U.S. Department
of the Interior

Heritage Conservation
and Recreation Service

Report of the Barrier Island Work Group

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In any consideration of our coastal barrier islands, we must understand this paradox: their only constant is change.

Low-lying barrier islands are a limited resource, shifting position, buffeted as they are by storm and wave action.

Development for human enjoyment—expanding cities, proliferating vacation homes and growing resort facilities—tends to ignore the inevitable. While it has been some two decades since a major hurricane devastated these islands, our scientists predict that another may occur any year.

We believe that strong environmental safeguards, based on an understanding recognition of the natural forces of the sea, must be foremost in any program for protecting barrier islands from unwise development and use.

Cecil D. Andrus
Secretary of the Interior

U.S. Department
of the Interior

Heritage Conservation
and Recreation Service - DC

December 18, 1978

Report of the Barrier Island Work Group

U. S. DEPARTMENT OF COMMERCE NOAA
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Chapter 1

The Barrier Island Problem

The barrier islands off our Atlantic and Gulf Coasts have been subject to alternating periods of concern and neglect by the Nation. The periods of concern have been marked by the selective preservation of some of the more outstanding islands, while those of neglect have been marked by the unwise development and wasteful treatment of others.

As a result of our recently awakened concern for the environment, people from numerous backgrounds—conservationists, scientists, politicians, and public employees—have turned their attention to the preservation and wise use of barrier islands. Many of the islands have already been developed for urban and commerical uses, or otherwise seriously altered. Others are as yet undeveloped, and it is these barrier islands that have received much recent concern. An important consequence of that concern is President Carter's decision to take the steps necessary to preserve the islands. In his Environmental Protection Message of May 23, 1977, the President declared:

Coastal barrier islands are a fragile buffer between the wetlands and the sea. The 189 barrier islands on the Atlantic and Gulf coasts are an integral part of an ecosystem which helps protect inland areas from flood waves and hurricanes. Many of them are unstable and not suited for development, yet in the past the Federal Government has subsidized and insured new construction on them. Eventually, we can expect heavy economic losses from this shortsighted policy.

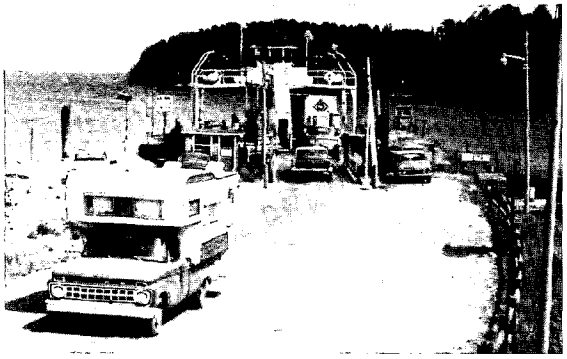
About 68 coastal barrier islands are still unspoiled. Because I believe these remaining natural islands should be protected from unwise development, I am directing the Secretary of the Interior, in consultation with the Secretary of Commerce, the Council on Environmental Quality, and State and local officials of coastal areas, to develop an effective plan for protecting the islands.

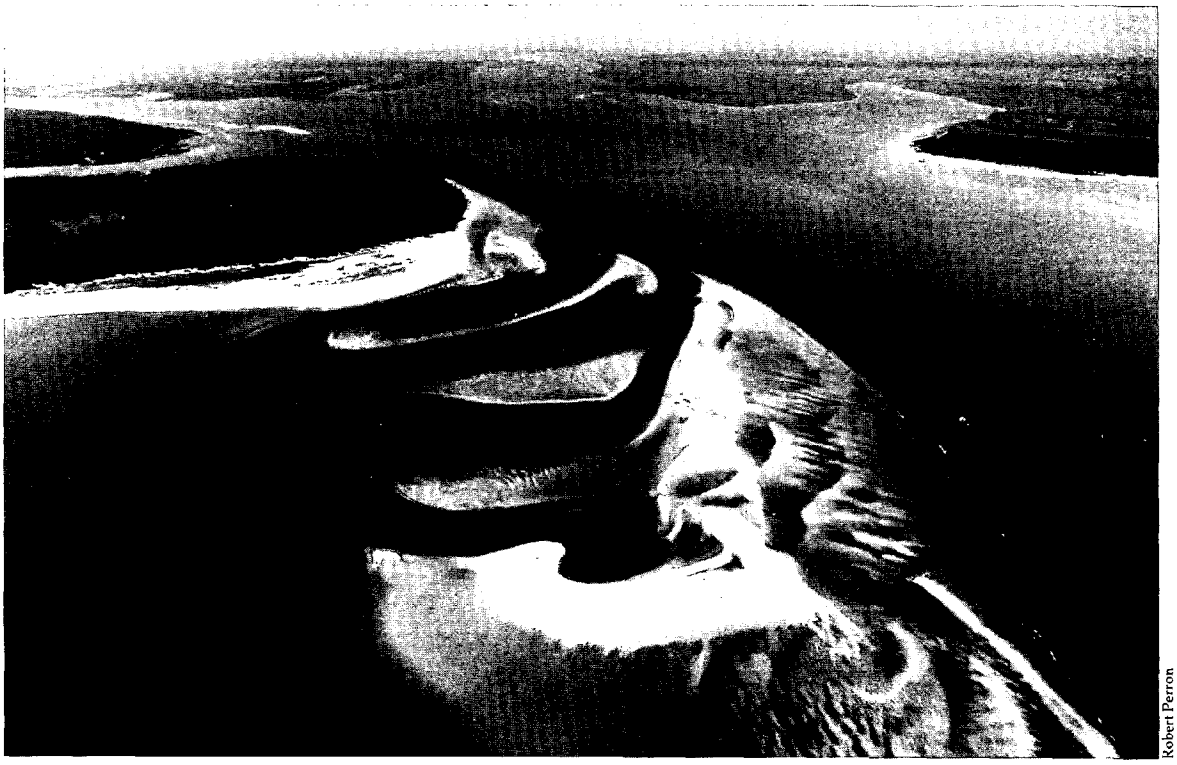
His report should include recommendations for action to achieve this purpose.

Characteristics and Role of the Barrier Islands

In order to understand the concern for the barrier islands, it is necessary to understand what they are and what role they play. The barrier islands of the Eastern United States stretch in an irregular chain from Maine to Texas (Fig. 1). Each is an elongated, narrow landform consisting of unconsolidated and shifting sand (Fig. 2). They are generally characterized by a dynamic beach system consisting of offshore bars, crashing surf, and a sand beach, dune ridges just behind the beach, interior lowlands, and bay-side wetlands. They are separated from the mainland by marshes or open water, which are intimately related to the island.

These islands are formed by material eroded from glacial deposits or by the action of rising sea level which submerges coastal lowlands, separating Pleistocene uplands and dune systems from the mainland. This continually changing relationship between the ocean floor, surf line, and moving sediments produces islands that are both locationally and structurally unstable. They are *locationally* unstable because the constant erosion by waves and currents often effects a lengthwise migration along the coast, and also because the rising sea level contributes to a movement landward, following the receding shoreline. They are *structurally* unstable because unconsolidated sands are in constant flux, being ceaselessly eroded and deposited by winds, waves, and currents. Beaches expand in summer and contract in winter. Inlets (sea water passages that extend from the open ocean through the barrier to the bayside) migrate, are filled in, and are created anew by violent storms. Dunes are altered by storms and often reestablished by coastal vegetation which either emerges through sand deposited by storms or is established from seeds and plant





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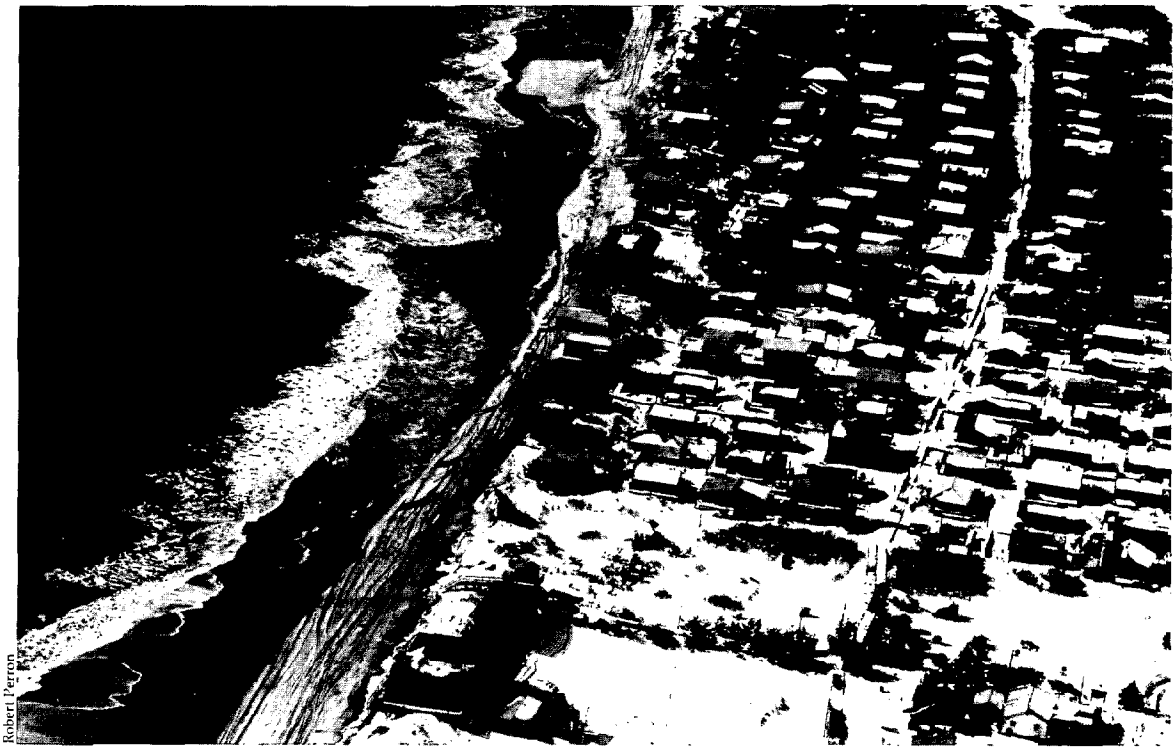
fragments and accumulate in drift lines.

There are some exceptions to the above generalities. One is the mangrove islands of the Gulf Coast of Florida, which lack the typical profile of the barrier island. They are of biological origin, having been formed by the entrapment of sediments by the root systems of the mangrove. Another is the islands of South Carolina and Georgia, which were created through the submergence of Pleistocene sediments rather than the more typical pattern of the reworking of Pleistocene and recent (Holocene) deposits. Although they display a typical barrier island profile, they lack a well-developed bay system.

Permanent human habitation of the islands is hazardous, if for no other reason than that unconsolidated sand routinely moves about, while roads and houses cannot. The islands are also subject to the fury of hurricanes and other storms. Storm waves breach or overwash the dunes, and entire islands or sections can be inundated. Because egress from the islands usually depends on a narrow bridge or a ferry, it is often impossible to evacuate large numbers of people on short notice.



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Although these islands are not permanently habitable, they are valuable in many other respects. The estuaries and sounds that barrier islands protect are among the richest and most productive ecosystems known, providing nurseries, shelter, and feeding for many species of fish, shellfish, and wildlife. In addition, the surf zones of barrier islands provide unique habitats for the feeding activities for the larvae of many commercially important fish. Because of the unique relationship between salt water, fresh water, sand, and storms, the islands support fascinating ecosystems not found elsewhere. They are also places of great attraction and recreational opportunity.

Because of these important public values, a number of barrier islands have been preserved in their undeveloped state. Nine of the most outstanding scenic and natural islands or island groups have been set aside as national seashores, and many others are preserved as national wildlife refuges. Most of the States have placed one or more barrier islands under protection as parks or wildlife refuges, as have a number of local governments. Private conservation organizations also have involved themselves in island protection, with activities extending from acquisition and preservation of islands to planning and lobbying efforts.

The barrier island is an ephemeral but resilient (except when modified by man) landform. It is important to recognize that it is also a very different kind of place than the mainland. From the standpoints of ecology, economy, safety, and recreation, these islands should be treated and used in ways consistent with their special characteristics. This has not often been the case. Our use and occupancy of the islands have often proceeded without concern, and sometimes in defiance of their geomorphic reality.

Development of the Barrier Islands

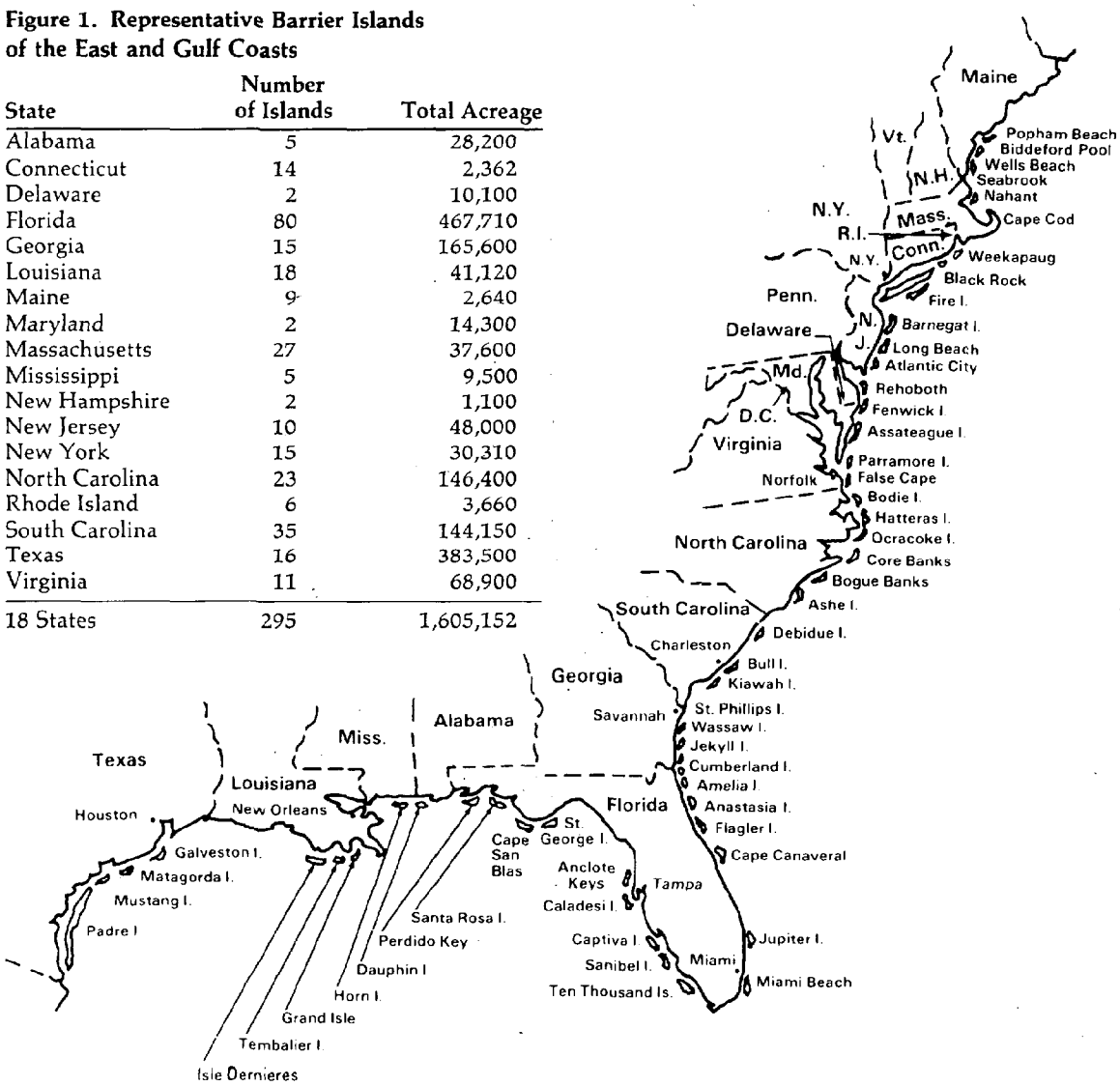
Although some of the islands were settled early in our colonial period, and others were used as sources of materials or coastal defense sites, barrier islands as a group have not been under development pressure until relatively recently. This is easy to understand given the inherent dangers and high costs associated with developing them, and the fact that more convenient and less costly sites were plentiful on the mainland. Recently, however,

changing technological, economic, and social conditions have made the islands seem more feasible and desirable for development. The fact that people now have enough money to purchase second homes and have more leisure time, coupled with the ease of modern transportation, may have largely changed our attitudes about the barrier islands and how we use them. But it hasn't changed the natural problems and hazards associated with them.

Developing the islands is a costly undertaking. Access must be provided across water, appropriate upland sites are relatively scarce without expensive dredging and filling, and the constant threat and effects of storms and flooding makes everything—from road maintenance to house construction and property insurance—more expensive. Unaided, most developers would probably seek less costly mainland sites. It is therefore ironic that, as mentioned by the President in his Environmental Message, many Federal programs subsidize and insure the development of the islands. By neutralizing the disadvantages inherent in the barrier island environment, and thereby reducing the economic burden on the developer, not only is that burden

Figure 1. Representative Barrier Islands of the East and Gulf Coasts

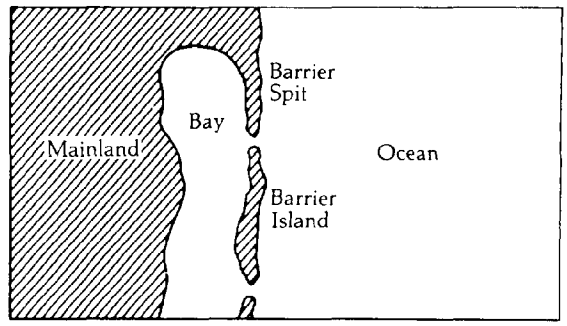
State	Number of Islands	Total Acreage
Alabama	5	28,200
Connecticut	14	2,362
Delaware	2	10,100
Florida	80	467,710
Georgia	15	165,600
Louisiana	18	41,120
Maine	9	2,640
Maryland	2	14,300
Massachusetts	27	37,600
Mississippi	5	9,500
New Hampshire	2	1,100
New Jersey	10	48,000
New York	15	30,310
North Carolina	23	146,400
Rhode Island	6	3,660
South Carolina	35	144,150
Texas	16	383,500
Virginia	11	68,900
18 States	295	1,605,152



shifted to the mainland taxpayer, but a valuable resource is potentially jeopardized.

The result has been a pronounced trend in barrier island development in recent years that has changed public perception of the islands, as well as seriously altering many of the islands themselves. One facet of this trend is the real estate boom that has seen the development of one island after another into second home residential communities, retirement villages, and exclusive waterfront colonies. Another is the ever-increasing public demand for and use of coastal beaches for recreation.

Figure 2. Map View of Barrier Islands and Spits



Interest in Protecting the Islands

The current interest in protecting the barrier islands is a logical outgrowth of the conservation-environmental movement, but more specifically it is the result of the efforts of a number of conservationists to encourage a more enlightened, farsighted treatment of the islands. A Barrier Island Workshop, held in Annapolis, Maryland in May 1976 under the combined auspices of the Office of Coastal Zone Management (Department of Commerce) and the Conservation Foundation, led to the creation of the Barrier Island Coalition. This coalition of scientists, citizens, and approximately 25 private conservation organizations continues the work and interest generated by the Workshop and was instrumental in putting the barrier island problem on the conservation agenda of the Carter administration.

In response to the President's directive, a work group was established within the Department of the Interior under the general direction of the Heritage Conservation and Recreation Service. The group consisted of representatives of the National Park Service, the Fish and Wildlife Service, the Barrier Island Coalition, the Office of Coastal Zone Management, and the Council on Environmental Quality. Data were submitted to the work group by each of the Federal agencies whose programs assist or encourage the development of barrier islands, and information on programs, problems, and future plans was obtained from the coastal States and interested parties.

Study Methodology

At the outset, the work group decided to amplify the President's assignment. First, the figure of 68 undeveloped islands mentioned in the Environmental Message is inexact; that is, there are more than 68 islands undeveloped in whole or in part, while some of the undeveloped islands included in that figure are already protected. It was also recognized that a complete understanding of the islands would be required as a basis for the development of sensible policies, and that this would entail a review of all islands, developed as well as undeveloped. Next was the question of just what *is* a barrier island. In addition to the normal insular examples are many sand spits which, although they are not islands, function as barriers and often *become* barrier islands when new storm-created inlets isolate them from the mainland (Fig. 2). The mangrove islands of Florida were also considered, since they play a role similar to that of the authentic barrier islands and share much of their value to society.

After examining maps, inventories, and reports, the work group identified what appeared to be distinct barrier islands, spits, and mangrove islands, or closely related groups, in order to establish the parameters of the study. The result was identification of nearly 300 barrier island study units, some of which consist of a single large island, and others of closely related groups of islands (Appendix A). The study units were then inventoried with respect to over 50 information areas (management, land use, land cover, etc.) and categorized for automated data processing. A list of these study units and maps delineating them were reviewed by representatives of Federal field offices and State agencies and by "Island Watchers" of the Barrier Island Coalition. A number of changes were made to reflect the comments received. Unfortunately, because of the lateness of some responses and the pressure of time, it was impossible to incorporate all suggested changes. As planned, however, the

barrier island data inventory and data bank will be updated on a regular basis in order to correct inaccuracies and account for changes in management and island conditions.

The study units were then subdivided into three categories according to the islands' dominant characteristics:

1. developed 2. undeveloped 3. protected

1. **Developed** barrier islands are those with 75 percent or more of their area developed, or with 1,000 or more acres of developed land area.
2. **Undeveloped** barrier islands are those with no more than 10 percent of the land area developed, or with 5,000 or more acres of undeveloped land.
3. **Protected** barrier islands are those which are at least 50 percent owned and managed by a public agency, private group, or individual whose long-term intention is to maintain the natural conditions.

Protected islands in public ownership (i.e., national seashores and wildlife refuges) are usually available for public recreational use, and usually have some administrative or public use facilities, ranging from simple campgrounds to elaborate overnight accommodations. These islands range from virtually natural to quite altered environments. Those in non-public ownership are held by their owners (commonly, non-profit conservation organizations) in some sort of permanent legal protection.

