2 feet. Extreme low water is minus 2.0 feet. Extreme high water during hurricanes has reached 14.0 feet above mean low water (U.S. Army Corps of Engineers, 1962).

Extreme high tides produced by storm systems such as hurricanes (winds of 73 miles per hour or higher), or other cyclones are called storm surges. The highest storm surge in the Smith Island area during recent historical times was probably during Hurricane Hazel, but there was no one on the island to observe it. This storm surge, or at least the damage produced, was observed on adjacent areas such as Southport and at Holden, Long, Carolina, and Wrightsville Beaches. Along these beaches the storm surge was at least 10 to 12 feet above mean low water. It may have been 14 to 16 feet. Heights of 20 feet were reported but cannot be verified (Burton, et al., 1965). All of Holden Beach, southwest of Smith Island, was covered. Southport had water in the lower streets where it was 14.0 feet above mean low water. Cooper (1969:3) reports that all of Smith Island except the Great Ridge was under water. The U.S. Weather Bureau Climatologist at Wilmington, Mr. Sam Duke, reports storm surges in that area as high as seven feet during the past 10 years that he has been there.

In addition to the water piled against the coast by wind during a storm, there would be breakers. The height of these depends upon the strength and direction of the wind, the depth of the water, and the shape of the bottom. Based on the depth of the water, and the shape of the bottom off Smith Island, breakers could be expected to commonly run five to six feet above the storm surge. For other coastal areas mathematical models have been produced that predict the heights of storm

surges and breakers and the expected frequencies. RTI is currently working on one for Pamlico Sound.

It is not necessary to have hurricane force winds to have extremely damaging storm surges capped by high breakers that damage coastal areas. The most devastating coastal storm in the United States never reached hurricane force. This storm, the Ash Wednesday storm of March 6-7, 1962, was born between Florida and Bermuda. It combined with a dying storm system from the Mississippi Valley near Cape Hatteras. Winds of 50 miles per hour developed. These winds blowing over a fetch upwards of 1,200 miles developed a storm surge that battered the coasts of New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina. The battering and erosive action through three successive high tides caused damage of about \$190,000,000 and an estimated loss of 34 lives. Swells developed by this storm caused heavy damage to shore installations southward to the coast of Florida. In the Nags Head area this storm produced a tide estimated to be 7 to 9 feet above mean sea level, and this was capped by 12-foot breakers.

## 2. Coastal Storms

In order to evaluate the risk of damage from coastal storms it is necessary to have information about the major factors contributing to such risk. For risk of damage from coastal storms the following factors should be included:

- a) The occurrence of coastal storms.
- b) The frequency of damage from wind and waves.
- c) The changing pattern of damage.
- d) The nature defenses against damage, both natural and man-made.

These factors combine to determine the frequency and degree of damage that can be expected by occupants of the coastal margin.

## 3. The Occurrence of Coastal Storms

The record of hurricanes is fairly complete since colonization began on the eastern seaboard of North America. Hurricane

damage is particularly well documented over the past 50 years. Storms of such intensity, however, constitute only about one-third of the total storms damaging coastal areas. Figure B-1 gives the yearly number of all storms that have caused some water damage somewhere along the Atlantic coast for each year from 1921 through 1964. This figure shows a marked increase in the number of damaging storms following 1945.

Burton and others (1965) examined the daily synoptic charts for the 195 storms that occurred during the 1921-1964 period. Their study showed that certain weather patterns recurred many times. With the exception of six they were able to classify coastal storms into the following eight types on the basis of their origin, structure, and path of movement:

a) Hurricanes and Severe Tropical Storms

Hurricanes possess higher wind velocities than other storms that affect the East coast. Their destructive power is great although damages do not generally appear more severe than for many class 2 storms. This is undoubtedly related to their more rapid movement and the relatively small diameter of the storms, which result in shorter over-water fetch of the winds and, hence, less opportunity for wind-driven waves to pile up along the coast. During the period of record, 62 hurricanes brought damage to some part of the Atlantic coast.

b) Wave Developments forming in the Atlantic Ocean Well East of the United States Mainland or in the Vicinity of Cuba