Broadly speaking, the work group translated the President's charge into two fundamental issues:

- How can the remaining undeveloped barrier islands be preserved in their natural state?
- How can any further development of the already developed or partly developed islands be guided to minimize adverse environmental and economic impacts?

Those broad issues led the work group to seek answers to more specific, secondary questions:

- How can Federal programs refrain from assisting or encouraging unwise barrier island development?
- What can the States and local governments do to guide better development of the islands, and how can these efforts be encouraged by the Federal Government? How can private preservation efforts be encouraged by the Federal Government? In what ways can the management of Federally-administered barrier islands be improved?

Chapter 2

The Barrier Island: A Storm-Dependent Feature[1]

The barrier islands are common landforms along the Gulf and Atlantic Coasts of the United States.[2] They consist of sand and other loose sediments that have been and continue to be transported by winds, waves, and storm surges. Geologically speaking, they are quite young, having been formed only in the last five or six thousand years. The barrier islands are so named because they protect lagoons, salt marshes, estuarine systems, and the mainland from the direct attack of ocean waves and storm surges. On one side, they face and absorb the full force and energy of the oceanic environment. On the other, they face the relatively calm waters and shore that result from the physical barrier formed by the island itself.

The term "barrier island," as used in this report, includes the barrier spits. Spits are attached to the mainland, with one end forming an attenuated peninsula, and can become barrier islands when a storm-caused inlet severs the peninsula from the mainland (Fig. 2).

Description and Origin of the Barrier Islands

There are several different types of barrier islands, owing their differences to their geologic history. Along the northeastern coast of the United States, from New York north, they have generally been formed by the erosion of glacial deposits and the subsequent deposition of the eroded material in elongated spits. Later, if the spit is breached, thus breaking free from the mainland, an island is formed. Examples of this type of island include Monomoy, Massachusetts, and Fire Island, New York. It is thought that many of the islands along much of the southern Atlantic Coasts owe their formation to a second cause, related to a rising sea level. According to this theory, as the sea rises, dune ridges form on the mainland shore. When this ridge is breached by the continued rise of the sea, the lowland section of the mainland behind the dunes is flooded, creating lagoons and leaving the dune ridge isolated as an island. The Outer Banks of North Carolina, Miami Beach, and Padre Island, Texas, are examples.

A third mechanism of barrier island formation suggests that the islands are a function of the upward aggradation of submerged offshore shoal areas. Examples are found in the barrier islands off the coast of Mississippi. A fourth mechanism involves the isolation of certain Pleistocene uplands of the mainland. These sections of the coast are cut off from the mainland as the rising sea level inundates surrounding low areas or river valleys, and are left as islands. Many of the sea islands of Georgia are of this type, for example Sapelo and Cumberland Islands. A fifth mechanism is that in which major rivers deposit large quantities of sediments in the ocean and the resulting deltaic deposits are eroded by the waves and subsequently redeposited as barrier spits or islands down beach. Examples of these are found around Cape Romain, South Carolina, and the Mississippi delta Chandeleur group.

Although they vary considerably from place to place, barrier islands generally have several charac-

[1]This chapter relies heavily on the work of Drs. Paul Godfrey and Stephen Leatherman of the National Park Service Cooperative Research Unit, University of Massachusetts. Dr. Godfrey served as a member of the interagency barrier island work group.

[2]Although the President's Environmental Message singled out the Gulf and Atlantic Coast barrier islands for consideration, these features also exist in Alaska, and to a lesser extent along the West Coast and on the Great Lakes, as well as elsewhere in the world.

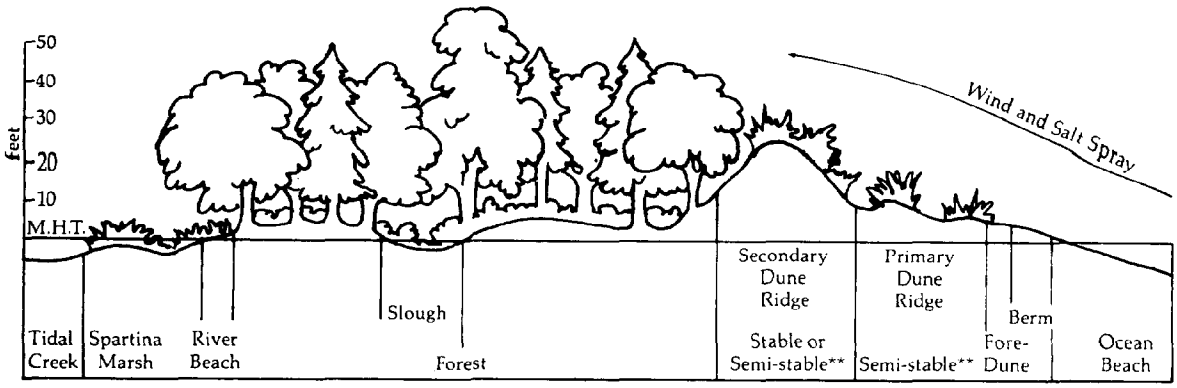
teristic parts (Fig. 3.). With respect to the generalized barrier island, the *beach* faces the ocean and absorbs the full force of the waves on an hourly basis. Because the loose sand and shell fragments are subjected to constant impact and movement, the beach is the most unstable section of the barrier island. Most plants and animals cannot survive in this habitat. The organisms that do exist are adapted to constant change, mainly animals (like mole crabs and coquina clams) that can rebury themselves rapidly, and microscopic animals and single cell algae.

Immediately behind or above the beach is the *dune zone*, which may consist of a single dune ridge that is stabilized by beach grasses, or of several dune ridges that are either parallel to each other or that occur in curving arcuate lines. Open dune fields without any distinctive ridges also occur. Depending on its geologic history, an island's dune zone may extend all the way to the intertidal zone on the backside of the island, or grade into the barrier flats.

Plants are important in the dune zone because they stabilize the dune or ridges and act as traps. Sand blown off the beach would just keep moving inland if it were not for beach grasses in the northeast and sea oats in the southeast. These grasses have two distinctive characteristics: they can tolerate the salt spray that is a major component of the beach-dune environment and they can sustain burial by windblown sand, growing upward and outward as the blowing sand accumulates around them. As the dune grows and the grass continually recolonizes the sand surface, the dune becomes stabilized. Later, nitrogen-fixing plants such as bayberry and beach pea invade the dune, adding nitrates to the barren sand that fertilize other plants. With long-term stability and shelter from salt spray, shrub thickets and, eventually, woodlands can develop on the landward side of the frontal dunes.

Behind the dunes is the *barrier flat*, an extensive plain. These flats are typically covered with grass or meadow vegetation that is adapted to frequent sand burial and flooding. One of the most important of these species is salt meadow cord grass. In the absence of flooding and where stability has prevailed for some time, shrub-thickets, woodlands, and even forests can develop in the flats. Finally, on the backside of the island is the shore of the lagoon

Figure 3. Hypothetical Cross—Section of a Barrier Island *



* Dimensions and features vary from island to island.

** A semi-stable dune or dune ridge is constant in terms of position on the shoreline, but functions as part of the sand-sharing system.

A stable dune or dune ridge is a dune which has reached its peak elevation and is covered with woodland vegetation.

Source: Clement, C. D., 1971, "Recreation on the Georgia Coast: An Ecological Approach," Georgia Business: Vol. 30, no. 11, p. 1-24. Adapted by J. R. Richardson.

(or bay, estuary, or sound). Here, the intertidal zone supports the *salt marsh*, a very productive ecosystem that ranges from the highest reaches of the spring tide down to mean sea level. The high marsh is periodically flooded from the lagoon, but only on the monthly cycle of the spring tide or during storms. This plant community, like barrier flats, is dominated by salt meadow cord grass. Next is the low marsh, extending downward from the neap tide to approximately mean sea level, and dominated by salt marsh cord grass. It is the most productive part of the barrier island since it is flooded during diurnal tidal cycles. The extremely high levels of productivity of the salt marsh (as high at 2 $kg/m^2/year$ in some locations) is a key to the biotic wealth of the adjacent lagoon, into which the organic detritus and nutrients of the salt marsh drain to become a base of the estuarine food chain. A good deal of the marsh detritus also goes into the organic peat deposits that make up the foundation of the marsh.

The plants that live on the dunes and flats require fresh water, which is normally available to them in two ways. First, the dunes — although dry on the surface — hold sufficient moisture within to support the plants. Second, beneath the dunes there is a lens of fresh water that floats on the salt water that saturates the lower sediments. The upper level of this lens (the water table) is usually quite close to the surface of the barrier flats, within reach of the plant roots. In those low spots where the water table intersects the ground surface, freshwater ponds or marshes occur. All of this fresh water on the island orginates in rain or snow that falls directly on the island; there is no inflow from other sources.[3] Fresh water can therefore be quite scarce on a barrier island, limited to the lens between the ground surface and salt water.

It should be noted that barrier islands similar to those off the coast of Mississippi may differ considerably from the preceding generalized description. These islands have five major divisions: (1) outer beach with broad berm, (2) a belt of dunes, (3) an inner flat or marsh, (4) a second belt of smaller dunes, and (5) an inner beach with a narrow berm. Usually the dune belt includes a series of low ridges (1.5-6.1 m) which are difficult to distinguish from beach ridges.

[3]In some coastal situations mainland aquifers sloping outwards into the ocean bed extend under the barrier islands. This water is sometimes available by sinking deep wells from the island, going down through the sand, salt water zone, and any intervening strata. The water in such an aquifer orignally fell over the mainland and percolated downward to its subocean bottom location.

The Barrier Role of Barrier Islands

The barrier island is not merely a structure unto itself, but is an integral part of an island-bay system, and is important to our coastal development and saltwater activities. Since the lagoon or bay would not exist without the island, it is important to this system.

The barrier island beach is a high-energy landform, exposed to the full impact of wind and storm waves. As the waves run up the foreshore and as those that infrequently overwash the dunes spread out onto the barrier flats beyond, tremendous amounts of energy are absorbed by the island and thus dissipated. By the time such an overwash flood passes over the beach, dunes, and flats, its has usually become a thin sheet of water flowing gently into the lagoon. As a result, the lagoon is a low-energy, protected environment of tidal wetlands, marshes, and/or open water. Here, fresh water flowing from mainland streams mixes with sea water flowing over and around the barrier island, creating a special and uniquely rich environment for plants and animals.

Nutrients are continually washed into the bay from the streams, and are regenerated in the intertidal marshes of both barrier island and mainland. Diurnally the flood and ebb tides stir up the nutrients and import additional nutrients and organisms from the sea. It is an extremely fertile environment, supporting a highly productive food chain. A large number of species of shellfish and finfish spawn in these bays, which then serve as nursery grounds; many of them later migrate to the ocean. Another group of species that uses these waters and marshes is birds. Of special interest are the numerous migratory waterfowl that find shelter, rest, and feeding during their spring and fall migrations. Many lagoons, especially those along the Southeast and Gulf Coasts, also serve as wintering places for the birds.

The crucial protection afforded by the barrier island also extends to the mainland shore. The impact of storm waves and hurricane surges on the shore is greatly reduced by the barrier effect of the island. Many harbors and coastal communities along low-lying sections of the Gulf and Southeast Coasts owe their permanence to just such protection.

Given this relationship, it is essential to recognize the importance of the barrier island to the continued existence and well-being of the lagoon. It follows that what we do on or to the islands will have a direct effect on the sheltered area behind.

Barrier Island Dynamics

There is a world of difference between the barrier islands and most other landscapes in terms of geologic and geographic stability. The Grand Canyon is still being eroded by the Colorado River, yet it looks about the same today as it did 100 years ago. The Sierra Nevada is still rising, but the rise is noticeable only by careful measurement. But the barrier islands are dynamic, unstable, evolving landforms. Moreover, the change that occurs is continual, is readily apparent on a seasonal basis, sometimes occurs with suddenness and violence, and affects many of man's activities.

Along the Atlantic Coast, for example, the periodic passage of cyclonic storms (northeasters) makes winter a stormier season than summer. During this stormy period the barrier island beaches are under much greater stress from the energy contained in waves. The waves move large quantities of sand from the beach to the offshore bar, leaving

a narrow beach. During the calmer, low energy seas of summer, the beach is broadened as the waves move sand from the offshore bar onto the beach. The effects are apparent and sometimes startling. A beach may, on a seasonal basis, be halved in size and then doubled to its previous size.

More dramatic, and essential to an understanding of barrier island instability, is the process in which the entire island migrates toward the land. Many people call this "erosion," but it is more accurately termed "retreat" since the island moves as a complete ecological unit. The ultimate driving force in this landward retreat of the island (and the simultaneous retreat of the mainland shore itself) is the slowly rising sea level, amounting to approximately one foot per century along the Atlantic Coast. Another driving force is the storms, essentially hurricanes and northeasters, that affect the coastal zone. There are three processes by which the rising sea and storms push back the islands: inlet dynamics, overwash, and windblown sand (aeolian transport).

An *inlet* is a sea level channel across an island. Once cut by storm action, it tends to migrate down the length of the island, and often closes by siltation or shoaling. When an inlet is open, flood tide currents and the littoral drift (see below) tend to move sand from the beach zone through the inlet to the bay-side, where the sand settles in the calm water and forms extensive shoals. These shoals, called the flood tide delta, form the basement for the creation of new salt marshes, and eventually dry land, when the inlet moves on or closes. Inlets are the major barrier island corridors through which sand is transported landward in response to the tidal currents. rising sea, and storm surges.

The second process by which sand is transported across the island is *overwash*. This occurs when storm surges rise up over the beach and dunes, carrying quantities of sand across barrier flats and into the bay. The third process is *wind transport*. This is most effective when sand is exposed to strong or persistent winds, and where anchoring vegetation is sparse.

In regions where winds are predominantly offshore, wind transport acts counter to dune overwash processes. When on-shore winds prevail, all of these processes, working in concert, pick up sand from the ocean side of the island, move it across the island, and deposit it in the bay. The result is a vir-

tual "rollover" of the island that moves it landward. This rollover is seen in the layers of peat, once formed under the bayside salt marsh, that are commonly found under the interior barrier flats and even the dune zones. On a few islands, there are remnant forests in the form of low stumps. These once grew on the bayside of the island and now protrude from the ocean waves at low tide. While the stumps remained in place, the entire island literally passed over them. This process is more descriptive of the processes that affect and shape islands along the Atlantic coast than of those occurring in the Gulf of Mexico.

It is important to remember that overwash and inlet formation—the most effective processes in barrier island migration—are responses to the rising sea level. It is equally important to note that all evidence suggests that the present trend of relative sea level rise will continue and possibly increase.

One additional element of sand transport, *littoral drift,* is not related to sea level change. This movement of sand along the beach (i.e., lengthwise down the island) is accomplished by littoral currents created by waves breaking on the beach. As waves approach the beach from almost any direction but straight on, they tend to break and then wash back to the sea in an angular fashion. The net result of this angular pushing and washing of countless grains of sand is a migration of sand down the beach in the direction of the breaking waves. This littoral drift, often called a river of sand, does in a lengthwise sense what the above described processes do in a transverse sense: it takes sand from one end of an island, slowly moves it down the beach, and deposits it at the opposite end, accreting new land there. In many cases, the littoral drift does not end with deposition on the island's tail, but continues around an inlet to be deposited on the next downdrift island. The littoral drift is a continuous, natural process that occurs as long as waves break on a beach.

Although it is true that the barrier islands are dynamic, and without regard to what it augurs for human habitation and use of the islands, it is vital to recognize that it is this same dynamic nature that makes the barrier island stable in the ecologic and geologic sense. The entire system is flexible enough to adapt to and absorb great energy stress. The barrier islands as we know them have undoubtedly moved a considerable distance since their formation, and represent the forces that have dominated the coast for hundreds of years. It is clear that the islands are still evolving and moving in response to the forces of ocean and storm, and it is unlikely that any major changes will occur in the patterns we now see unless the sea level begins to fall—in which case entirely new conditions would prevail.

Conclusion

In nearly all cases, the natural functioning of the barrier island and its associated bays and estuaries have evolved together in equilibrium with the dynamic nature of the oceanic environment. But, ironically, as will be discussed in the following chapter, these dynamic, storm-dependent systems of sand and water have not evolved the capacity to absorb human intervention. They are very susceptible to human disturbance, and can be thrown completely out of balance by human activity in excess of the island's ability to absorb it.

Chapter 3

Impact of Development on the Barrier Island

The barrier island results from and exists in an environment of extreme energy stress. Its location, topography, vegetation, animal life, and relationships with nearby land and water bodies are either determined or modified by that ever-present stress. Waves, wind, tidal action, ocean flooding, incessant erosion, and deposition—these natural forces shape and regulate the barrier island system, maintaining it in a constant state of flux.

This singular relationship between land, water, and energy, and the resulting dynamic balance poses a question that is basic to our success or failure on the islands: how does human habitation, development, and use of the barrier islands affect the island itself?

The following describes intended and unintended impacts on the barrier islands resulting from man's activities. The physical and environmental changes that result from these activities are interwoven and complex. Recognizing this, the following is simply an attempt to clarify the complex relationships between man and the islands, and necessarily results in somewhat artificial divisions.

Intended Physical Changes

People who visit a barrier island only briefly, as for recreational enjoyment of the beach, do not require much beyond what the island itself offers and a means of access to it. Unless they are careless, their brief stay leaves the island unchanged. But most human activities are of a more permanent nature and require that alterations be made in the land. Wherever we locate our cities, construct highways or dams, or cultivate the land, we see conscious, purposeful change.

Creating building sites is one such activity that has had great impact on the barrier islands. The physical picture drawn in Chapter 2 makes it clear that large parts of most islands are inadequate for development or human habitation. Dune ridges and dune fields are not only unstable, but they preclude an essential ingredient of oceanfront lots—a view of the ocean. Interior lowlands and wetlands are difficult to build on, are inappropriate for septic tanks, and are subject to frequent flooding. And the bayside marshes are more water than land, totally unsuited to any construction.

To alter these features by way of improving them for building purposes is to destroy them and their natural functions. The dunes are quickly and easily

bulldozed, providing level sites and opening up broad vistas of the sea. Low sites are diked, drained, and raised by filling, eliminating the wetland communities of plants and animals. The bay side of the island usually presents special problems as well as special opportunities for the developer. Not only is the marshy edge of the land unusable for building sites, but the shallow, often shoal-choked bay or channel discourages the use of pleasure craft. These deficiencies can be turned to advantage by simply dredging the bay and filling the marsh. By constructing seawalls and selectively dredging and filling

among them, fingers of solid land are created that are separated by fingers of navigable water. What was marsh becomes real estate, and a large percentage of the new lots front on the water. Groins and jetties are built to collect sand to enhance certain beachfront properties. Generally, they are effective structures for that intended purpose but the unintended effect on adjacent down-drift properties is an unwelcome starvation of the beach. These changes are more or less immediate, and result in the partial or total destruction of the features that make barrier islands ecologically and geologically different.

Unintended Environmental Changes

When a dune is bulldozed or a marsh is buried under fill material, it is a purposeful act, carried out with the specific intention of altering the island to accommodate a particular activity or development. But such activities also often carry with them a number of destructive consequences that are *not* intended, that are merely unplanned and often unforeseen concomitants to the unwise use of a fragile landform.

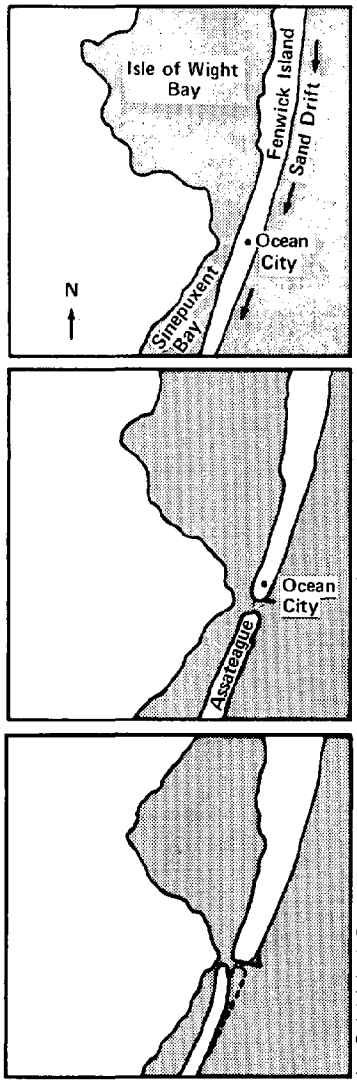
The main dune ridge, for example, is normally located parallel to and just behind the ocean beach of a barrier island. Because the beach is often the most popular part of the island, there is a large volume of traffic across the dunes. These dunes, so important to the rest of the island and the bay beyond for the storm and wave protection they provide, are usually stabilized by species of grass well adapted to their harsh environment. Although the grasses are hardy enough to survive washovers and storm winds, they cannot survive the impact of vehicle wheels or repeated trampling by human feet. With the destruction of the grasses and their anchoring roots, it takes the winds little time to erode gaps in the dunes, and ultimately to remove them altogether.

Another place where vehicles have a devastating impact is the wetland portions of the islands. In addition to the physical damage to plants, wheel ruts remain in the soft mucky soil. By the mere collection of rainwater, the ruts become small reservoirs of fresh water in a brackish—or salt water environment, or vice versa. This results in the demise of the marine or freshwater plants and animals. Vehicles can also make lasting impressions in subsurface peat, opening the area to erosion, and serving as channels for rising and falling tides. A good example of a planned action with unplanned consequences occurred on Sanibel Island, off the southwest coast of Florida. A 70-acre tract of valuable and beautiful tidal mangrove forest was seriously damaged, not by actions aimed at it, but rather by the dredging and filling of an adjacent tract. Freshwater flooding of the forest was caused by the work, killing many of the trees. Culverts under a road that separated the two tracts were unable to relieve the condition. Additional culvert construction and the replanting of 40 acres is not likely to save the mangroves, since the forest—so dependent on a critically balanced flow of fresh and salt water—is still deprived of its proper tidal circulation.

Another example of purposeful action leading to unforeseen and unintended geologic change is that of Assateague Island. Until 1933, a long barrier spit extended south from Ocean City, Maryland, separated from the mainland by Sinepuxent Bay (Fig. 4). In that year a violent storm struck the area and created an inlet through the spit just south of Ocean City, separating Assateague from the mainland. Because of the convenience of the new entrance to the bay, it was decided that the inlet should be preserved by the construction of jetties out into the ocean. By trapping the southward flow of sand along the beach, the jetties prevented that sand from entering the inlet and shoaling it. They also prevented the sand from reaching Assateague Island to the south, and thus accelerated its erosion by wave action. The result is that in 45 years the island has eroded back its full width, and is close to pinching off the bay and attaching itself to the mainland.

Some ecosystems or landforms are more easily upset, while others can more readily absorb the impact of human development. Barrier islands are among the former. In this case, even if the damage is unintentional, it is nonetheless real. A destroyed dune provides no protection to the land and water behind it, regardless of the method by which it was destroyed.

Figure 4. Creation and Subsequent Erosion of Assateague Island *



Conditions Prior to 1933

Erosion-Deposition Proceeds Coastwise From North to South

Storm-Created Inlet Cuts the Spit, Creates Assateague Island

Jetties Installed to Maintain the New Inlet

Resultant Accretion of Sand on Ocean City Side of Inlet

Continued Erosion Without Sand Replacement Causes Pronounced Retreat Of North End of Assateague

*Maps Are Approximation Only

Water

Water usually occurs in three forms on the islands—as salt water on the ocean side, fresh water on the island itself, and brackish water on the marsh or bay side. Each is important to the ecology and geology of the island, and each is very important to man and to man's activities on the island.

Of the three, ocean water is the most plentiful, the most frequently replaced, and the least affected by man's activities on the island. As we know, however, these waters—and the barrier islands they wash—are easily polluted by activities both on the mainland and at sea. Sewer outfalls (from the mainland or island), ocean dumping of garbage, petroleum drilling and handling, and maritime accidents all have destructive effects on the water quality, and may influence our use of the surf zone and beach.

The fresh water naturally occurring on an island comes from local precipitation falling directly on the island. None of the water comes from upstream watersheds because there is no upstream. Although it is a self-replenishing resource, the rate of replenishment is governed by the island's limited precipitation and catchment area.[4] If an island community obtains its water by wells, an imbalance between demand and replenishment can cause an overdraft on the limited groundwater supply. It is important to recall that this groundwater, at its subterranean margins, is in contact with and holds back the oceanic salt water. Overdrafting this water not only means that sooner or later the islanders'

[4]For deep aquifers, see footnote p. 22, Chapter 2.

supply of fresh water will be depleted or exhausted, but also that the intrusion of subterranean salt water, as the fresh water body contracts, will bring unusable brackish water into the wells. Barring the availability of a deep aquifer, the only alternative for a permanent community is to pipe water over from the mainland. If this is done on a barrier spit with a land connection to the mainland, little harm may be done. However, to reach a barrier island, the pipe must be laid across the easily disturbed bay or marsh, and substantial ecological disturbance may result.

As indicated by the perennially or periodically wet lowlands of many islands, the upper surface of the fresh groundwater is in many places at or near the ground surface. This condition, combined with the sandy soil, makes it very difficult to install septic systems and drain fields. Not only is the septic drainage impeded by the saturated condition of the soil, there is always the possibility of the waste discharge mixing with the fresh water that is later used for domestic purposes, or of polluting the estuary.

It is clear that the water regime of many barrier islands imposes severe limitations on urban, residential, or commercial development of modest size or larger. Potable water has to be imported from the mainland and sewage must be treated on site. To the extent that the residents pump from the groundwater but export their treated (or untreated) sewage via discharge pipes at sea, the groundwater is depleted. Given this particular hydrology, barrier island development will be costly: either the island community, or the Federal, State, or local government pays the economic cost of water pipes, pumping stations, sewage collection, and treating plants, or we all pay the environmental costs of depleted groundwater, saltwater incursion, and pollution by effluents.

The third water resource—the brackish bay or marsh on the landward margin of the islands—is extremely valuable, not only for its contribution to the production of vast quantities of commercial seafood, but also for its recreational importance to island and mainland residents. These are protected waters, the location most sought-after for the construction of marinas and waterfront subdivisions. Ironically, the waters are protected by the very dunes that are often damaged or destroyed by the development that includes the marinas or subdivisions. Construction of these facilities as well as their later use and occupation considerably disturbs all elements of these fragile water bodies. The construction usually requires extensive dredging, which not only destroys the bay bottom and surface and floating vegetation, but also churns up large amounts of sediments, making the water turbid. The churned sediments often contain pesticides and other contaminants that had previously settled. Even if this turbid condition lasts only while the dredging takes place, it can still disrupt the waters at a considerable distance from the activity. Frequently, where the dredged spoil is deposited to form dry land, vegetation is destroyed.[5]

After construction, when the remaining bay bottom, water, and vegetation have adjusted to the new conditions, there are still disturbances that will affect the area. The operation of marinas and the coming and going of pleasure boats cause noise and vibration in the water. Frequently there are spills and leaks of fuel and oil, and periodic maintenance dredging of approach channels and anchorages tends to keep the water perturbed.

Land activities also cause contamination. For example, golf courses or other developments associated with marinas or waterfront subdivisions, as well as house lawns, may leak pesticide- and fertilizer-contaminated runoff into the water. In addition, fresh water from rain or snow, which would have percolated into the subsoil, now runs off on newly paved surfaces into the marshes and is lost to the freshwater lens.

It should be remembered that these salt marsh and bay-estuarine ecosystems are finely-tuned associations of fresh water, salt water, transported

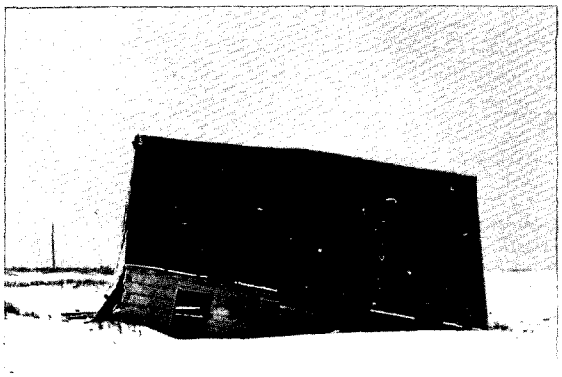
[5]However, it is important to note that the U.S. Corps of Army Engineers, through its Dredged Material Research Program, has sponsored considerable research on revegetation of spoil disposal sites.

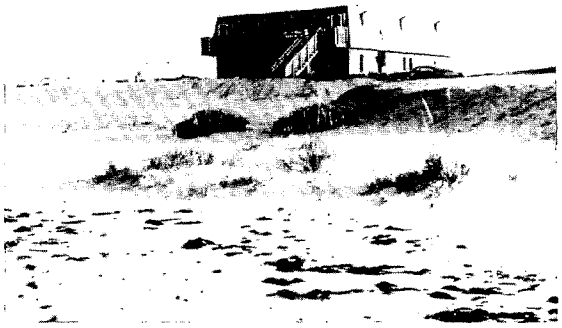
nutrients, native vegetation, and many other factors. Their plants and animals are conditioned to, and depend upon, the natural ambient conditions, including the flux of salinity, the seasonal changes of temperature or dissolved oxygen, and, especially, the protection offered by the barrier island from major storm winds and tides. These water bodies are fragile in the sense that it does not require a very serious intrusion by humans to upset the existing dynamic balance. The intrusions described here, which are common on many barrier islands, *are* serious.

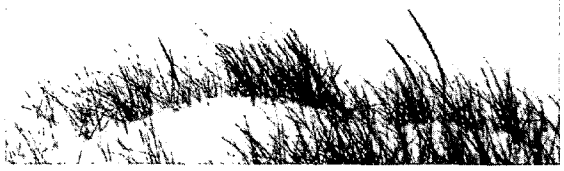
Plant and Animal Life

One of the fascinations of the barrier island—as of other environmentally harsh places—is the manner in which plant and animal forms have evolved the means not merely to cope with their stressful conditions, but to thrive in them. Yet, although they are adapted to harsh conditions, human beings introduce a new set of conditions with which these hardy species cannot cope. Two examples suffice to illustrate this problem.

The loggerhead sea turtle spends its entire life at sea, with one exception. Once a year, the females come to certain barrier islands to lay their eggs. On a given night, in an astoundingly ungainly performance, this large sea-going animal lumbers far up on the beach, laboriously digs a deep hole in the sand with her flippers, deposits a clutch of eggs, covers the nest and erases the signs of its presence, and returns to the sea. The eggs left to incubate in the sand are vulnerable to the predation of raccoons and ghost crabs and to the beach-destroying force of storms. But enough nests remain undisturbed through the gestation period, and enough hatchlings dig their way up to the air and make their way down to the water to have assured the species' survival. Unfortunately, neither the female's remarkable fecundity nor her amazing ability to bury and disguise her nest are sufficient protection against dune-leveling bulldozers, rooting feral pigs, or egg-poaching humans. The loggerhead depends on the barrier beach. It cannot change its ways and lay its eggs in swamps or forests, nor can it conceivably evolve a defense against the new threats that man has created on its nesting beaches. It can only do what it has always done, and we can already see the ultimate







result in the species' dwindling numbers.[6] The only probable salvation for the turtles is for humans to protect the beaches instead of destroying them.

A plant that illustrates the same type of adaptation to the islands' harsh conditions, yet a lack of resistance to the new threats introduced by humans, is the *Spartina patens*, salt meadow cordgrass, that grows on the dunes and sand flats of North Carolina's Outer Banks. The ability to thrive on the inhospitable and blowing sand, exposed to continual salt spray and periodic dessication, would in itself indicate remarkable adaptation by the plant. But the barrier islands of the southeast impose another harsh condition on this *Spartina*; that of overwash. Periodically, storms and high tides either breach or overtop the barrier dunes, and flood the now-exposed section of the island. Immense quantities of sand are deposited by the flood water on the lowlands and marshes behind the dune, burying the grass under several to 20 or 30 inches of sand. Soon, often within a year, the grass pushes up from its buried members and recolonizes the surface. Yet, although *Spartina* is hardy enough to withstand burial, it has no defense against being churned and crushed by four-wheel drive vehicles, nor can its remarkable water-gathering root system cope with a falling water table that results from excessive pumping. This grass, which plays such an important role in holding the sand (and hence the island) in place, adapted as it is to environmental stresses, is unfortunately quite fragile in relation to man's activities.

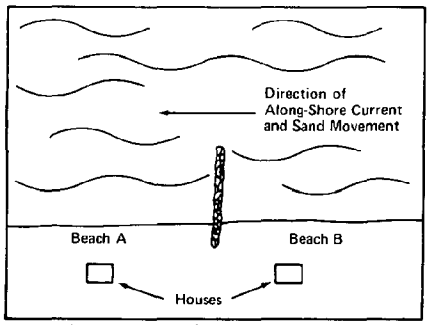
Protecting What's Been Built

There is one final category of impacts resulting from man's habitation and development of the barrier islands that deserves attention because of what it suggests to us about the relationship between man and the barrier island. The problem arises because houses and roads are not designed to migrate with the moving beaches and dunes. The individual parts of the natural system are adapted to the movements and the instability; what we construct on the barrier island generally is not. It follows that, notwithstanding the movement of sand from beach to beach and from island to island and the continual reordering of beaches and dunes and vegetation, erosion does not take on human significance until man builds a structure on the island. Suddenly, a natural condition of the island geology that bothered nobody when the island was uninhabited takes on great significance. We can no longer cope with the normal, dynamic course of events; therefore, we try to control them artifically. The line of beach-front cottages or condominiums becomes a line of defense against the "encroaching sea."

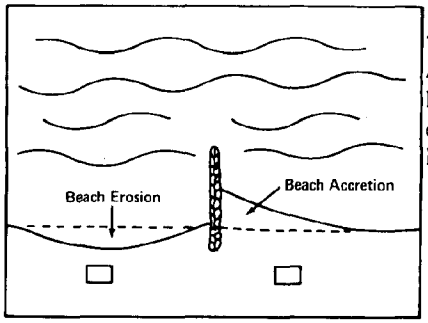
After construction of a beach-front house, the occupants may soon notice that the very beach that made their house so desirable and expensive is eroding away. The occupant has an economic

[6]The loggerhead turtle is on the Federal endangered species list, as well as those of each State from North Carolina to Texas.

Figure 5. Effect of Groin on Shore Line *



A. Groin Newly Constructed to Protect Beach B



B. Trapped Sand Accretes Beach B at Expense of Eroded Beach A

* Adapted From Orrin H. Pilkey, et al, *How to Live With an Island*

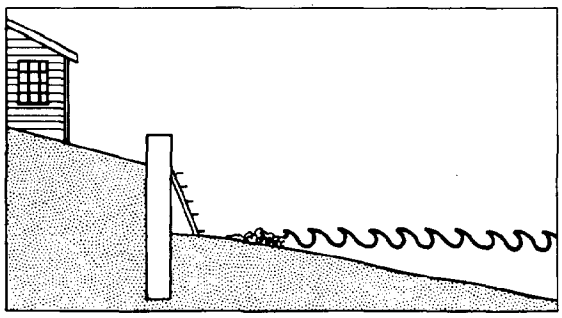
investment and a place chosen for its desirable qualities, both of which are threatened by the continuing erosion.

A common solution to this problem is to construct a groin extending out from the beach into the ocean (Fig. 5A). This structure is intended to trap sand in the littoral drift, thus holding and collecting the sand on a specific portion of the beach. This tactic is successful from the standpoint of the individual whose house is above that beach. But it is a disaster for the downbeach neighbors (Fig. 5B), as illustrated by the Assateague experience (Fig. 4). By building the groin, the house owner has inhibited the longshore transport of the sand, but the wave action that caused it is unchanged. The result is that the downbeach neighbors continue to suffer erosion by waves and its ensuing sand depletion, without the compensating effect of deposition of new sand moving into their beach from upbeach. The new sand that should be "theirs" is trapped on the other side of the neighbor's groin, while "their" beach undergoes accelerated erosion. So they too build a groin, and the problem is compounded (Fig. 7).

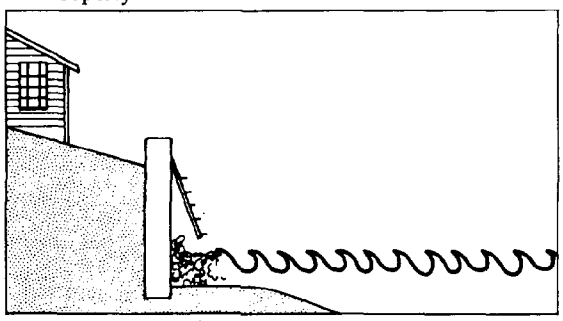
The seawall is another structural approach to arresting beach erosion. On those barrier islands experiencing a relatively rapid inland migration (perhaps aggravated by the groin-trapping of sand upbeach), the hapless homeowner who builds too close to the dunes will find the advancing waves breaking closer and closer to the house. In many cases, this entirely removes what was once a broad beach and undermines the house's supports. The purpose of the seawall, which runs parallel to the beach, is to interpose a physical barrier between the oncoming waves and the property to be protected. In some cases, the wall does halt erosion, at least for a while, But from the standpoint of esthetics and beach recreation—presumably the reasons for which the

house was built so near the water in the first place—it is often a Pyrrhic victory. The wall deflects the force of the oncoming waves into a scouring action that removes the berm and beach (Fig. 6). What remains of the once gently sloping sand beach is often an ugly, flat, unusable terrace exposed to the crashing waves and extending to the very base of the wall. It is also a temporary victory. Unless the seawall is so large as to dwarf both the beach and the waves, as in the case of the enormous seawall at Galveston, the wall itself is soon attacked by the waves and is eventually undermined. A seawall can at best delay the

Figure 6. Effect of Seawall on Beach



A. Seawall Built to Protect Beach Front Property



B. Subsequent Beach Erosion Due to Deflected Wave Energy

erosion, it cannot prevent it.

A third, non-structural means of attempting to impede or prevent the natural processes of beach change is that of beach and dune restoration (or nourishment). Sand dredged from either the bay or ocean bottom is hydraulically deposited on the beach, thus replacing sand that had been removed by erosion. This is neither a simple nor inexpensive operation, as can be seen from the experience of the beach nourishment project at Miami Beach.

What happened to Miami Beach is the United States' best example of what not to do on a barrier island. Most of us are familiar with the travel brochure aerial photo of the beach that shows the endless row of hotels and high and massive buildings that extend from bay to ocean, each with its own groin built out into the ocean (Fig. 7). The photo also shows the waves splashing on the hotel seawalls, and in some cases at the very base of the buildings themselves. In spite of the long succession of groins, what was once a broad, sandy beach spreading 200 to 300 feet in front of the hotels has virtually disappeared.

The U.S. Army Corps of Engineers is currently engaged in a beach erosion and hurricane protection project along nine miles of Miami Beach. The project, initially requested by local interests, planned by the Corps of Engineers, and authorized and funded by Congress, calls for rebuilding the beach over several years' time by pumping 14 million cubic yards of sand onto the beach from the ocean bottom. The current (1978) cost of the project is estimated to be $65 million. The local interest's share of the project is $30 million, based on the percentage of public and private beach frontage involved. Even after such massive sand placement, the Corps recognizes the need for continued nourishment at the rate of 190,000 cubic yards per year in order to maintain that which will have been rebuilt. Because maintenance of the beach is important to this area as an economic and recreational resource, the Corps estimates that the benefits of this project continue to outweigh the costs. However, it should be noted that excessive public and private investment is often required to protect extensive developments on barrier islands.

What happened gradually to Miami Beach often happens suddenly and violently. In October 1977, for example, 50-knot winds from a tropical storm sent 15-foot high waves crashing against Ocean City, Maryland, another heavily developed barrier

island. Large sections of beach were washed away and at least one high-rise building's parking lot and sidewalk were dangerously undermined. The city then made a rather quixotic attempt, with rented bulldozers, to restore the beach by pushing sand back from the ocean.

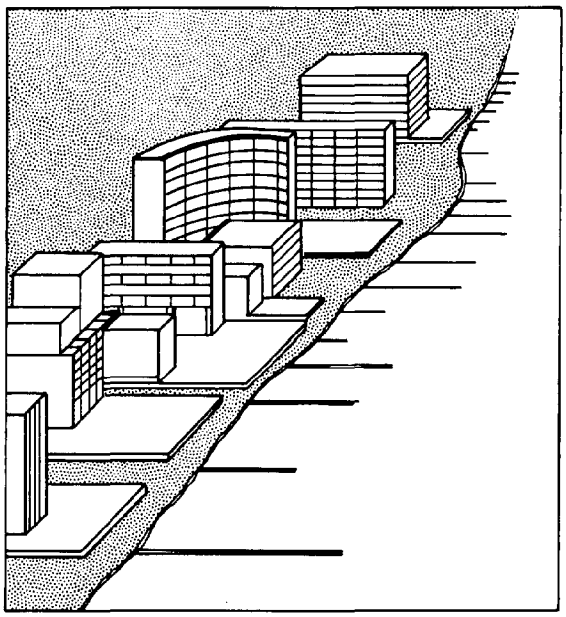
The problem was created when condominiums were allowed to be constructed on top of and in front of the primary dunes, which might naturally have absorbed the impact of storm waves. What was once a quiet area of summer homes and a few resorts has become a battleground between man and nature. That nature is winning is axiomatic; that man has the technological skills to protect what has now become an area of high economic investment is also certain. The cost to adjacent areas, however, is another question. The fact is that substantial effort and many dollars will now be required to protect another substantial investment that perhaps should never have been allowed in the first place.

Ocean City has been placed in a precarious position. On the one hand, it has the huge investment in money and prestige represented by its condominiums and tourist attractions; on the other it faces the insuperable natural processes that were ignored when the condominium construction boom of the 1960's and 70's was under way. As an indication of that boom, the number of dwelling units constructed per year increased from 480 in 1967 to over 4,000 in 1972—a ninefold increase in just five years. The ultimate futility of both its barrier island land use policy and its attempt to halt erosion with bulldozers is apparent from the events of the winter of 1977-78. Although the bulldozers have been working for months to restore the beaches so badly eroded in October, several intervening storms have already removed most of the new sand, and the beaches are substantially the same as they were following the October storm.[7]

There is a serious and portentous double irony in these attempts to stabilize the barrier islands. First, a dune stabilization project, the construction of a seawall or groin, or the nourishment of an eroded beach can provide the embattled residents of the island with a false sense of security and a false image of permanence.

We tend to trust engineers and to have faith in technological solutions. We assume that seawalls and groins and beach restoration projects will protect the areas behind them, as they are intended to do. Not only does this embolden the present residents to stay, but the new "safety" encourages yet more development along the beach, which soon requires additional groins and seawalls. The second point is that expensive, unplanned emergency restoration of an eroding beach, as illustrated by the experience of Ocean City, is at best temporary. The loss of the restored beach is the inevitable result of the same erosion that caused the loss of the original beach, because the same forces are still operating.

Figure 7. Groins and Beach Erosion at Miami Beach



(Facsimile)

[7]Washington Post, April 30, 1978.

"Whether a stable dune line is built with sand fences and beach grass, or by dredges, bulldozers, and beach grass, the results are the same: a wall against the sea. The idea is to get that dune line up as high as possible, and not to allow any messy natural processes such as the wind blowing the sand around, the ocean overtopping dunes, or the beach continuing to retreat. In other words, total artificial control of the coastline is attempted. The trouble is, it doesn't work."[8]

The barrier islands seem to be wrapped in an enigma. They exist in and are the products of an environment of high energy and wide oscillations, yet they are fragile when touched by man's works. Barrier islands have evolved with their environments and are part of them. They have the means for adjusting to the conditions presented by those environments, but their adjustment to the works of man is sometimes detrimental to neighboring islands or to the system as a whole.