These storms are slow-moving and have a pronounced east-west elongation. This leads to a long over-water fetch of the winds and the build-up of significant wind-driven waves along the coast. This group is probably the most destructive of all the storms that influence the coast. There were nine storms in this class during the 44-year period of record.

c) Wave Developments Along Cold or Stationary Fronts Over the Southeast Coastal States or in the Atlantic Ocean Just Off the Southeast Coast

Class 3 storms also have a long east-west orientation and are also frequently blocked by high pressure systems pushing eastward north of the low center. There were 27 storms in this class during the 44-year period of study.

d) Wave Developments Along Cold or Stationary Fronts in the Gulf of Mexico Forming West of 85° W Longitude

These storms usually move eastward across Florida and often strengthen as they reach the Atlantic Ocean. Since they are seldom blocked, these storms generally move up the coast quite rapidly and are often pushed out to sea.

During the period of investigation there were 25 storms of this type that brought damage to the East coast.

e) Depressions Moving Across the Southern Half of the United States That Intensify Upon Reaching the Atlantic Coast; No Secondary Development Ahead of the Storm Center

Class 5 storms are relatively few in number. They generally move fairly rapidly eastward or northeastward. There were only 15 storms of this class which produced damage to the coastal areas during the 44-year period of record.

f) Depressions Which Develop as Strong Secondary Cyclonic Disturbances Along the Coast (Often in the Hatteras Area) Ahead of a Trailing Wave or Occluded Center

Here, wave development over the coastal area can be most rapid, but generally the storm center moves rapidly northeastward so that damage is minimized. Twenty-six storms of this type have resulted in damage to the coast since 1921.

g) Intense Cyclonic Storms Whose Origin and Entire Path of Movement Are Over Land Surfaces So That The Low Center Remains West of the Coastal Margin

Class 7 storms consist of disturbances which generally move northward over the Great Lakes and down the St. Lawrence River valley. These storms are usually highly developed and often move rapidly. There were 17 storms in this category.

h) Strong Cold Fronts Accompanied by Squall Lines and Severe Local Weather

Class 8 storms consist mostly of severe local storms accompanying squalls. Damage produced is generally localized and relatively unimportant. There were eight storms in this class during the 44-year period of study.

As expected the maximum number of hurricanes occur in September. Class 2 storms are most frequent in the fall. Class 3 storms are most frequent in late summer and early fall but also occur in the winter and spring. The maximum of class 4 storms comes in March and class 5, 6 and 7 storms are most frequent in the winter and early spring. Class 8 storms seem to favor the late summer, but the distribution is not significant because the number is so low.

4. The Frequency of Damage

The frequency by storm type is shown by Table B-1. In addition a rough estimate of the average severity of each storm class is shown. This is based on published damage estimates divided into low, moderate, and severe classes and assigned one for slight damage, two for moderate, and four for severe. This shows that class 2 storms are the most damaging followed by class 1 and class 3.

In testimony before a congressional committee following the March 5-8, 1962 (Ash Wednesday) storm, it was estimated that some part of the Atlantic coast would experience appreciable storm damage about once in four years. It was pointed out that there had been ten storms comparable in severity to the March 5-8, 1962 storm since 1900. In addition it was estimated that any one locality on the coast might experience a storm as damaging about once in 30 to once in 60 years.

This may give the erroneous impression that damaging coastal storms are rather infrequent. What is overlooked is that these estimates are for very damaging storms. What an individual living on the coast wants to know is how often he can expect damage to his house or other property. Table B-2 lists by state and class the number of coastal storms causing



some damage during the 1921-1964 period. Massachusetts has the highest storm rate, with 88 storms during this period for an average of 2.00 per year; Georgia is lowest on the list with 19 storms, and a yearly average of .43. The North Carolina coast has experienced 46 damaging storms during this period for an average of 1.05 storms per year.

The number of storms says nothing about the severity of the storms involved. During this period in North Carolina 14 storms produced light damage, 23 produced moderate damage, and 9 produced severe damage. The average severity is 2.09 based on one for light damage, two for moderate damage, and four for severe damage. There were 32 storms resulting in moderate or severe damage. For storms producing moderate or severe damage this gives an average recurrence interval for the North Carolina coast of 1.4 years.