Simply stated, the barrier island doesn't take physical alterations lightly, especially in its more fragile zones. With only slight modifications to its dunes, beaches, water table, or marshes, it no longer functions as it used to nor does it have the same capacity to adjust to environmental exigencies. Left alone, however, the island rides out the storm. It goes through cycles of beach buildup and beach erosion, of dune advance and dune retreat, and of inlet formation and inlet closing, and while the entire island moves gradually toward the mainland or along the coast in response to the enormous forces acting upon it, it continues to provide us with outstanding recreational, esthetic, and fish and wildlife values. These benefits are free to society.

In view of all this, we must consider a question that has wide ranging policy, economic, and safety implications: is urban, residential, or commercial development a prudent use of barrier islands?

[8]Paul Godfrey and Melinda Godfrey, *Barrier Island Ecology of Cape Lookout National Seashore and Vicinity*, North Carolina, (Washington, D.C.: National Park Service, 1976), p. 3.

Chapter 4

Why Should the Barrier Island Ecosystems Be Protected?

The foregoing descriptions of those qualities and characteristics that make the islands different and of the often destructive effects that result from developing the islands lead us to the questions: why should man-caused changes and impacts on the barrier island ecosystems be prevented? Put another way, why are the barrier islands important enough to justify different treatment from other land areas?

The answer to these questions provides us with what could be termed the national interest in the barrier islands. This national interest has two closely related aspects. First, the barrier islands offer superlative resources and values that should be preserved for the common benefit. These resources and values, such as numerous land and water animal species and their habitats, the physical protection afforded by the barrier dunes, and outstanding places for outdoor recreation are usually destroyed when the islands are altered and their natural processes disrupted. People from all over the nation travel great distances to enjoy the wildlife and recreation of the islands, thin slivers of land on the edge of the continent.

Second, the unwise development of the barrier islands, with its resultant ecological-geologic disruption, provides the possibility of serious public danger and cost. Development and/or protection of some islands may either reduce or increase pressures on other islands in other states. Similarly, the ecosystem and its economic benefits extend across state lines. In instances of conflict, only the national government may be able to mediate disputes between States. It has already been accepted as policy that the problems and costs that ensue from the unwise use of specific classes of dangerous or geographically sensitive areas, such as floodplains and wetlands, are of national, not merely local, interest because people all over are affected. It follows that the Federal role is to *prevent* (or at least not contribute to) these problems and costs.

"Protection" of the Barrier Islands

President Carter, in his 1977 Environmental Message, called for a plan for "protecting the islands." There are two ways to define "protection" as it applies to the islands; it is important to know the distinction and to understand which one is intended by this report.

This islands' dynamic responses and relationships do not stop when we build on the islands. The beach continues to recede in the direction in which it has always receded, now toward the rows of recently constructed beach homes. The groin built to stop the erosive drift of sand from the beach doesn't stop the process, but merely shifts the unwanted results to the neighboring beach that should have received the trapped sand. Inlets continue to be cut by storm waves, to migrate down the island, and to shoal up, regardless of what roads, shopping centers, or condominiums have been built in their paths. Hurricane and storm waves overwash the dunes, flood the island, and deposit large quantities of sand on the

lowland and in the bay, destroying, damaging, and injuring nonstorm-adapted features that lie in their path. From the vantage point of the cottage or motel owners who see their property threatened by water or sand, these are examples of "nature on the rampage." The response generally is to build the dunes higher, construct seawalls and groins. In other words, as in the case of Ocean City and Miami Beach, the idea is to employ engineering works to correct the problem. Furthermore, the feeling is that the Federal government ought to do it, "they owe us the protection." The first definition of "protection" is that the Federal government should prevent natural, regular, and expected events; erect barriers that will stop the unwanted erosion and overwash and thereby protect our buildings. In addition, it should help pick up the pieces, using disaster relief, and put them back together with Federal assistance when the engineering projects do not achieve the expected results. In essence, this method transfers general tax dollars from programs beneficial to many to projects beneficial to a few.

The second definition of "protection," that advocated by the President, addresses the problem from the standpoint of the island itself. It suggests that there is no "problem" with storms or waves or erosion until man builds on the island. Rather than attempts to control nature and to defend houses, this view would prevent putting houses in fragile and dangerous spots in the first place. This concept was well expressed by Orrin Pilkey, Jr., et al. in a book entitled *How to Live With an Island:*

> *It is important that we understand (how an island works) and that dwellers not get in the way of the island as it naturally evolves. Once you understand an island, you can see that it doesn't need saving, except perhaps from man. The islands are in no danger from nature. They will respond in a perfectly predictable way to whatever nature throws at them.*[9]

In addition to the idea of protecting man and his structures, this second definition includes the protection of the functional integrity of the islands' valuable ecologic, fish and wildlife, storm barrier, and recreational resources from the disturbances and destruction that accompany unwise development. This definition of "protection," rather than trying to protect man and his structures by preventing natural phenomena, attempts to prevent the damage by placing man's communities in safer locations and by preventing destructive tinkering with the islands' valuable resources. This report considers both aspects of the protection question.

Hazards of Permanent Occupancy

Hazards to permanent human occupation exist in many regions and settings. The west coast is subject to earthquakes, the midwest to tornadoes, and northern New York to enormous snowfalls. But the hurricane, which is one of the greatest hazards to inhabitants of a barrier island, differs from other hazards in nature and degree. It is the second most destructive, violent, and costly natural event that occurs on an annual cycle. On the average, two hurricanes per year strike the U.S. coasts and cause more combined damage than any other type of natural disaster.[10]

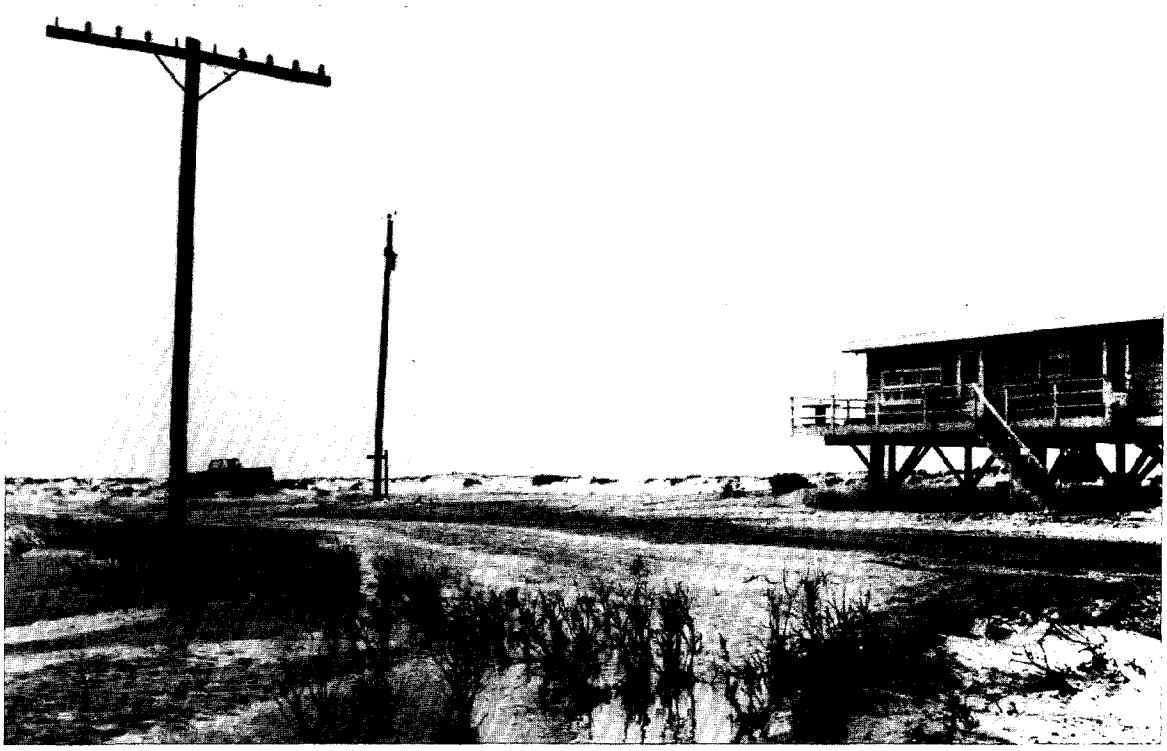
These storms begin in the southern North Atlantic or Caribbean, gain energy in the warm subtropical waters, and roar northward toward the North American coasts. Their paths and landfalls are unpredictable, and no spot on the Gulf or Eastern Coast is immune. Hurricanes have struck the shore all the way from the Texas-Mexico border to Maine. These storms derive their energy from the warm seas, and dissipate it as they move inland. Their powerful winds are generally in their most destructive state when they blow on land, precisely at the location of the barrier islands. Much of the destructive power is transmitted by the ocean water itself in the form of wind-driven waves and hurricane surges, a rapidly moving plateau of water raised above the surrounding sea level by the extremely low atmospheric pressure of the hurricane's eye. Wind, waves, and surges strike hardest at coastal locations, and with especially disastrous results for settlements on the usually low-lying barrier islands.

In addition to these destructive forces, natural inlets or man-made channels of the islands often receive additional impact: storm waves formed in deep water create a particularly powerful water ram as they move up the shallow channels. Few structures can withstand such force.

We cannot forecast with much certainty when the next hurricane will occur, nor where it will strike the

[9]Orrin H. Pilkey, Jr., Orrin H. Pilkey, Sr., and Robb Turner, *How to Live With an Island* (Raleigh, N.C.: North Carolina Department of Natural and Economic Resources, 1975), p. 9.

[10]Jerry L. Machemehl, in *Coastal Zone '78*, Vol. III, (New York: American Society of Civil Engineers, 1978), pp. 1453-1468.



coast. But, as Dr. Pilkey remarks, "we know there will always be a next hurricane and we know what the next hurricane will do."[11] With the exception of the Virginia-Maryland-Delaware-New Jersey shore, which has been relatively free from full-force hurricanes,[12] all sections of the Gulf and East Coasts have been repeatedly subject to hurricanes and sub-hurricane tropical storms. A few sections of the coast are worth mentioning in this regard:

Portions of the Texas Coast are disasters waiting to happen. According to recent research, the catastrophe potential due to hurricanes striking coastal areas has increased dramatically. The growing amount of coastal development, the natural hazards of subsidence and erosion, the disregard for natural protective elements on the coast, plus poor locational decisions and construction practices, are all causes of this increased catastrophe potential.[13]

To understand what is meant by "increased catastrophe potential," one need merely observe recent activity along that coast. Hurricane Carla (1961) eroded some shorelines as much as 800 feet, yet along that coast numerous subdivisions and trailer courts have, since 1961, been built within 300 or 400 feet of the beach. Hurricane Beulah (1967), among others, cut a large washover channel across South Padre Island, yet—despite the fact that subsequent storms tend to reopen old washover channels—a major development has since been built on that very site. Twenty-seven hurricanes struck Texas between 1900 and 1972.

Dr. Robert Simpson of the National Hurricane Center in Miami says Florida is building toward a major hurricane disaster which could reach the proportions of an unbelievable catastrophe. He states that the mass evacuations which have saved so many lives in past hurricanes would be virtually impossible under existing conditions. The increased population densities and inadequate evacuation arteries would create such staggering traffic jams that people would just get in each other's way, and accidents due to bad driving conditions and flooded highways would block traffic and jeopardize everybody's chance of escape.[14]

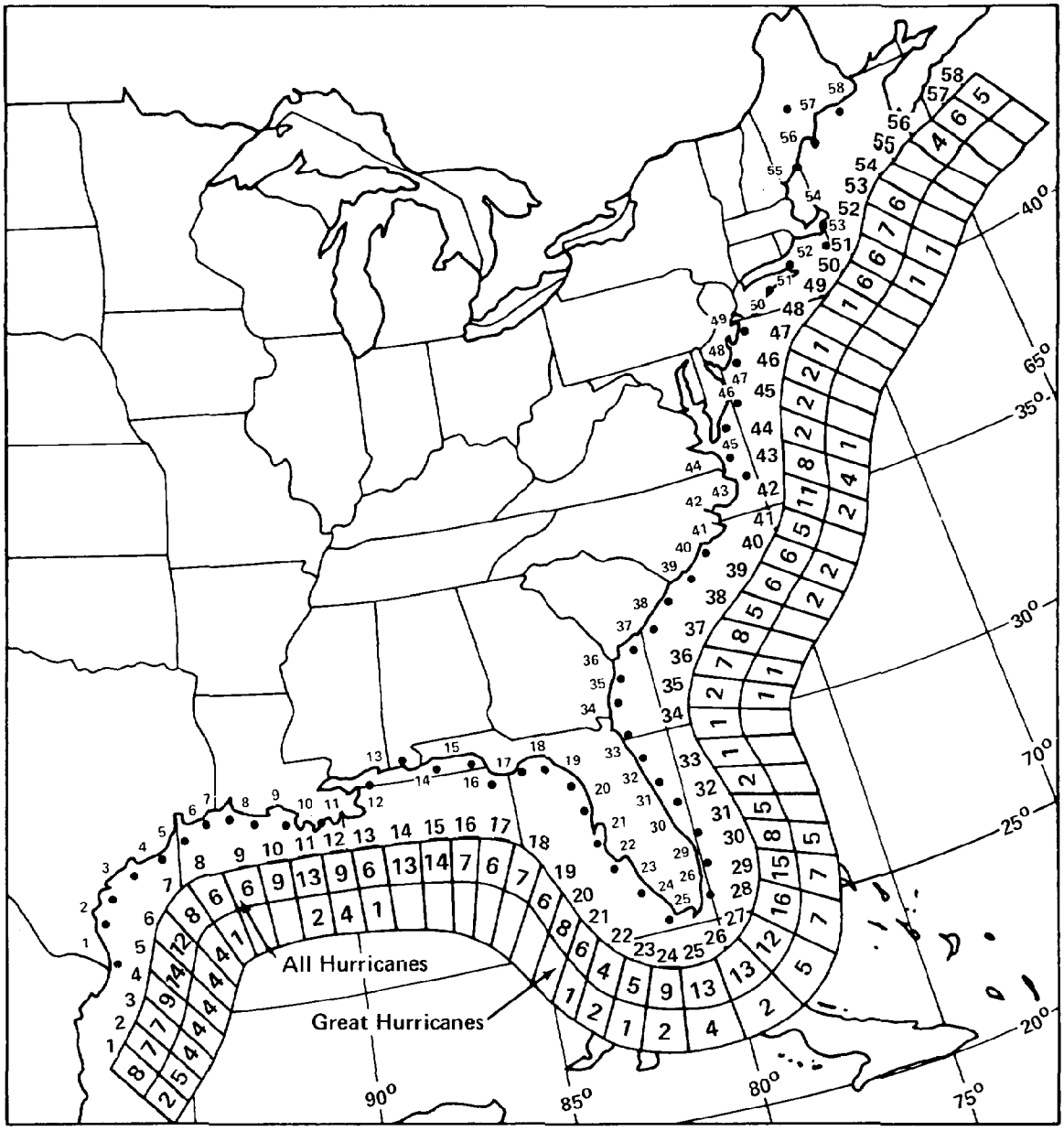
[11]Pilkey, et al., *How to Live with an Island*, p. 1.

[12]But not from "spent" hurricanes, reduced to a tropical storm, which often move north parallel to the coast after having struck the coast farther south. Nor are they free of northeasters, violent non-tropical storms which hit this section of the coast with notable destruction.

[13]*Pictorial Atlas of Texas Coastal Hazards*, Texas Coastal and Marine Council, 1977, p.2.

[14]Enfo Newsletter, Environmental Information Center of the Florida Conservation Foundation, Inc., July 1973, p. 9.

Figure 8. Hurricane Probability on the East and Gulf Coasts



The probability (expressed in percent) that a hurricane (winds exceeding 73 MPH; shown on inside row) or a great hurricane (winds exceeding 125 MPH; shown in outside row) will occur in any one year in a 50 mile segment of the coastline.

For example, segment 22 in southwest Florida: In a given year, there is a 4% likelihood that a hurricane will strike within that 50 mile segment, and a 2% likelihood of a great hurricane.

(After Simpson and Lawrence, 1971)

Florida, especially its southeastern coast, is probably the most hurricane-prone area of the country (Fig. 8). Forty-three hurricanes struck Florida between 1900 and 1960. During that period, the longest interval *without* one was four years. Between 1900 and 1975, the low-lying coastal areas of the State suffered approximately $1.5 billion of damage. Yet it has been nearly two decades since the last major hurricane struck southern Florida—a period which has seen the rapid development of coastal areas[15]. It is estimated that today, due to the extensive development of recent years on the low mainland coast and the barrier islands, the damage that could be inflicted by one major hurricane would approach the 75 year total.[16] In Florida, as in Texas, a large percentage of the coast is paralleled by low barrier islands.

Bogue Banks is a North Carolina barrier island located to the west of Cape Lookout, and has a long history of hurricane damage. During one seven-year period (1953 to 1960), Bogue Banks was either hit or seriously affected by eight hurricanes. In 1955, Connie, Diane, and Ione hit the Banks within five weeks. Since 1960, when Donna caused $1,600,000 damage to the island, it has not been hit. This is a hurricane-free period apparently without precedent.[17] It is ironic, potentially tragic, and also one of the reasons for the current concern for more enlightened land use on the barrier islands, that what amounts to a major construction boom has taken place on Bogue Banks during the same period, as if this unusual interregnum were a permanent change of climate that has eliminated hurricanes from the island's future.

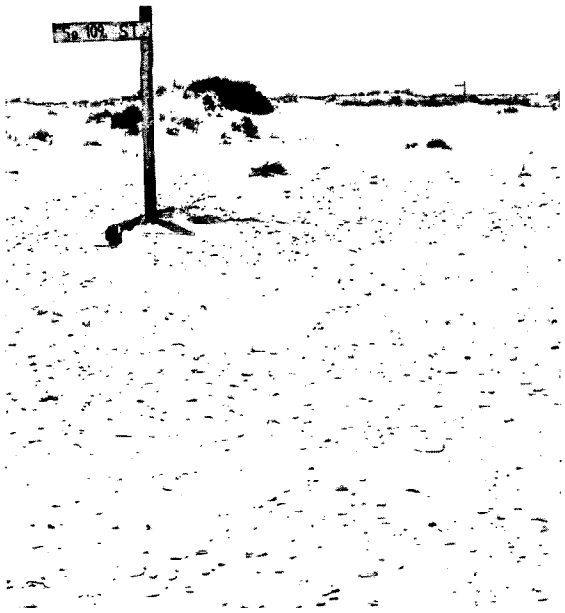
As awesome as they are on the mainland, hurricanes have an even greater effect on the barrier island because of the physical character of the islands and human alteration of them. On many islands, the only physical defense that residences and other structures have against storm waves, tides, and surges, is the barrier dune system. And yet these very dunes have often been leveled purposely to provide building sites, or have been leveled through careless treatment, as with dune buggies. Borrow pits, which are dredged or excavated for building material, and artificial boat channels and marinas provide ready-made paths of least resistance for the storms, encouraging the formation of new inlets and washover channels. On many islands, recent construction has occurred in filled low areas and previous washover channels, areas where future flooding is certain to recur under hurricane or northeaster conditions. Construction has also occurred on top of the dunes, the most open and exposed place on a barrier island. Another feature of recent barrier island development is the proliferation of mobile homes. When placed in exposed locations, their structural fragility and tenuous fastening to the ground make these structures almost defenseless against the flooding, wind, and violent changes in air pressure associated with hurricanes.

Notwithstanding the severity of these problems, the single problem that most worries public safety officials is that of escape. Everything about the hurricane emergency tends to thwart the safe egress of the population from a barrier island. On many barrier islands the roads are extremely low, often only eight to 10 feet above mean sea level. Even where people inhabit higher ground, the escape road often must traverse the low ground. It is obvious that these low-lying roads will be flooded. Even if the flooding is in one spot, that is sufficient to trap all those who have

[15]Hurricane David did come ashore at about the mid-point of the Florida coast in August 1979.

[16]The Florida Coastal Management Program Workshop Draft, Department of Environmental Regulation, 1977, pp. 16-17.

[17]Pilkey, et al., *How to Live With an Island*, p. 6.



not yet passed. In addition to flooding, these roads may be destroyed outright, either by the force of the floodwaters smashing against them or from undermining of the sand. Even if the roads remain secure, the fleeing vehicles from all sections of an island must converge on one or two bridges or causeways, creating a potentially lethal bottleneck.

Sanibel Island, Florida was swept by seven to eleven foot tides during a hurricane in 1921, when it had relatively few inhabitants. Now, after a period of intense development, the population is approximately 13,000. Sanibel is connected to the mainland by one bridge and causeway. Assuming that the island residents and visitors could negotiate the dangers between their lodgings and the bridge, their chances of crossing to the mainland are still slim. A portion of the road to the mainland is only four feet above mean sea level.

Key Biscayne, Florida is a highly-developed residential community on low ground just south of Miami Beach. It is connected to the mainland at Coral Gables by the two-mile long Rickenbacker Causeway over Biscayne Bay. The causeway is parted in the center by a drawbridge. It has been estimated that at least nine to 10 hours would be needed to evacuate the island's 10,000 residents. White and Haas have pointed out some of the things that are likely to go wrong in this fragile escape system during a hurricane.[18] For one thing, it is far from certain that the residents will be warned 10 hours in advance of the storm's landfall, and even if they are, the sea normally begins to rise in the path of the storm five or six hours before landfall. This would be terribly disruptive on Key Biscayne, where sections of the approach roads to the causeways are only two feet above mean sea level. Second, the terrible driving conditions occasioned by high winds, rain, and moving water, plus the confusion and fright of the situation, could lead to impassable congestion, accidents, and mechanical failures. Finally, the drawbridge itself is a weak link. In times of storm warnings many commercial vessels and barges pass under or by the bridge seeking shelter in the Miami River. Since the water traffic has the right-of-way at the crossing, the bridge would probably be opened to allow its passage. It is sobering to note that drawbridges occasionally jam in the open position under normal conditions. Also, on several occasions, barges have jackknifed while passing through the raised Rickenbacker drawbridge and jammed its mechanisms.

One final factor acts to increase the hurricane hazard. Because of the cyclical nature of climatic events, the last 25 years have been relatively free of hurricane activity. Reference has been made to the current 17-year pause in hurricanes at Bogue Banks, located on the mid-Atlantic coast. The same is true elsewhere: Texas, which was hit repeatedly by hurricanes until around 1950, received fewer in the 60's, with only Carla, Cindy, and Beulah, and has had nothing since Delia in 1973. Southern Florida, historically the most hurricane-prone section of the coasts, has not been hit by a hurricane since Betsy in 1965. Add to this the fact that the coasts have seen a major population and construction boom during the same period. It is estimated that 80 percent of current coastal area inhabitants have never experienced a major hurricane,[19] nor have their homes. When the next hurricane hits, it is these same people who, if

[18]Gilbert White and J. Eugene Haas, *Assessment of Research on Natural Hazards*, (Cambridge, Mass.: MIT Press, 1975), pp. 29-36.

[19]H. Crane Miller, "Coastal Flood Hazards and the National Flood Insurance Program," Department of Housing and Urban Development, 1977, p. i.

they will accept the fact that hurricanes are destructive, dangerous storms, will have to heed the frantic warnings, do what can be done to secure their belongings, and drive their vehicles over the flooding roads and congested bridge away from their barrier island.

Hurricanes are certainly the greatest threat to humans on the barrier islands, but they are not the only one. Northeasters also batter the coast, often with great destruction and occasionally with wind velocities rivaling those of a hurricane.[20] In March of 1962, for example, an especially violent northeaster lashed the entire coast from Georgia to Long Island.

For three days sixty-mile-an-hour winds whipped the high spring tides across a thousand miles of ocean. Forty-foot waves pounded the (New Jersey) shore, breached the dunes and filled the bay, which spilled across the islands back to the ocean. When the storm subsided, the extent of the disaster was clear. Three days of storm had produced eighty million dollars worth of damage, twenty-four hundred houses destroyed or damaged beyond repair, eighty-three hundred partially damaged, several people killed and many injured in New Jersey alone. Fires subsequently added to this destruction; roads were destroyed, as were utilities.[21]

Assateague Island, Maryland, which was struck by the same storm, was just beginning to be developed. Many roads were destroyed, as well as the relatively few homes that had been constructed. More recently, the great blizzard of February 1978, which struck the same coast, eroded beaches in Massachusetts, toppling into the surf houses that sat behind 100-foot wide beaches before the storm.

The erosive forces that constantly work the islands and reshape them, while neither violent nor sudden, also pose threats to the barrier island residents. For example, there is the experience of Broadwater, a small village that once existed on Hog Island, Virginia. The lighthouse that was built there in 1852 was lost to the encroaching ocean in the 1920's. The ceaseless erosion continued to bring the breaking surf closer to the resident's homes until they finally acknowledged the true nature of the place, and prudently withdrew to safer sites on the mainland. Their decision was not only wise, but timely, for today the site that once contained some 40 to 50 homes, a school, a church, and 250 people is somewhere out in the ocean, Hog Island having continued its relentless migration. Another such case is that of Edingsville, built around 1900 on Edisto Island, S.C., the site of which has also been completely eroded from the island.[22]

Although the barrier island, as a class and in comparison to most mainland areas, is a hazardous place to live, there are sites on some islands that are safer than other parts of the islands. The types of locations already discussed are never safe: beaches, dunes, washover areas, relict inlets, lowlands, or filled wetlands.

But areas that exhibit mature soil profiles and mature vegetative cover probably represent areas that haven't undergone catastrophic changes for long periods and are therefore reasonably stable. Likewise, hills or uplands that are high enough to prevent flooding from the maximum predictable height of combined high tide and storm waves are also relatively secure. It is important to note that most barrier islands are quite low, therefore such sites are relatively scarce.

Given the hazards of wind, atmospheric pressure, flood, and unstable land, there are ways of structurally improving the safety of a building. Such practices as anchoring the roof to the walls, securely tying the walls to the foundation and to the rafters, reinforcing the rafters and joists, and reinforcing masonry walls can greatly add to a structure's ability to withstand hurricanes.[23] The manner of anchoring the house to the ground is also of critical importance. Although Donna (1960) destroyed almost 2,000 homes and trailers in Florida and seriously damaged almost 20,000 more, homes built off the ground on pilings survived both the wind and tide. Those on the ground, even if well constructed, were destroyed on the spot or, if improperly anchored to foundation, floated away.[24]

[20]They are not, however, tropical hurricanes. Rather they are mid-latitude storms resulting from the forceful mixing of warm and cold air masses. They are so named because, although the storm often moves *toward* the northeast across the eastern U.S., its most destructive winds blow out of the northeast quadrant (i.e., in a southwesterly direction).

[21]Ian L. McHarg, *Design With Nature*, (Garden City, New York: Doubleday/Natural History Press, 1969), p. 16.

[22]Langdon Warner and David Strauss, "Inventory of the Status of the Barrier Islands of the Southeast," Open Space Institute, 1976, p. 187.

[23]Pilkey, et al., *How to Live With an Island*, Chapter V.

[24] Enfo Newsletter, p. 4.

Reasons for Protecting the Unspoiled Barrier Islands

The preceding are reasons for not developing the barrier islands. They are not the only reasons for protecting them. Equally important is the fact that there are benefits and values that we receive from the islands which are often sacrificed when the islands are developed. The most important benefit is the island itself and its amenity values—its landforms, vegetation, the animal life that lives on and is protected by it, and the opportunities it affords for outdoor recreation.

One reflection of this viewpoint is the Natural Landmarks Program.[25] The purpose of this program is to identify physical and biological resources that possess attributes of national significance and to protect and preserve them. This is achieved through systematic studies at the level of biotic provinces or physiographic regions. Features recognized as having the requisite outstanding natural qualities are nominated as *potential* natural landmarks, and recommended to the Secretary of the Interior. On his approval, they become natural landmarks and are *eligible* for listing on the National Registry of Natural Landmarks. If the owner of the resource formally agrees to protect the landmark, it becomes *registered*.

All of the studies on the Atlantic Coast have been completed, while those on the Gulf Coast are still in progress. To date (February 1978), as an indication of the barrier islands' importance as geologic, ecologic, and esthetic resources, 74 sites on 68 barrier islands have been singled out in the screening process (See Appendix C). Of these, 17 have been officially designated as Natural Landmarks. Thirteen of the 17 landmarks have been entered on the Registry and the necessary protection agreements signed. Experience with the program has shown that roughly half the sites judged to be potential are later found to meet natural landmark criteria.

In most cases, the islands have been found to possess more than one outstanding attribute. Fifty-one of the 74 were found to be notable in their tidal marshes, 41 in their maritime forests and the diversity of their ecosystems, 39 in their dune communi-

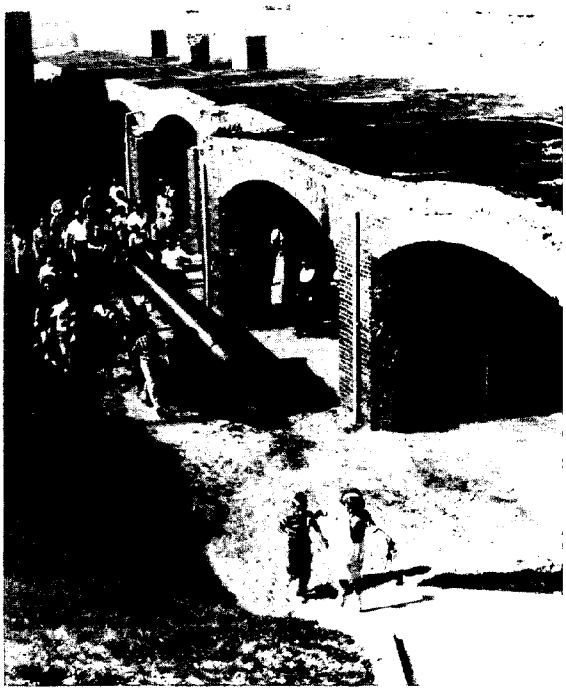
[25]Created by the Historic Sites Act of 1935 and under the authority of the Department of Interior, the program was until February 1978 administered by the National Park Service. It is now administered by the Heritage Conservation and Recreation Service.

ties and their habitats for colonially nesting waterbirds, 38 in their raptor habitats, and 36 in providing habitats for rare animal species. Other qualities recognized were those of isolation and pristine condition, maritime thicket communities, freshwater ponds, and beach and dune formations. The studies also took note of any influences or actions threatening the integrity or existence of the 74 sites. It is significant that the most often mentioned threat to these nationally significant resources is residential development (with 30 of the sites mentioned in conjunction).

In addition to these natural features, the islands also have much historic and cultural importance. Not only were they long used and occupied by Native Americans, these outer banks were often the first land sighted and trod by the arriving European explorers, and later became the homes of early settlers. Settlements on some of the barrier islands have survived until the present, and they and their inhabitants have often retained distinguishing cultural characteristics of earlier times. These characteristics are recognizable in language patterns, life styles, building techniques, and attitudes.

The islands were (and in some cases still are) important for the location of lighthouses, so vital for warning sailors of the nearby shoals and for helping them to determine their position. Today there are active and inactive lighthouses that date back as far as 1765, exhibiting the wide range of designs, construction techniques, and building materials that characterized this architectural form. A closely-related aid to coastal navigation that became a cultural feature of the islands was the chain of lifesaving stations created to aid seamen in distress. After performing a valuable service to the country, a number of the stations still exist. Another use of the barrier islands related to their forward location was that of coastal defense. Ship Island, Mississippi, Santa Rosa Island, Florida, and Sandy Hook, New Jersey are but three examples of barrier islands that still contain substantial remnants of fortifications that span a long period of American history.

Although much of the physical evidence of successive occupation and use of the islands—especially that related to the earlier Native Americans—has been lost to erosion and storms, we are fortunate that much remains. Below ground sites, above ground remnants, foundations, and solid structures still abound. As an indication of the important role



the islands have played in American history and the development of American culture, 76 sites located on 43 barrier islands have been listed on the National Register of Historic Places (See Appendix D). Included are military fortifications, colonial settlements, historic structures dating from the 17th through the 19th Centuries, lighthouses, and lifesaving stations. Three have been judged sufficiently significant to be designated National Historic Landmarks (Sandy Hook Light, Sandy Hook, New Jersey; Brick House Ruin, Edisto Island, South Carolina; Spanish Mission and home of Button Gwinnett, St. Catherine's Island, Georgia).

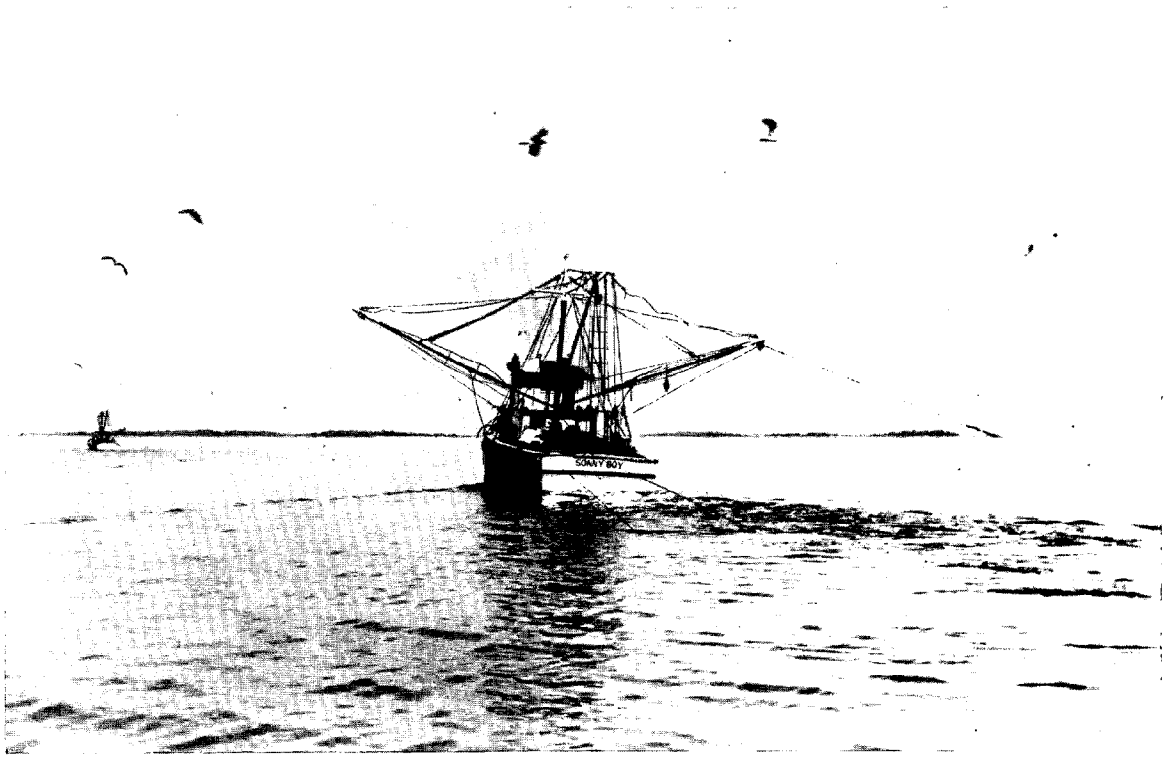
We have already discussed the brackish, relatively quiet bays and estuaries that lie between the barrier islands and the mainland, and the way in which they owe their existence and special qualities to the protection afforded by the islands. These waters, which are a blend of the terrestrial-freshwater systems of the mainland and the saltwater system of the ocean, are probably one of the richest ecosystems known. Many of the species that use the estuaries and adjacent marshes as spawning, nursery, and feeding grounds are important to us for food, sport, and education. It is estimated that "two thirds of the top-value Atlantic and Gulf Coast species of fish are directly dependent in some stage of life on conditions of the estuaries."[26] A marvelous example of this relationship is the Apalachicola Bay of northwestern Florida. This bay, protected by St. Vincent and St. George Islands, receives a flow of fresh water and a supply of nutrients from the Apalachicola River that support a high level of plankton productivity.

It is thus not surprising that the Apalachicola Bay System provides over 80 percent of the State's oysters, and serves as one of the most productive areas of blue crab propagation along the Gulf Coast of Florida. . . . In addition, this bay system is a major nursery for penaeid shrimp and a broad range of invertebrates and finfishes which supply extensive commercial and sport fisheries. . . [27]

Without the protection afforded these bays by the barrier islands, such productivity would cease, with obvious consequences for commercial and sport fishing. It is important to note that to the extent that

[26]John Clark, in Barrier Islands and Beaches—Technical Proceedings of the Barrier Island Workshop, The Conservation Foundation, 1976, p. 47.

[27]Robert J. Livingston, in Barrier Islands and Beaches, p. 87.



the bay bottom is disturbed by bridge construction and by accelerated sedimentation due to man-induced island erosion, or by dredging and filling operations, or that the brackish water is altered by artifically opened or closed inlets, pesticide runoff, or sewage effluent, this island protection is diminished.

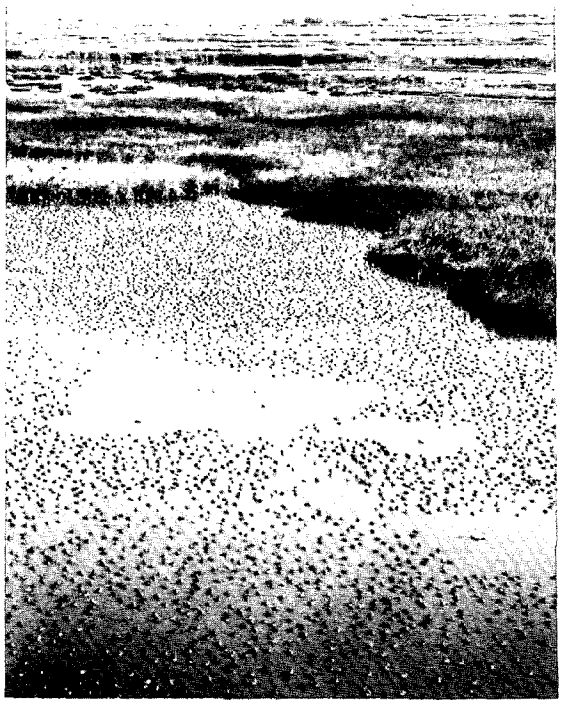
Another benefit of both the islands and their adjacent marshes and bays is that of providing habitats for a large number of birds and other animals. It is not a coincidence that the Atlantic Coast barrier islands and bays are important elements of the Atlantic flyway, a broad bank of land and coast that is used by numerous species of migrating birds in their semiannual spring and fall migrations. With their high productivity of plankton, shell- and finfish, and aquatic vegetation, and because of the tranquil waters protected by the islands, the bays and marshes and island wetlands provide crucial resting and feeding areas for migrating water fowl and other birds. At various points, especially along the mid- and southern Atlantic Coast and the Gulf Coast, large numbers of birds find wintering habitat. Some migrating birds continue south into the Caribbean Islands, Central America, and the South American continent; on their return (depending on their route) the Gulf Coast barrier islands are the first landfall after a wearying trans-Gulf flight, and offer a safe harbor during adverse weather. During a cold spell in April 1969, for example, 84 species of birds were observed on St. George Island, Florida.[28]

The importance of these lands and waters to both non-migratory and migratory birds (and to U.S. responsibilities under international agreements to protect the latter) has long been recognized by the U.S. Fish and Wildlife Service. A large number of refuges have been established along the Atlantic and Gulf Coasts to preserve the variety of nursery, migration, and wintering habitats required by the different visitors and residents: waterfowl, shorebirds, and marshbirds. Thirty-one of the refuges are located at least in part on barrier islands[29] (see Table IV).

The islands also provide habitat for several threatened or endangered species. The loggerhead turtle, previously mentioned in Chapter 3, finds

[28]Ibid., p. 91.

[29]Some refuges are fractionated, with separated sections on the mainland and/or one or more islands.



nesting beaches on a number of islands. The southern bald eagle and the peregrine falcon have been reported on several of the northern islands as have alligators and brown pelicans in the south.

The value of the barrier islands as outdoor recreational resources cannot be overemphasized. Each of the above-discussed values (i.e., natural areas, historic-cultural sites, and wildlife) has implications for recreation. For example, National Environmental Study Areas (NESA) have been established on six of the National Park Service areas[30] on barrier islands in order to take excellent advantage of the islands' natural environments. Environmental education programs are conducted on these six islands, as well as on Gateway National Recreation Area. These programs, which are made available to schools and other interested groups, promote the awareness that man is an interacting part of nature. The NESA, which may be a natural area or a modified or manmade area, serves as a resource base for students to learn about the environment and their relationship and responsibility to it.

[30]Cape Cod NS, Fire Island NS, Assateague Island NS, Cape Hatteras NS, Gulf Islands NS, and Padre Island NS.

The beach has traditionally been attractive for recreation. This has greatly increased in recent years, with the large increase in the population of coastal areas, especially along the south Atlantic and Gulf Coasts. Picnics, swimming, fishing, and boating are centered on the beach, but there are other popular activities clearly related to the beach environment, including camping, hiking, hunting, and nature study-interpretive activities. Due to the rapid and extensive residential development of beaches (both mainland and barrier islands) that has occurred in recent years, and because of their proximity to large metropolitan areas, the remaining unspoiled barrier island beaches are under heavy pressure for recreational use by the public. For example, in 1956, Cape Hatteras received about 300,000 visits. Twenty years later, approximately 1,800,000 visits were made, an increase of 500 percent. The role played by the national seashores (and by any close, available, and unspoiled ocean beach) in providing recreation to the urban areas can be readily seen from the number of visits made in 1976 to the two National Park System barrier island areas closest to the major eastern cities:

- Cape Cod NS (Southeast New England)—5,018,700 visits
- Gateway National Recreation Area (New York City)—9,631,400 visits

All told, in 1976 the ten NPS-administered barrier islands[31] received an astounding 22,000,000 recreational visits (Table III). The fact that beaches attract visitors for recreation from considerable distances is shown by the estimated 70 percent of those visiting Delaware's beaches are from out of State.[32]

The barrier islands offer a wide range of recreational possibilities. At one extreme is the opportunity for wilderness preservation and the extensive low-density use and enjoyment of unspoiled beaches. At such places there are opportunities to preserve nature and any extant historical or cultural sites. Interpretation of those values and environmental education programs are possible. This type of island and visitor program has usually been a Federal responsibility, carried out through the establishment and management of national seashores and refuges.

At the other extreme are the beaches that support a high-density, active, day use. Beach play and swimming, with related picnicking, are the major benefits. Preservation and interpretation are quite incidental. These heavily-used areas tend to be administered by towns and cities. Between the two extremes, State beaches tend to include both the wilderness beach, with primitive camping and the enjoyment of nature and solitude, and the densely-packed urban beach with hot dog stands and amusement rides.

Two additional points regarding the recreational use of the barrier island's beaches are worth noting. First, the sandy beach is perhaps unique among landforms in that it can absorb almost limitless numbers of visitors without physical deterioration. Due to the special qualities of the sand, as well as to its continual reworking by wave action, the beach does not erode from foot trampling, nor does it have vegetation that will deteriorate. On Monday morning, after a peak summer weekend of heavy visitation, the beach is much the same as it was on Friday. However, the dunes and nesting sites of certain

[31]Nine national seashores plus Gateway National Recreation Area.

[32]Letter from David S. Hugg, III, Coastal Management Program, Delaware, to Richard R. Gardner, Office of Coastal Zone Management, November 22, 1977.

species of wildlife which are dependent on the sandy beach are a different matter. They require protection, with selected and controlled crossing points to the beach. Second, private residential or recreational development along the coast, even though it may not impinge on the public beach, can effectively close public access to that beach.