The region immediately north and south of Cape Hatteras, from Albemarle Sound to Cape Fear, was damaged more often than any other reach of southern coast from 1955 to 1965. In addition there has been a marked increase in the relative damage frequency along this coast since 1955. In a storm hazard rating system developed by Burton and others (1965) the Hatteras region from Albemarle Sound to Morehead City was rated "considerably hazardous." The coast from Morehead City to the South Carolina state line was rated "moderately hazardous." Their rating system was the total number of damage occurrences from 1955-1964 per 25 mile reach of coast weighted by degree of damage, with heavy damage weighted double, then divided into low, moderate, considerable and great hazard categories. It must be remembered that heavy damage may be as much a result of the pattern of coastal development as of the severity of the storm attack.

##### 5. The Changing Pattern of Damage

To predict expected frequencies, one might simply project past rates of occurrence into the future. This may be acceptable if there is no evidence that the rate of occurrence of storms or the pattern and level of coastal development is changing. There

is clear evidence, however, that each of these three major factors in storm damage occurrence is changing.

As noted in Figure , there was a marked increase in the number of damaging storms starting in the mid-1940's and lasting at least through 1964. This trend is accompanied by an increase in the strength of damaging low pressure systems. Correlated with this trend is an increase in excessively high tides. However, when Burton and others (1965) examined storm tracks and locations of damaging low pressure centers they could find no readily apparent physical reason for the increased numbers and intensity of the storms noted.

There is really no indication that the increases in numbers of storms and of storm intensity is the only thing responsible for the increased damage along the coastal margin. Another factor is the rapid and almost completely unplanned development of many coastal areas starting about 1950. Such unplanned development can make storm damage inevitable through poor location, design, construction and through the weakening of natural coastal defenses against storms. In addition, coastal development makes possible the greatly increased dollar value of damage. Thus, the increase in number and strength of storms and the weakening of coastal defenses will both result in the same end: increased damage frequency and dollar amount of loss.

#### 6. Defense Against Damage

Poorly planned coastal development can make storm damage inevitable. Good planning cannot reduce this risk to zero, but it can minimize the risk that must be endured. Such planning begins with the location of development. Buildings located below levels of frequent storm surges or too close to beaches invite damage from water and breakers.

While leveling dunes may improve the view or provide fill for low areas, it also weakens the natural defense against pounding by waves. Design and construction techniques that raise buildings on piling help to minimize such damage by permitting

water and floating debris to pass unrestricted beneath. Low profiles and minimum glass areas reduce wind damage risk. Finally, the choice of building materials can reduce or increase the risk of damage. Brittle materials such as brick or concrete block or asbestos shingles offer very little resistance to damage from any sort of blow. In the past much of the damage along coasts has been from pounding by waves and floating debris.

Sea walls, groins, and similar structures can also be used to help protect coastal property. However, they are costly to build and require considerable periodic maintenance. If they are not properly designed, constructed, and maintained, they can promote damage by improper channeling of destructive forces or by failing during a critical storm period. They can give an unwarranted sense of security that promotes coastal development eventually leading to disaster.

Good planning, taking into account the risk of storm damage and minimizing the risk that must be endured, can be promoted with zoning laws and building codes. While these restrict individual freedom to do as one pleases, they can promote awareness of the risks associated with coastal development and the techniques available to reduce damage. Such regulation can reduce public costs for disaster relief and demands for public agencies to provide protection with public funds for unsound coastal development.

Table B-1

FREQUENCY AND DAMAGE ESTIMATE BY STORM TYPE,  
ATLANTIC COAST, 1921-1964

<u>Class of Storm</u>	<u>Total Number</u>	<u>Damage Estimate</u>
1	62	2.40
2	9	2.89
3	27	2.18
4	25	2.00
5	15	1.64
6	26	1.84
7	17	1.44
8	8	1.00

Source: Burton et al., 1965, p. 531.

Table B-2

NUMBER OF DAMAGE-PRODUCING STORMS, BY CLASS AND STATE, 1921-1964

<u>State</u>	<u>Total</u>	<u>Storms Per Year</u>
Virginia	33	.86
North Carolina	46	1.05
South Carolina	19	.59

Source: Burton et al., 1965, p. 533.