There is a fiscal argument against barrier island development: it requires more government spending to provide infrastructure and services on barrier islands than on mainland sites because more energy must be expended to counteract the natural barriers to developing the islands. The Texas legislature requested the Texas Coastal and Marine Council[33] to compile a comparison of the costs of development on the islands and the mainland. Although the study was not completed and has been discontinued, the incomplete study showed some tentative results in three areas. Road construction on Mustang Island cost the same as on the mainland, but routine maintenance costs are more than three times higher. Causeways and ferries add to the cost. Without regard to hurricane damage (Beulah cut the Padre Island pipeline in more than 40 places), the provision of fresh water is 4-5 times more expensive than on the mainland. And, as can be expected, disaster relief and recovery costs are higher on the islands. Additional costs studied by the Council include those for sewage, schools, health, fire protection, and recreational facilities.

Because of the important role barrier islands play in both the ecosystem and in the provision of social values, and because of the disruption that is caused by their careless development and improper use, it is in the national interest to preserve these barrier islands, or portions of them, in their undeveloped state. This is intended both to preserve for the public an important and disappearing natural resource that provides a variety of environmental and recreational benefits, and to prevent the needless human suffering and economic losses that are a certain result of intensive development of the islands.

What about the Already Developed Islands?

There are fundamental differences of opinion on the issue of barrier island development. Some see development as a greater opportunity for human use (such

[33]The address of the Texas Coastal and Marine Council is P.O. Box 13407, Austin, Texas 78711.

as general public recreation) while others view development as a foreclosing of future options for recreational use by the general public. Whatever the viewpoint, the fact remains that much damage has already been done to the physical and ecological integrity of many barrier islands. More and more people are living in extremely dangerous places on the islands, where there is little protection against hurricanes and northeasters, and from which there is no adequate means of escape in times of emergency.

We must acknowledge the likelihood that existing urban, commercial, and residential developments on barrier islands could be laid to waste by future hurricanes or northeasters. Simultaneous with the emergency relief and the human suffering, we will be faced with the question: should the rubble be cleared and rebuilding be allowed, or should the island be put to a different use? Should the Federal government allow public tax dollars to be used to subsidize redevelopment of obviously hazardous places? It seems clear that the destruction that occurred in Massachusetts in February 1978, in Ocean City in 1977, and in hundreds of other barrier island disasters is ample proof of the mistakes we make in deciding where and how to build. To ignore the harsh lessons, to pretend that it can't happen again, to delude ourselves with the idea that a temporary pause in major hurricanes signals a permanent change in climate is to merely ignore the inevitable.

The Federal government heavily subsidizes the development of barrier islands, as well as mainland sites. The taxpayer then shoulders the main financial burden in times of disaster on the islands (hurricane tracking and warning; dispatch of troops, army engineers, and Coast Guard patrols to save lives; provision of emergency housing, food, medical care; insurance payments on property; etc.). That the Federal government, on the heels of saving peoples'

lives and paying for the destruction, should once again encourage or facilitate the rebuilding on the same hazardous site seems to be both dangerous and fiscally imprudent. Another approach is suggested by Orrin Pilkey:

After the next inevitable storm, (the State should) buy up the lots where houses once stood and let the shoreline evolve naturally. Unquestionably, this approach would be cheaper than armouring the shoreline, and we would still have a beach to boot.[34]

[34]Pilkey, op. cit., p. 25

However, to simply adopt Pilkey's recommendation for State acquisition, without considering modifications to Federal programs which subsidize reconstruction, will undoubtedly lead to serious conflicts.

What About the Already Protected Islands?

A number of barrier islands have been protected from development and set aside for special purposes. Although all of these islands are nominally preserved, the actual degree of preservation ranges from complete to negligible. Current efforts include those of the National Park Service and the Fish and Wildlife Service, those of State parks and animal refuges, and those of individuals and private groups. Problems affecting these efforts range from the lack of adequate planning, to incompatible land uses on adjacent non-preserved property, overdevelopment, and misguided development on islands that are nominally preserved. Barrier island managers have learned lessons about the lands and waters they manage, and have recognized deficiencies in their management. In addition, researchers have provided a wealth of data to apply to those lessons and problems.

The topic of existing efforts to preserve the barrier islands will be examined in the following chapter, and the question of how to improve that preservation will be addressed. The point of this section is to indicate that the already-preserved islands, as is the case with the already-developed islands, must be considered in a comprehensive plan for the islands.

Chapter 5

Governmental and Private Protection Efforts

There are many ways to protect a barrier island, and there are many parties, private as well as public, that are capable of doing it. The meaning of "protection" extends from the complete preservation of an island's wilderness values to the protection and maintenance of an island's non-commercial, non-urban character, yet with the necessary infrastructure and services for public enjoyment. In this chapter, one additional meaning is explicit, which refers to those methods that aim to limit the amount of development, determine where development can and cannot take place, and deal with the esthetic questions of development. This definition applies to already-developed islands or to those that are reasonably expected to be developed.

Federal Programs

In 1962, the rush to the beaches was well underway, and several previously undeveloped barrier islands were experiencing change. Assateague Island, Maryland[35] was undergoing platting and sub-

[35]The Virginia section of the island (the southern tip) had already been established as the Chincoteague National Wildlife Refuge.

division, and already had a main paved road, unpaved access roads, and numerous houses constructed when a March northeaster struck with devastating effects. The only thing that prevented the massive destruction that occurred in 1962 in New Jersey was the fact that development was just beginning. The political response could have been, as it has in the aftermath of many natural disasters, that dunes should be artifically raised, or seawalls constructed—that *something* should be done by the government to prevent future losses to lives and property on Assateague. Instead the response reflected the environmental awakening of the 1960's: the State and Federal governments acted to preserve all of Assateague Island as undeveloped parkland. The mid-section, where the bridge from the mainland connects, became a State park, and, with the exception of a few small private inholdings, the remainder became Assateague Island National Seashore.

Back in 1934,[36] the National Park Service surveyed the East and Gulf Coasts, looking for seashores worthy of preservation in public ownership. Among other beaches, some seven barrier islands were identified as outstanding, including Assateague and adjacent sections of the Eastern Shore (See column 1, Table I). An immediate result (in 1937) was the establishment of Cape Hatteras as the first national seashore. Nothing more happened for almost 20 years. Then, in 1955, a second survey was made for the same purpose and 15 barrier islands were recommended as outstanding, including Padre Island, Texas, and Bogue Banks, North Carolina, which had previously been recommended in 1934 (See column 2, Table I). It is interesting to learn why Assateague was *not* recommended again: the field people noted that Assateague in 1955 was already undergoing substantial change, that its "advanced stages of real estate development appear to preclude the possibility of this area being set aside for public recreational use."[37] Seven years later, the effects of the 1962 storm, in destroying homes and roads, served to resurrect earlier hopes of preserving the island in a natural state. An emergency survey by the NPS of the northeast coast immediately after the storm noted that:

> *The severe and extensive storm damage to natural features (on Assateague) including the dunes and destruction of summer places demonstrates (its) unsuitability for permanent development, and the importance for establishment of a program for restoration and protection of natural conditions with compatible public use.*[38]

Assateague Island became a national seashore three years later. The devastating storm of March 1962 had two important results: it vividly showed us the hazards of developing a barrier island; and it gave us another chance to preserve an island that appeared to be on the way to development.

The post-World War II building and population boom accelerated change on the barrier islands. Small hamlets and fishing villages became urbanized centers for summer recreation, especially in the corridor from Massachusetts to New Jersey. Later, the relatively untouched islands from North Carolina south to Florida came under the same or new pressures. Entire residential and vacation developments were created on previously undeveloped islands. Following the precedent-setting creation of Cape Hatteras National Seashore in 1937, nothing happened until the 1960's. Then, beginning with the establishment of Cape Cod National Seashore in 1961, a busy 14 years brought nine new barrier island units into the National Park System.[39] Although each of the national seashores maintains barrier islands in public ownership and protects them against the large-scale, intensive development that has occurred on other barrier islands, they display a considerable degree of variety in development, management, and public use. Gateway National Recreation Area, at one extreme, is located in the New York City area and serves as an extension of that city's park system. Cumberland Island National Seashore, at the other extreme, is almost completely undeveloped, is far from large population centers, and lacks bridge access.

[36]Also reported as having taken place in 1935.

[37]A Report on the Seashore Recreation Area Survey of the Atlantic and Gulf Coasts, (Washington, D.C.: National Park Service, 1955), p. 105.

[38]Seashore Preservation and Recreation Opportunities and Storm Damage, (Washington, D.C.: National Park Service, April 1962), p. 21.

[39]Six of these were new national seashores which, as shown in column 3 of Table I, had been recommended in one or both of the NPS studies. The other three units were Cape Lookout National Seashore (1966), Gateway NRA (1972), and Canaveral National Seashore (1975).

Table I. Results of the 1934 and 1955 NPS Surveys

Barrier Island Areas Recommended		Those Preserved			Not Preserved
1934	1955	National Seashore	National Wildlife Refuge	Other	
Eastern Shore, Md.	.....	Assateague I. (1965)	Chincoteague NWR	Assateague St. Park	
Hatteras, N.C.	.....	Cape Hatteras (1937)			
Santa Rosa, Fl.	.....	Gulf Islands (1971)			
Padre Island, Tx.	Padre Island, Tx.	Padre Islands (1962)			
Sapelo Island, Ga.	.....	.....	.....	State Wildlife Refuge	
Barnegat, N.J.	.....	.....	.....	Island Beach St. Park	Private/Partially Developed
Bogue Banks, N.C.	Bogue Banks, N.C.	.....	.....	.....	Private/Developed
	Great Beach, Ma.	Cape Cod (1961)			
	Cumberland I., Ga.	Cumberland (1972)			
	Fire Island, N.Y.	Fire Island (1964)			
	St. Joseph Pen., Fl.	.....	.....	State Park	
	Parramore I., Va.	.....	.....	Nature Conservancy	
	Mosquito Lagoon, Fl.	.....	Merritt I., NWR		
	Popham/St. John, Me.	.....	.....	Popham Beach St. Pk.	Remainder—Private/Developed
	Shinnecock Inlet, N.Y.	.....	.....	.....	Private/Partially Developed
	Smith I., N.C.	.....	.....	.....	Private/Partially Developed
	Debidue I., S.C.	.....	.....	.....	Private/Undeveloped
	Brazos I., Tx.	.....	.....	.....	Private/Undeveloped
	Kiawah I., S.C.	.....	.....	.....	Private/Developed
	Marco I., Fl.	.....	.....	.....	Private/Developed

National Park System

The National Park Service's (NPS) primary responsibilities in protecting barrier islands are associated with its stewardship of nine national seashores, one national recreation area, one national monument, and part of one national park (Fig. 9). Under authorities contained in the National Park Service's 1916 Organic Act, these units of the National Park System are administered to ensure long-term protection and preservation of natural and cultural resources.

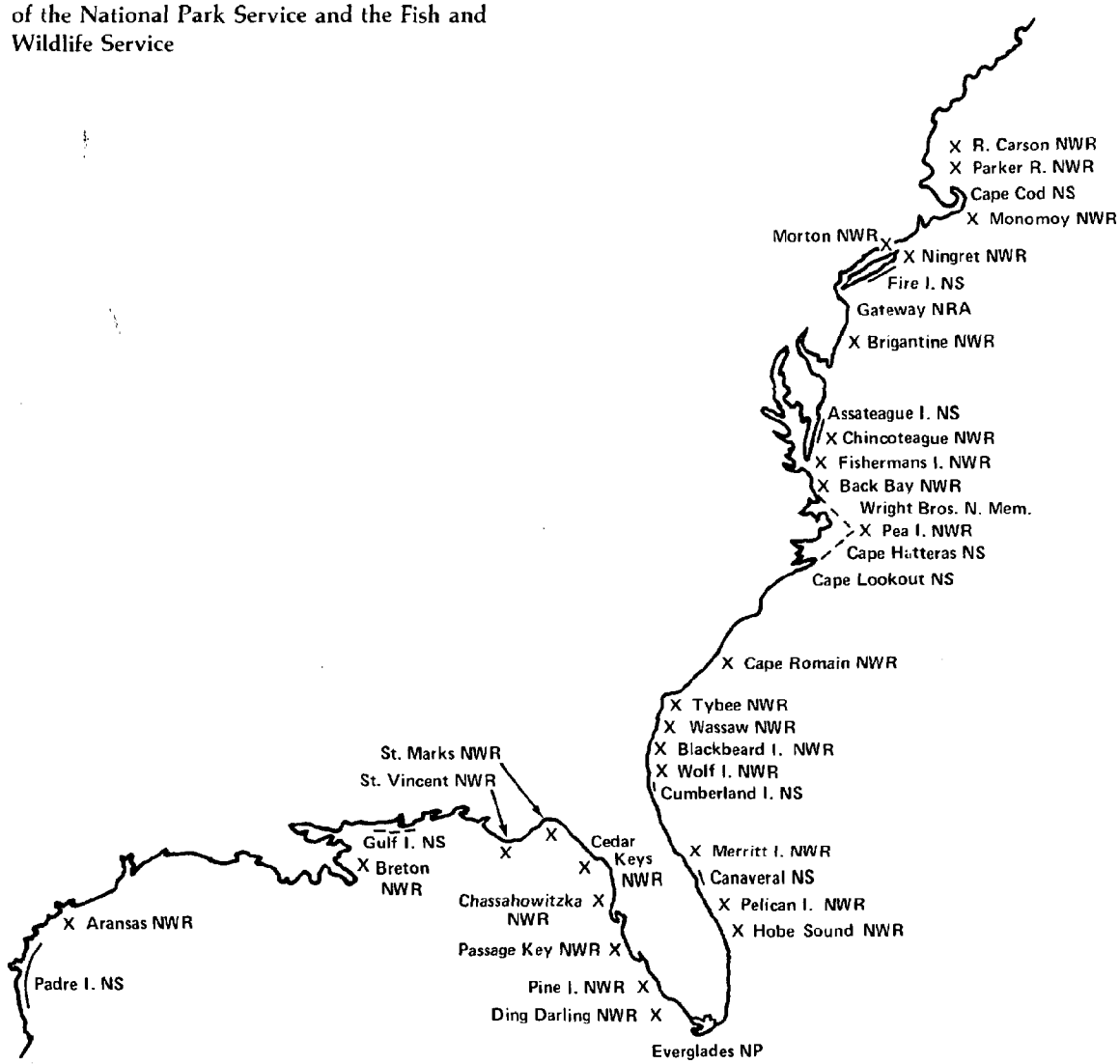
Wright Brothers National Memorial, on the site of the first powered flight, shares Bodie Island, North Carolina with Cape Hatteras National Seashore. Everglades National Park, Florida includes mangrove islands. Some of the seashores, such as Cape Cod, Fire Island, and Cape Hatteras, exist side by side with towns. Other seashores have only scattered residences and camps. Although the total authorized acreage[40] is 717,383 (as of December 31, 1976), only 78 percent of that is owned in fee by the NPS (see Table II). The remainder is held by the NPS in less than fee (1%), by other public agencies (17%), and by private owners (4%).

The barrier island units administered by the National Park Service occur at fairly regular intervals on the Atlantic and Gulf Coasts from Massachusetts to Texas. Except for Wright Brothers National Monument, which was established by Presidential Proclamation in 1927, the remaining 11 units were authorized by separate acts of Congress. These Acts set forth the specific purpose of each unit as well as constraints and obligations in its administration. The latter legislative provisions are a major consideration in the preparation of plans which establish future management strategies for each unit.

The recreational use of these NPS units reflects several factors. One is proximity to urban centers: Gateway NRA, although one of the most recently-established units, drew over 9 million visits in 1978, mainly from the adjacent New York City environs, and Cape Cod, close to the Rhode Island-Boston population centers, drew more than 5 million. Another factor is accessibility: those units that are more remote or lack bridge access (Cape Lookout, Cumberland Island) draw fewer visitors. Only 36,400 visits were made to Cumberland, which is difficult to get to. A third factor is public familiarity,

[40]The number of acres within the seashore boundaries.

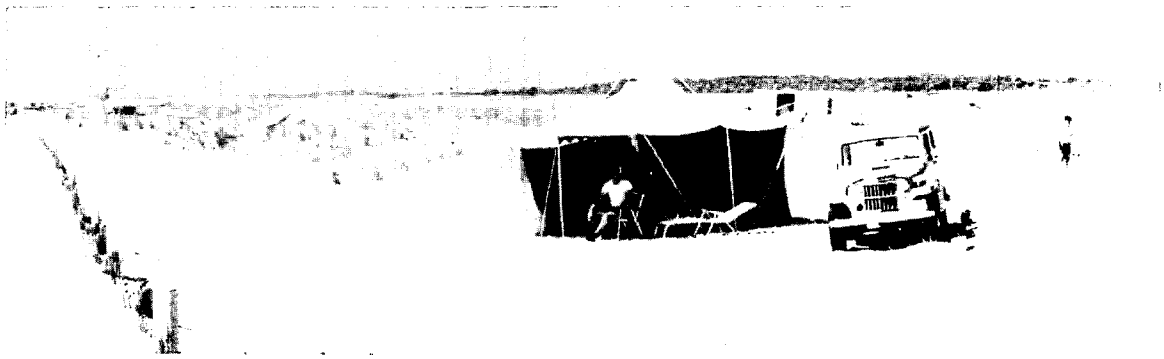
Figure 9. Locations of Barrier Island-Related Units of the National Park Service and the Fish and Wildlife Service



with the earlier established seashores showing steady visitation growth through the years (see Table III). The recreational opportunities provided by the national seashores run the gamut of beach activities: swimming and beach play, surf and bay fishing, and shell fishing.

Hiking, camping, and bike riding are also available. Equally important, both in terms of visitor enjoyment and educational value, are the interpretive programs that deal with the human history and natural history of the islands, describing and showing the natural functions, ecological-geographical values, and historic events and structures that have been referred to in previous chapters.

The National Park Service has undertaken and sponsored a multi-faceted program of research which continually expands our understanding of the barrier island environment and the unique constraints the environment places on development and use. With respect to barrier islands administered by the National Park Service, the research findings have demonstrated the inability of these areas to support the amount of permanent development and public use typically envisioned at the time the units were



legislatively authorized. Management objectives are continually being revised to point future use of the barrier island units in the direction of less permanent development, less manipulation of natural processes, and increased opportunities for unstructured recreation related to appreciation of the natural environment. Management plans now in preparation for nine of the 12 barrier island units reflect a generally conservative approach to development and public use that was born of an awareness of the fragility and vulnerability of these resources and the dynamic nature of the forces acting upon them. The only exception is Gateway National Seashore, where the provision of facilities for intensive structured recreation is a major objective.

Fish and Wildlife Service

The other major Federal effort to preserve and manage the barrier islands is that of the Fish and Wildlife Service (see map, Fig. 9, and list, Table IV). Thirty-one National Wildlife Refuges (NWR) have been established along the East and Gulf coasts, preserving valuable breeding, nesting, and resting areas for many species of fish, shellfish, and wildlife. An important purpose of the refuges is the fulfillment of U.S. responsibilities for migratory birds, as established in treaties with Great Britain (on behalf of Canada) and Mexico and implemented in the Migratory Bird Treaty of 1918, as amended.[41] The refuges often occupy barrier island fast land, but also include large areas of the marshes and bays, those exceedingly productive ecosystems that provide key habitats for fish and wildlife. The refuges shelter or provide habitat for a large number of species, including several that are listed as endangered, such as the bald eagle, brown pelican, whooping crane, and peregrine falcon.

Most of the animals, excluding the bog and loggerhead turtle, have been listed. Many of the plants have not. In any event, it is important that the inventory and listing of endangered species on barrier islands be conducted quickly. It is also important to delineate areas of critical habitat for these species. Presently, few such areas of critical habitat have been identified under Fish and Wildlife Service regulation. That process should be accelerated since the designation of critical habitat gives the Endangered Species Act (ESA) its most definitive thrust. In short, it is important to have a complete inventory of endangered plants and animals, and a carefully documented delineation of critical habitats on barrier islands.

The Service has primary responsibility for implementation of the Endangered Species Act. Section 7 of the ESA[42] requires all Federal agencies to take whatever action is necessary to insure that their activities will not further jeopardize an already endangered species of plant or animal, or result in the destruction or modification of habitat critical to the existence of that species. This is a particularly powerful statute, and could be used to protect fragile ecosystems such as the barrier islands which nourish and sustain scarce species of flora and fauna. Further, the Fish and Wildlife Coordination Act as amended requires each Federal agency to submit to the Fish and Wildlife Service development plans that would modify water bodies (Guidelines for Navigable Waters Work—U.S. Fish and Wildlife Service).

[41] 16 USC 703-711; 40 stat. 755.

[42] 16 USC 1536

Table II: Land Ownership Within Authorized Boundaries of NPS Barrier Island Units
(as of December 31, 1976)

Administrative Unit	Total Authorized Acreage	Federal Acreage In-fee	Federal Acreage Less than fee	Non-Federal Acreage Other Public	Non-Federal Acreage Private
Cape Cod National Seashore	44,600	25,366	378	14,153	4,703
Fire Island National Seashore	19,357	2,794	3,152	12,378	1,033
Gateway National Recreation Area	26,172	20,389	1	5,378	403
Assateague Island National Seashore	39,631	16,078	18	21,849	1,686
Wright Brothers National Memorial*	431	431	0	0	0
Cape Hatteras National Seashore	30,326	30,326	0	0	1
Cape Lookout National Seashore	28,400	17,053	7,170	1,986	2,190
Cumberland Island National Seashore	36,877	15,630	2	13,820	7,425
Canaveral National Seashore	57,627	41,025	0	15,369	1,234
Everglades National Park**	160,868	160,868	0	0	0
Gulf Islands National Seashore	139,175	97,712	0	35,652	5,812
Padre Island National Seashore	133,919	132,203	0	79	1,637
Total	717,383	559,875	10,721	120,664	26,123
% of Total	—	78%	1%	17%	4%

*Occupies a small part of Bodie Island just north of Cape Hatteras National Seashore.
**Mangrove Islands and labyrinth of waterways on Gulf Coast only.

Table III. Total Visits to NPS-Administered Barrier Islands —1956 to 1978 (in thousands)*

Area	1956	1961	1966	1971	1976	1978
Assateague Island National Seashore	—	—	—	1,662.9	1,866.2	2,135.9
Canaveral National Seashore	—	—	—	—	715.4	882.6
Cape Cod National Seashore	—	—	2,803.3	4,188.3	5,018.7	5,025.9
Cape Hatteras National Seashore	301.7	547.3	1,133.0	1,696.9	1,817.2	2,043.3
Cape Lookout National Seashore**	—	—	—	—	26.9	54.3
Cumberland Island National Seashore	—	—	—	—	17.8	36.4
Fire Island National Seashore	—	—	—	445.4	702.2	637.1
Gateway National Recreation Area	—	—	—	—	9,631.4	9,017.5
Gulf Island National Seashore	—	—	—	—	2,375.3	3,971.6
Padre Island National Seashore	—	—	152.4	904.4	986.1	867.0
Total	301.7	547.3	4,115.7	8,897.9	23,140.2	24,671.6

*Total visits includes all entries onto lands or water administered by the NPS (excludes NPS Personnel).
**Cape Lookout National Seashore did not begin reporting until June of 1976.

Wilderness System

In accordance with the provisions of the Wilderness Act of 1964, the Fish and Wildlife Service and National Park Service barrier island units are being studied for possible inclusion in the wilderness system. Twelve wilderness areas on wildlife refuges have already been congressionally mandated, ranging in size from an 8-acre wilderness area at the Pelican Island NWR on Vero Beach, Florida to one of 29,000 acres at the Cape Romain NWR on Cape Island, Raccoon Key, and Bull Island, South Carolina. Five other refuges have been studied and found to lack qualifications for the establishment of wilderness areas, while four others have been found to be qualified, and the Department of the Interior recommendations are awaiting congressional action. Two NPS units have been legislatively designated wilderness areas (Everglades and Gulf Island) and the NPS's recommendations for the establishment of wilderness areas on Assateague have been sent to Congress and are awaiting legislative action. Two national seashores have been found to be unqualified (Padre Island and the Florida section of Gulf Islands); five other seashores are either currently being studied or are programmed for study in the near future.

Both the NPS and the FWS attempt to manage their barrier islands in such a manner as to protect the islands' physical integrity and to prevent their unwise development. Although the two agencies have sometimes fallen short of their goal, the islands as a group are protected against the major impacts of development. The number of islands under consideration for wilderness status is an indication of their unspoiled character. But, consistent with the two agencies' different purposes, there are considerable differences in the way they manage their units.

National Park Service Policies

Until recently, the national seashores were managed under the National Park Service's guidelines for recreation areas, as opposed to natural areas and historic areas. The primary purpose of the seashore was to provide appropriate recreational oppor-

Table: IV. National Wildlife Refuges (NWR) on Barrier Islands[1]

State	Refuge	Date Estab.	Total Refuge Area[2] (acres)	Est. Beach Length (miles)	Wilderness Designation Status[4]	Wilderness Designation Area (acres)	FY 1978 Public Use (000's) Activity Hours Education Interpretation	Other Mission Related Use	Non-mission Related Use	Total	Total Visits
ME	Rachel Carson	12/21/66	2,068	—	[5]	—	*	8	*	8	9
MA	Parker River	12/30/42	4,650	6.5	Proposed[7]	3,110	62	925	275	1,262	428
	Monomoy	06/01/44	2,702	8.5	Established[8]	2,420	6	105	10	121	26
	Nantucket	05/01/73	40	0.4	[5]	—	—	1	1	2	1
RI	Trustom Pond	08/15/74	365	0.5	[5]	—	5	4	24	33	13
	Ninigret	08/12/70	28	0.2	[5]	—	—	1	*	1	1
	Block Island	11/01/73	29	0.3	[5]	—	—	4	1	3	4
NJ	Brigantine	10/05/39	20,197	6.1	Established[9]	6,681	154	218	13	385	151
MD/VA	Chincoteague	05/13/43	9,439	13.3	Proposed[7]	1,300	186	1,137	593	1,916	1,221
VA	Wallops Island	03/11/71	3,373	3.5	[5]	—	[12]	[12]	[12]	[12]	[12]
	Fisherman Island	01/17/69	1,025	2.1	[5]	—	[13]	[13]	[13]	[13]	[13]
	Back Bay	06/06/38	4,589	4.2	Proposed[7]	2,165	5	51	12	68	43
NC	Pea Island	04/08/38	5,915	12.9	Proposed[7]	180	14	909	221	1,144	1,037
SC	Cape Romain	06/06/32	34,229	19.1	Established[9]	29,000	14	114	—	128	53
GA	Tybee Island[3]	05/09/38	100	0.6	Not qualified (CE owns land)	—	—	1	*	1	*
	Wassaw	10/20/69	10,070	5.4	[5]	—	3	42	19	64	18
	Blackbeard Island	02/15/24	5,618	7.4	Established[9]	3,000	*	94	4	98	11
	Wolf Island	04/03/30	5,126	3.9	Established[9]	5,126	—	10	—	10	2
FL	Merritt Island	08/28/63	139,305	—	Not Qualified (NASA owns land)	—	108	1,450	1,663	3,221	5,380
	Pelican Island	03/14/03	4,358	—	Established[8]	6	2	50	1	53	26
	Hobe Sound	09/23/68	965	3.9	[5]	—	11	114	36	161	86
	J.N. "Ding" Darling	12/01/45	4,833	0.3	Established[11]	2,619	323	713	96	1,132	709
	Pine Island	09/15/08	31	—	Not qualified (ownership uncertain)	—	[14]	[14]	[14]	[14]	[14]
	Passage Key	10/10/05	36	0.4	Established[8]	20	[14]	[14]	[14]	[14]	[14]
	Egmont Key	07/10/74	328	2.3	[5]	—	[14]	[14]	[14]	[14]	[14]
	Cedar Keys	07/16/29	379	3.9	Established[11]	375	22	2	—	24	2
	St. Vincent	02/12/68	12,490	8.8	[5]	—	1	67	*	68	5
LA	Breton	10/04/04	9,047	27.8	Established[9]	5,000	—	20	*	20	3
TX	Sea Rim	02/01/79	8,997	5.9	[5]	—	—	—	—	—	—
	San Bernard	11/07/68	24,422	6.7	[5]	—	*	25	3	28	7
	Aransas	12/31/37	73,828	26.8	Not qualified (mineral/oil gas rights outstanding)		316	578	—	894	173
		Totals	388,582	179.8		61,002	1,232	6,643	2,972	10,847	9,409

[1]Includes refuges which are located in CBI Study Units.
[2]As of September 30, 1978, or, if established later, as of date established.
[3]There is some question as to whether this island is located in South Carolina or Georgia.
[4]Four categories are recognized: 1) not qualified (not an island, less than 5,000 acre roadless area, FWS does not own fee title to the land or other reasons as noted); 2) considered, but found unsuitable; 3) proposed (date sent to Congress indicated); and 4) established (public law number, date approved indicated). Not all or, in some instances, any of a wilderness area is within the CBI Study Unit.
[5]Refuge established after 1964 Wilderness Act enacted, hence, it has not been considered for wilderness status.
[6]Part of joint FWS-NPS Assateague Island wilderness proposal. NPS portion totals 440 acres and is located in Maryland. FWS portion totals 1,300 acres and is located in Virginia.
[7]Submitted to Congress December 4, 1974.
[8]Established by P.L. 91-504, approved October 23, 1970.
[9]Established by P.L. 93-632, approved January 3, 1975.
[10]Established by P.L. 94-557, approved October 19, 1976.
[11]Established by P.L. 92-364, approved August 7, 1972.
[12]Satellite station. Public use information under Chincoteague NWR.
[13]Satellite station. Public use information under Back Bay NWR.
[14]Satellite stations. Public use information under J.N. "Ding" Darling NWR.

*Less than 500.

tunities, sometimes for large numbers of visitors. This has required the construction of roads, utilities, visitor centers, campgrounds, and other facilities. Not surprisingly, the NPS, like other owners of barrier island property, felt obliged to protect its investments against the islands' natural proclivities to move around. Over a period of several decades, and on a wide variety of barrier island beaches, the NPS did all that available money and engineering ability could do to arrest the erosion and to prevent storm damage. The results seem to prove that it is not worth it, neither in economic nor ecological terms. The newly-approved "Management Policy for Shoreline Processes" (See Appendix 5 for complete text) states that, as far as possible, and cognizant of NPS responsibilities that accrue from its previous policy and actions, there will be no further attempts to restrain the natural processes of erosion, deposi-

tion, dune formation, and inlet formation. The policy further states that:

In development zones, management should plan to phase out, systematically relocate, or provide alternative developments to facilities located in hazardous areas. New facilities will not be placed in areas subject to flood or wave erosion hazard unless it can be demonstrated that they are essential to meet the park's purpose, that no alternative locations are available, and that the facilities will be reasonably assured of surviving during their planned lifespans without the need of shoreline control measures.

This new policy for barrier island land management will be implemented on a seashore-by-seashore basis, and will be accomplished through each unit's general management plan. The specific application of the policy can be seen in the example of Fire Island National Seashore, where the following decisions have been implemented:

- The NPS will attempt to restore the island's natural sand movement.
- A sand bypass structure will be developed to maintain a more natural littoral drift system on the Seashore.
- Sand nourishment of beaches on the Seashore will be conditional upon implementation by the Corps of Engineers of sand by-pass systems at the inlets.
- No inlets will be opened artifically.
- There will be no beach stabilization structures.
- All pedestrian dune crossings will be on elevated boardwalks, and vehicular dune crossing limited to those essential for access and management.
- There will be no anti-mosquito ditching in the marshes.

Each of these policies is subject to a case-by-case analysis of the situation, with possible modification due to extenuating circumstances or long-established patterns or rights. The policy recognizes the existing reality of adjacent property owners' expectation of protection, of the need to maintain services and transportation routes in neighboring communities, and the need to protect historic zones and some previously-constructed NPS structures. It recognizes that a complete break with past, now discredited policies will not always be possible. But it also makes clear a new direction for seashore planning and management that takes into consideration the dynamics of barrier island geology and ecology.

Fish and Wildlife Service Policies

National wildlife refuges are managed in order to protect the feeding, hatching, rearing, and habitats of a wide variety of animal species. Management practices aim at improving, and sometimes creating, those habitats. Because development would be inimical to the tranquil, unpolluted, and natural environment required by the animals, the refuges are kept largely natural.

Visitors are of secondary, but increasing importance on the refuges. The seasonal gatherings of immense numbers of migratory birds or the chance to see an endangered species are of great interest to the public, and more and more visitors are coming to see them. The refuges were created for animals, however, and until the early 1960's were for the most part closed to human visitors. The Refuge Recreation Act of 1962 (P.L. 87-714) changed that policy, establishing the principle that opening the refuges to the public and permitting recreational activities would be desirable as long as the activities were compatible with the primary purpose for which the refuges were established—the protection of animals and their habitats. Within this legal and managerial

designation as an "appropriate incidental or secondary use," a number of the barrier island refuges have been opened to the public. The main recreational activities encouraged are those that are wildlife-oriented, such as fishing, use of nature trails, bird watching, and natural history interpretation. All of these activities are consistent with the "incidental and secondary" principle, and are strictly controlled in terms of the number of people engaged in these activities as well as where and when it occurs, in order not to disturb animals during such critical times as nesting, and to protect fragile or susceptible habitats from adverse impact.

Natural Landmarks and National Register Sites

One additional type of protection provided for barrier island resources by the Federal Government, although less encompassing and effective than those described above, covers the Natural Landmarks and National Register sites found on the islands (see Chapter 4 and Appendices 3 and 4).

Natural Landmarks, meeting the criteria for "significant resources," come under the protection of section 102 of the National Environmental Protection Act. Any Federal agency that intends to carry out, fund, license, or permit a project that would adversely affect a landmark must circulate an environmental impact statement (EIS) describing the probable impacts, means of mitigation, and the feasible alternatives to the project as planned. The Heritage Conservation and Recreation Service reviews and comments on these EIS's. The final decision is that of the originating agency. Additionally, the General Authorities Act of 1976 (P.L. 94-458) requires that the Department of Interior present annually to the Congress a list of Landmarks that are in any way threatened.

A similar form of protection is extended to any item on the National Register, but in this case it is done so by the explicit mandate of section 106 in the Historic Preservation Act of 1966 (P.L. 89-665). Any Federal agency, prior to its funding, licensing, or approval of a project must consider the project's effect on sites included in or eligible for inclusion on the Register, and must provide the Advisory Council on Historic Preservation with the opportunity to comment on the undertaking. In this case, as in the preceding, the protection is limited to advice and moral suasion; the final decision resting with the originating agency.

Land and Water Conservation Fund Grants

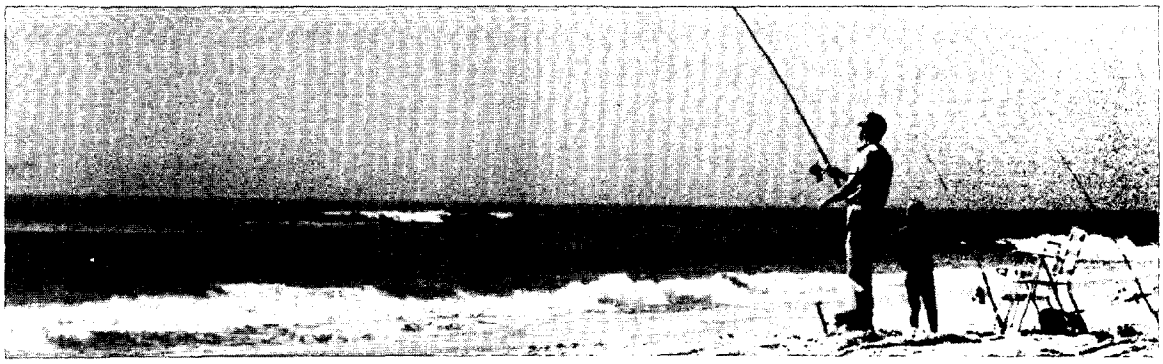
The Heritage Conservation and Recreation Service (formerly Bureau of Ourdoor Recreation) of the Department of Interior is responsible for administering the Land and Water Conservation Fund (LWCF) program. The Land and Water Conservation Fund Act of 1965[43] established a fund to increase outdoor recreation opportunities for the American people. The program provides for (1) acquisition of lands for Federally-administered parks, wildlife refuges, and recreation areas (the "Federal side"), and (2) matching grants for State recreation planning and State and local land acquisition and development (the "State side").

The Federal side, not less than 40 percent of the total Fund, provides money only for the *acquisition* of national recreation lands. No funds are provided for development, operation, or maintenance. Acquisition programs must be approved by Congress. They encompass recreational resources such as national parks, seashores, lakeshores, forests, wild and scenic refuges, and natural and wilderness areas. These areas are administered by the Department of Interior's National Park Service, Bureau of Land Management, and Fish and Wildlife Service, and the Department of Agriculture's Forest Service.

The State side, about 60 percent of the total Fund, provides grants to States, and through States to their political subdivisions (cities, counties, towns, etc.) for the acquisition and development of public outdoor recreation areas and facilities. Again, no funds are available for operation or maintenance. Project grants must be matched by not less than an equal amount of non-Federal funds. For the purposes of the LWCF, Community Development Block Grants and Revenue Sharing Funds are not considered Federal funds and may be used as part of the applicant's matching funds. These grants may also be supplemented under certain circumstances by Economic Development Assistance grants.

In order to receive grants from the Fund, the State or its political subdivisions must develop a comprehensive outdoor recreation plan, and update and refine it on a continuing basis. The Fund provides matching planning grants and technical assistance to States to help develop and update comprehensive

[43] PL 88-578.



outdoor recreation plans. The plan identifies capital investment priorities for acquiring, developing, and protecting all types of outdoor recreational resources within a State. It assures continuing opportunity for local units of government and private citizens to take part in their State's outdoor recreation and environmental planning programs, and it provides a practical tool for coordinating all State outdoor recreation and environmental conservation programs.

Heritage Conservation and Recreation Service figures (1978) show that during the 13 years of program operation, Federal agencies have spent over $128 million in LWCF monies to acquire barrier island acreage. Additionally, State and local agencies have received more than $48 million in matching grants to acquire acreage and develop projects located on barrier islands. This figure would probably be much higher if projects that had conservation rather than recreation as their primary purpose —e.g., barrier island acquisition—were given higher priority.

Coastal Zone Management

In 1972, Congress passed the Coastal Zone Management Act (CZMA). This law provides for coordination of Federal activities in the coastal zone and the appropriation of funds to aid States in coastal planning and research. The program is administered by the Secretary of Commerce through the Office of Coastal Zone Management (OCZM).

The Act provides funds for States to develop coastal zone management programs, which must meet guidelines prescribed in the law. Three guidelines apply to hazardous zones: first, the management program must establish permissible activities within the zone; second, the management program must designate critical environmental areas (coastal erosion is specifically included in the law); and third, the management program requires promulgation of guidelines on the priority of uses in the zone.

Under Section 315(1) of the Act, funds are available to aid in acquiring, developing, and operating estuarine sanctuaries. Through FY 1977, five sanctuaries had been established in Oregon, Georgia, Hawaii, Ohio, and Florida at a cost of $5,900,000, including maintenance and operations grants. Funding in FY 1978 will cover only maintenance and operation of existing sanctuaries. Current authority, at an annual level of $6,000,000, expires at the end of FY 1980.

Section 315(2) provides that:

The Secretary may, in accordance with this section and in accordance with such regulations as the Secretary shall promulgate, make grants to any coastal state for the purpose of. . . acquiring lands to provide for access to public beaches and other public coastal areas of environmental, recreational, historic, esthetic, ecological, or cultural value, and for the preservation of islands. The amount of any such grant shall not exceed 50 percentum of the cost of the project involved.

Funding is provided in subsection 318(a)(7) which provides for sums, "not to exceed $25 million for each of the fiscal years ending September 30, 1977; September 30, 1978; September 30, 1979; and September 30, 1980, respectively, as may be necessary for grants under section 315(2) to remain available until expended." As of December 1979, no funds had been appropriated for the program.

Although the Act does not specifically address the issue of hazardous areas, States can include a consideration of hazards in their management programs and receive funding from the Federal Government. Further, once a State has an approved plan, Federal

programs are required to be consistent with the goals and objectives established by the State plan.

Floodplain Management

The Floodplain Management Executive Order of 1977 (Exec. Order 11988) directs all Federal agencies to "...avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative..."

The Water Resources Council issued Floodplain Management Guidelines on February 10, 1978 to assist agencies in meeting their responsibilities under the floodplain order. Seven of the 12 Departments and three of seven major independent agencies have published draft or interim procedures in the *Federal Register*. Several subagencies, such as the Army Corps of Engineers, Soil Conservation Service, and Fish and Wildlife Service, have also published proposed procedures. The procedures clearly state the Federal government's policy prohibiting the degradation of floodplains. The President's statement in the June 6, 1978 Water Resources Policy Reform Message provides additional impetus to agency compliance.

The Order applies specifically to agencies that: (1) acquire, manage, or dispose of Federal lands and facilities; (2) undertake, finance, or assist construction and improvements; and (3) conduct activities and programs affecting land use, including planning, regulation, and licensing. The Order covers, as a minimum, areas subject to inundation by a flood with a one percent chance of occurring in any year (i.e., 100-year or base flood), whether these areas are located by or near rivers, streams, oceans, ponds, or related water bodies. As stated within the Order "this determination shall be made according to a Department of Housing and Urban Development floodplain map or a more detailed map of an area, if available." Based on a sampling of areas, it appears that a high percentage of barrier island lands under study (85% or more) are covered by the Floodplain Management Executive Order. Figure 10 is an example of a Flood Insurance Rate Map.

The Order requires agencies to amend or issue regulations and procedures to: (1) avoid development on the base floodplain if at all feasible, (2) provide alternatives to minimize adverse impacts in the base floodplain if development cannot be avoided, and (3) keep the public informed of proposed actions in the base floodplain and encourage participation in floodplain decision making. Each agency is required to issue or amend existing regulations/procedures to comply with the Order. These regulations are to be prepared in consultation with the Water Resources Council, the Federal Insurance Administration, and the Council on Environmental Quality. They will be updated as necessary. Coupled with this Order is Executive Order 11990 on the Protection of Wetlands, which directs all Federal agencies to "avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands whenever there is a practicable alternative."

Environmental Impact Statement Reviews

The National Environmental Policy Act (NEPA) requires all Federal agencies to take into account the value of environmental preservation in their activities, and it prescribes certain procedural measures to ensure that such values are fully respected. An important aspect of the law is the requirement of preparation of Environmental Impact Statements (EIS) for every proposal for legislation and other major Federal activities significantly affecting the quality of the human environment.

EIS's and environmental assessments under NEPA may be required for permits (Corps of Engineers, Coast Guard, Environmental Protection Agency), grants of money (Federal Highway Administration, Economic Development Agency, Office of Coastal Zone Management), and new housing (Department of Housing and Urban Development). Environmental review must also be undertaken for direct Federal projects and for land use management or disposal proposals (Department of Interior, Department of Defense, General Services Administration). NEPA processes serve to alert the public and other agencies on proposed actions affecting the barrier islands and are a means to coordinate various Federal decisions and viewpoints. Where problems exist, NEPA review can bring to the highest levels of the Federal government any proposal that might have serious adverse impacts on barrier islands and their environmental and economic values.

Air Quality Control

The Clean Air Act of 1970 established a two-phase strategy to maintain ambient air quality standards.

First is the regulation of new indirect, or complex sources—those facilities likely to generate substantially increased vehicular traffic. Such facilities in the coastal zone might include new ports or marinas, waterfront recreational complexes, and large industrial plants. Under the Clean Air Act, assurance would have to be provided that such facilities would not result in the violation of air quality standards. Second, and still largely unformulated, the EPA air quality maintenance strategy calls for the development of growth plans and development of a long-term control strategy where such growth may lead to air quality deterioration. This long-term growth control planning for the preservation of air quality should be incorporated into the State coastal zone planning under the CZMA.

State Efforts

Various State policies and/or programs are currently being implemented which either indirectly or directly provide protection to barrier islands and their resources. However, the States' attitudes toward their barrier islands and how they have dealt with them vary greatly.

The contrast between good and bad beach management under State jurisdiction (that is, where no Federal seashores or wildlife refuges are involved) is apparent in most States. A good example is the Delaware coast. There, the Delaware Seashore State Park is a model of barrier island beach management. Driving through the State Park, one sees nothing but dunes from the highway, with the carefully spaced parking areas mostly screened by dune fields.

The barrier dunes have been simply and effectively stabilized by sand-catching snow fences, and the natural dune vegetation has been encouraged and protected. Beach access is carefully controlled by means of entrance roads located at intervals along the coastal highway. Each of these entrance roads leads to a parking area on the inland side of the barrier dune, and controlled walkways provide pedestrian access to the beach proper. Disturbance to the dunes and vegetation is minimized by restricting vehicles and by limiting foot traffic to specified walks. The broad beaches are popular and heavily used for swimming and surf fishing. Great recreational benefits are enjoyed with minimum investment and maintenance. In the event of a serious

storm, the only loss would be to portable toilets and walkways.

To the south, however, near the town of Bethany, the contrast is striking. High-rise buildings, some of which impinge upon the barrier dunes, line the beach.

Apart from State beaches used for mass urban recreation (such as Robert Moses and Jones Beach State Parks in New York) and for which barrier island preservation is incidental, one of the most vivid contrasts to the type of area represented by Delaware Seashore State Park is Jekyll Island, Georgia.[44] Jekyll Island is entirely a State park. Although State legislation limits development to no more than 35% of the island's land area, much of its waterfront and adjacent lands have been heavily developed. The commercial enterprises and private residences occupy State park land under 70-99 year leases. The island has some 1,200 permanent occupants.[45] In the eagerness to develop the island, 200 acres of dunes and 175 acres of marsh were destroyed. There has been little effort to protect the island's natural system, which is normally the practice in State parks (including other mainland State parks in Georgia).

North Carolina has recognized the importance of beach and dune protection and maintenance for over 20 years, and passed a dune protection ordinance (G.S. 104-B) in 1957. This ordinance required a permit prior to damaging, destroying, or removing any sand dune, or part thereof, lying along the Outer Banks—or prior to killing, destroying, or removing any trees, shrubbery, grass, or other vegetation growing on the dunes. More serious protection of barrier island shorelines, estuarine waters, associated marshlands, and estuarine shorelines began in 1970 with stringent implementation of the North Carolina Dredge and Fill Law (G.S. 113-229) which was passed in 1969. This law requires permits for excavation and/or filling along the State's 300+ miles of ocean shoreline, and in the 2.3 million acres of estuarine waters and marshlands (including those marshes subject to occasional flooding). Additionally, the North Carolina Coastal Area Management Act initiated permits in designated Areas of Environmental Concern (AEC's) on March 1, 1978. Federal approval of North Carolina's Coastal Management Plan was obtained in September 1978—making North Carolina the first southern State to receive such approval.

Sixteen of the 18 East and Gulf Coast States have set aside selected barrier islands, or sections thereof, as State parks, wildlife refuges, or natural areas. All but one of the New England States have at least one barrier island reservation.[46] The relative scarcity and small size of these reservations reflect both the fact that northeastern barrier islands are smaller and less numerous than those further south, and that the northeast underwent extensive urbanization and coastal development at an earlier date than the more southerly coasts.

Several other States have special conditions that limit their opportunity to establish State parks on the islands. For example, 70% of Maryland's limited stretch of Atlantic coast is included in Assateague Island National Seashore, however, the State does maintain a 700 acre state park on Assateague. Similarly, North Carolina has two lengthy national seashores (Cape Hatteras and Cape Lookout), and three of Mississippi's five barrier islands are included in Gulf Islands National Seashore. Many of Virginia's barrier islands are owned by The Nature Conservancy and are protected in The Nature Conservancy's Coastal Preserve. Perhaps the most comprehensive State systems of barrier island preservation are found in the State parks of South Carolina, Florida, and Texas. In contrast to the New England States, these States have larger and more numerous barrier islands, and did not feel the pressure of urban and coastal zone development until later.

As with all other land areas and water bodies within a given State (except Federally-administered lands such as national seashores), States and their political subdivisions have great authority over how barrier islands are used. For the most part, the coastal States have been unwilling or unable to establish general land use controls (except for urban zoning) or to identify and restrict the development of hazardous areas and places of special significance

[44]Jekyll Island fulfills this study's definitions of both "protected" and "developed," and is entered on the respective lists in Appendix 2.

[45]Langdon Warner and David Strouss, Inventory of the Status of the Barrier Islands of the Southeast, (New York, New York: Open Space, Inst., 1976), p. 284.

[46]The exception is New Hampshire, which has the shortest coastline of all the coastal States. The other State with no State-owned barrier island reservations is Mississippi.

(ecologic, recreational, etc.). Where there has been a rapid surge in the demand for homesites and development properties with a concomitant increase in land value, as on the barrier islands, the real estate interests and large-scale subdivision developers usually have determined land use patterns.

There are, however, numerous controls available to States or their political subdivisions, and some jurisdictions have made excellent use of them to protect barrier islands. For example, the Coastal Resources Management Council of Rhode Island has adopted regulatory policies intended to control and limit further development of undeveloped beaches. The State's attitude toward the islands is apparent from the following statement of findings in the Council's regulations:

Rhode Island's barrier beaches, their associated sand dunes, wetlands and salt ponds are a limited and valuable natural resource in need of protection and careful management. The barrier beach system is a very delicate one, yet in an undisturbed state is a public asset of the greatest value.[47]

In issuing permits for projects involving the alteration of shorelines, the Council places the burden of proof on the applicant. The applicant must prove that such factors as sediment deposition patterns, biological communities, esthetic and recreational values, water quality, public access to beaches, and erosion and flood hazards are capable of supporting the proposed activity or land use. Sand dunes receive special attention: pedestrian as well as vehicular crossing of dunes is restricted to boardwalks or stabilized trails, and any construction on or alteration of the dunes is rigidly controlled.

Recognizing that, other things being equal, the closer a structure is to the waterline the more susceptible it is to damage from storm waves, the Florida Legislature has enacted a law which establishes a coastal construction control line. The statute prohibits construction or excavation seaward of the line without a permit from the Florida Department of Natural Resources (DNR). The Statute also makes provisions for any coastal county or municipality to establish coastal construction zoning and building codes in lieu of the State provisions, under condition of approval of the DNR as to the adequacy of such zoning and codes to protect the shoreline from erosion and safeguard adjacent structures.[48] The control line is established at the maximum expected reach of waves and floods during a 100-year storm. Its efficacy was shown in 1975 when hurricane Eloise struck near Panama City. The setback line had previously been established in that area, and the storm damage relative to the line was studied. Flood damage, on the average, was higher for properties located seaward than for those located landward of the line.[49]

The importance of dune protection has been specifically addressed in several States. For example, Texas has implemented a statute which makes it unlawful for:

"any person or association of persons, corporate or otherwise, to damage, destroy, or remove any sand dune or portion thereof on any barrier island or peninsula seaward of the dune protection line, or to kill, destroy, or remove in any manner vegetation growing on any sand dune seaward of the dune protection line, without having first obtained a permit as specified which authorized such conduct."

Another means of exercising control over island development is the management program being prepared by each coastal State under the Coastal Zone Management Act of 1972.[50] In section 305(b)(3) of the Act, the States are instructed to include an inventory of areas of particular concern in their management programs. Once so designated, these areas of particular concern must be given special protection in the management program. It is clear that barrier islands and their related wetlands and bays fall within the definition of "area of particular concern." At least four of the qualifying descriptions in the Office of Coastal Zone Management's pertinent regulations apply:

1. Areas of unique, scarce, fragile or vulnerable habitat. . .
2. Areas of high natural productivity or essential habitat for living resources. . .

[47]Letter and enclosure from John A. Lyons, Chairman of the Council, 12/28/77. (The term "barrier beach" is synonymous with both barrier island and barrier spit).

[48]Florida's coastal setback line: an effort to regulate beachfront development, E. Warren Shows, University of South Florida. From a study done for the State Department of Natural Resources, 1977.

[49]Letter from Edward T. LaRoe, PH.D., Chief, Bureau of Coastal Zone Planning to Chris T. Delaporte, Director of HCRS, 9/25/78.

[50]PL 92-583, 86 Stat. 1280.

3. Areas of substantial recreational value and/or opportunity . . .
4. Areas of significant hazard if developed, due to storms, slides, floods, erosion, settlement, etc.[51]

Connecticut's management program recommends that all of its barrier islands be considered areas of particular concern.

The preservation tools available to States are powerful. Because political systems and sentiments vary so widely from State to State, it is often difficult to identify a model "wetlands," "dune protection," or "barrier islands" protection law. A program that works satisfactorily in one state might be a total failure in another; legislators, planners, and other State officials, however, can learn from another's experience in dealing with a particular issue, like barrier island protection.

As discussed, some States *are* successfully implementing programs which are effectively addressing specific problems of barrier island protection. Unfortunately, this is not generally the case. In those instances where States have not enacted appropriate enabling or regulatory legislation, the task of ensuring appropriate barrier island use is obviously very difficult. Even in States that have developed some growth management related systems, the solution in terms of barrier island protection is far from satisfactory. Why the unsatisfactory results or failure of some States to adopt protection programs? As can be deduced from this report, protecting barrier islands is no simple task; it is a complicated mission requiring the fullest cooperation of a variety of agencies and a thorough understanding of the natural processes. It is in attempting to accomplish this mission, however, that various problems arise. Some of these problems include:

1. **Confusing and often conflicting regulatory schemes.**
   Bossellman, Callis and Banta, in their 1971 discussion of the land use management controversy, *The Taking Issue*, report that a:

   "Common failing of state land regulatory systems is that they do not relate in a logical manner to the continuing need for local participation. Most of them tend to by-pass the existing system of local regulation and set up completely independent and unrelated systems. This requires the developer (and ultimately the consumer) who is subject to both systems to go through two separate and distinct administrative processes, often doubling the time required and substantially increasing the costs required to obtain approval of the development proposal."

2. **Problems with monitoring and enforcement.**
   Even officials of States with outstanding barrier island related legislation on the books report that it is often very difficult to monitor infringements and/or enforce compliance. Such State programs operate at chronically low staff and funding levels. There are simply not enough personnel to patrol the beaches, carefully review development proposals, or monitor every local conservation committee meeting.

3. **Barrier islands/beaches as unique and discrete units of the coastal zone.**
   Few States in their Coastal Zone Management Planning process have identified barrier islands as vital protection areas; likewise, few States have specifically identified barrier island preservation concerns in their Statewide Comprehensive Outdoor Recreation Plans. All this

[51]Office of Coastal Zone Management Regs. §923.13(a).

reflects a general failure on the part of the States to consider barrier islands as a separate and quite different growth management question from the mainland.

4. **Objective base for growth management decisions.**
   Growth management systems, especially as related to barrier island protection should be based on local and regional recognition of land holding capacities. They should incorporate multiple environmental, economic, and service infrastructure constraints in their regulatory processes.

The aforementioned programs and problems clearly point out that the State's role in barrier island protection is an essential one and can not be overlooked. In order to develop a workable, rational, and consistent national policy for barrier island protection, each coastal state will have to evaluate its needs, determine its strategies, and implement its programs. They have the capability; what is needed is a strong commitment to protecting barrier islands and proof that the Federal programs, too, are being directed toward that end.

Local Efforts

If barrier islands are to be protected, all governmental agencies will have to participate equally in protective actions. Local government can determine, by their action or lack of action, the fate of the islands.

Glynn County, Georgia, for example, has passed some of the strictest beach and dune protection ordinances in the country. In the special Beach and Dune Protection District established by the County Commission, the following provisions (among others) apply:

- All permanent structures shall be mounted on pilings—not fill—with the first floor raised at least 14 feet above mean sea level.

- Such modifications as seawalls, jetties, roads, and sewers are allowed only if the applicant proves they will cause no short or long-term adverse environmental effects.

- A setback line for all construction is established 40 feet landward of the crest of the first stable dune.

Collier County, Florida controls growth on its Ten Thousand Island archipelago by means of a special treatment (ST) ordinance (enacted in 1974) designed to protect areas of environmental sensitivity.[52] Although the ordinance does not prohibit development outright, it is very restrictive, requiring lengthy site plan reviews and the approval of the Board of County Commissioners before any site alteration or development can take place. A special feature of the ST ordinance is that it encourages the preservation of barrier islands through the transfer of development rights to other, less fragile areas. If they relinquish their development rights to their island property, the developers are compensated by being permitted higher densities on the new site. The barrier island is then donated to the county for permanent preservation. Either way (the developer meets the stringent controls in order to develop the island, or transfers development rights to a less restrictive mainland site and donates the island to the county), the barrier island is preserved in a more or less natural condition, and the proposed development takes place in a more suitable area.

Another approach is that of the special regional commission empowered by the State to regulate land use and development. One example is the Martha's Vineyard Commission, established in 1974 on the island of Martha's Vineyard, Masssachusetts.[53] (The island is not a barrier island, but contains several barrier beaches.) The Commission, created by the State legislature along the lines of the American Law Institute's model land development code, has two basic functions:

- It designates specific geographic areas as Districts of Critical Planning Concern, and promulgates guidelines for their development.
- It identifies types of development, designated Developments of Regional Impact (DRI), which are likely to produce adverse regional impacts. The Commission also adopts standards for reviewing the applications for DRIs, as well as conditions that may be imposed on the proposed development to overcome the harmful effects.

[52]Neno J. Spagna, "A Case History of Marco Island, Florida," unpublished paper, 1977.

[53]Donald L. Connors, "A Regional Approach to Regulation of Land Use and Development: the Martha's Vinyard Commission," unpublished paper.

One of the most beneficial aspects of the Commission's operation is its ability to work cooperatively with the community regulatory agencies such as planning boards and conservation commissions. For example, a developer must have the Commission's approval for a DRI before a local (town) permit can be issued; thereby enhancing the town's ability to manage growth, shape its development, and deny projects that would be unwise. The major problem area usually involves local regulatory authorities. Local authorities perceive State actions (guidelines) more as a form of paternalistic criticism of local incompetence, while the State sees a lack of incentive by the local authorities to protect the State's interests. All too often, State authorities tend to feel that local authorities have enough difficulty just protecting their own interests, thus, their implementation of State programs is not always fully operative. What must be recognized and highlighted in protecting barrier islands is a relationship accentuating the positive role State and Federal levels of government can play in focusing their technical and financial resources to assist local governments.

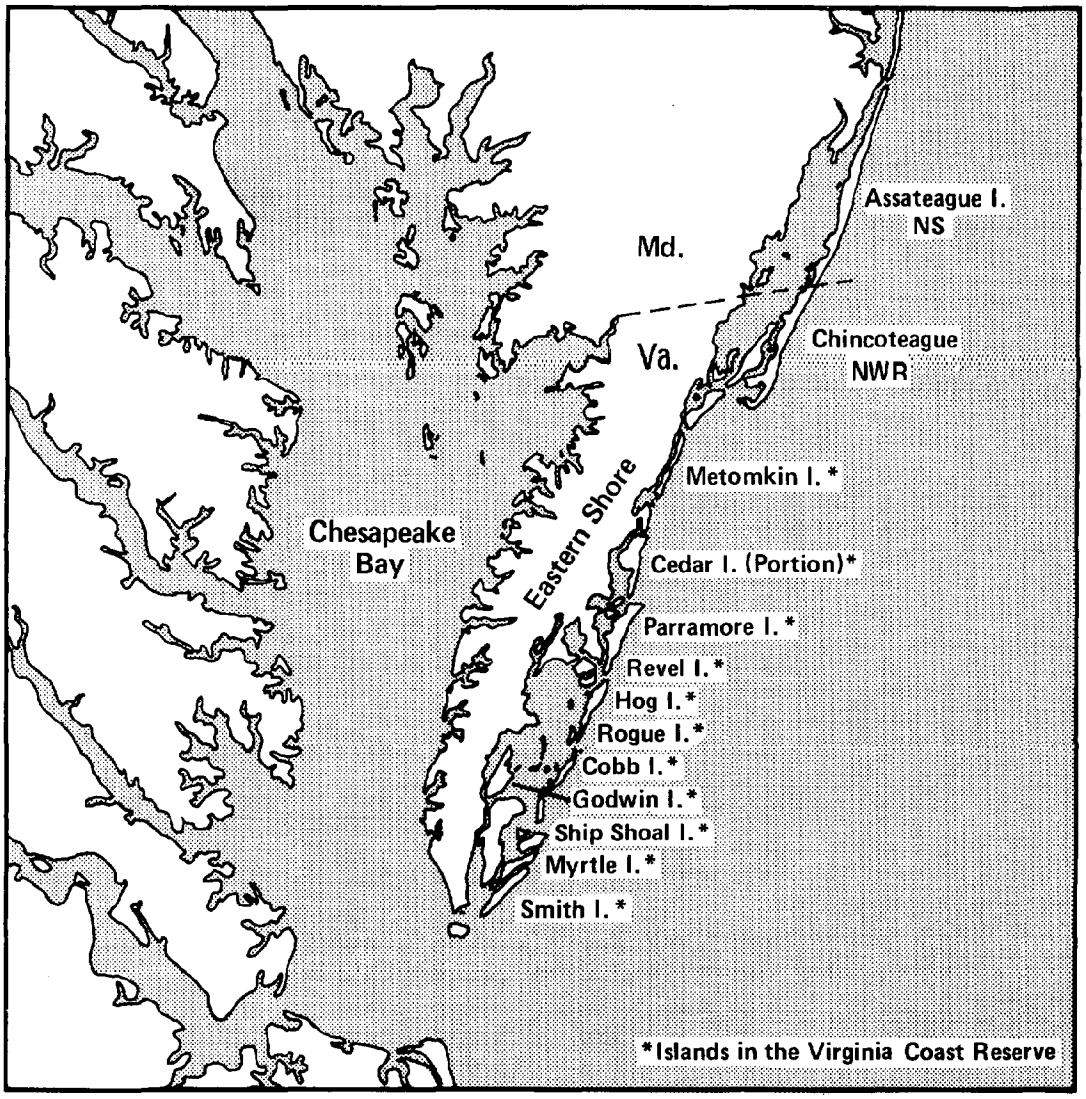
Private Efforts

Prompted by the rapid increase in barrier island development and by dissatisfaction with State and Federal Government's response to the problem, private parties (usually regional or national conservation organizations, but also small groups and individuals) have played an essential role in preserving the islands. Private action has generally taken four forms: the acquisition and retention of islands; special preservation efforts by private owners of their island properties; community action; and the acquisition and subsequent donation or sale of islands to State or Federal agencies for permanent retention in public ownership. Examples of each are described below.

Acquisition of Islands

The Nature Conservancy (TNC) is a national, citizen-supported conservation organization. The Conservancy acquires areas of outstanding natural or ecological value through donation or purchase. Some of these lands are held and provided with permanent stewardship, while others are transferred or

Figure 10. The Nature Conservancy's Virginia Coast Reserve



sold to Federal agencies when those agencies are prepared to maintain the Conservancy's protection of them. Among the areas held under its stewardship program is the Virginia Coast Reserve, an ambitious undertaking that is preserving a marvelous chain of uninhabited and pristine barrier islands and marshes on the Eastern Shore of Virginia (Fig. 11). These 13 islands, ten of which are owned entirely by TNC, will be held and managed in their undeveloped state as an outdoor laboratory for research, a facility for educational programs, and a place for various forms of compatible recreation. The Reserve is managed by a professional administrator operating from a headquarters office on the mainland. With the added help of TNC's efforts, the barrier islands of Virginia are almost completely protected, since three of the remaining five islands are protected by the Federal Government and one by the State.

The Conservancy, in purchasing over 33,000 acres on 13 islands and preserving and administering them, is clearly providing a public benefit, and doing so on a scale normally associated with Federal or State Governments. Yet it provides these

benefits without the financial and other resources available to the government, and with certain liabilities usually associated with private owners. For example, State or Federal bodies that have the power of condemnation can take protected property from the Conservancy. For another, they are not eligible for financial or technical assistance from the Federal barrier island-managing agencies.

A group that does the same type of work, but on a far more limited scale, is the Sanibel-Captiva Conservation Foundation of Florida. The Foundation was an outgrowth of a citizen's committee that was instrumental in creating the "Ding" Darling Wildlife Refuge on Sanibel Island. In addition to its interest in controlling and guiding local growth and development, in conducting a public environmental education program, and in campaigning for stronger environmental ordinances and their enforcement, the Foundation owns and protects over 500 acres of critical wetlands on the island.

The Trustees of Reservations also manages barrier islands. A privately-administered charitable corporation operating in the State of Massachusetts, the Trustees acquires and protects in perpetuity significant historic and natural areas throughout the State. Its management of these areas provides for public use and enjoyment, and the interpretation of the significance of the islands to visitors. Each reservation has a local committee consisting of residents of the area who take a personal interest in the reservation's management. The statewide program of the Trustees is administered through four management regions, three of which are each subdivided into several management units. Each region is administered by a superintendent. The Trustees currently holds two barrier beach areas—Chappaquiddick Island and Nantucket Island.

Preservation By Private Owners

A considerable amount of barrier island land is protected today by private owners who are dedicated to the preservation of the intrinsic value of their lands. One way to preserve many of the values of a property's natural environment, while still enjoying the benefits of private ownership and use, is to donate the conservation restrictions or easements to another party, private or public. A privately-organized plan for preserving the sensitive natural environment by donating such restrictions to a con-

servation organization is currently being implemented by landowners on Tuckernuck Island, Massachusetts.[54] (Although Tuckernuck is not itself a barrier island, the method is applicable to barrier islands.) By mutual agreement, and following a study of the island, the landowners voluntarily donate conservation restrictions on their land to the Trustees of Reservations. In such a restriction, the basic title to the property and its exclusive use remains with the owner. No rights are provided for public access to the property unless specifically granted by the owner. The land may be used by the owner in any manner consistent with the terms of the conservation restriction. The restrictions protect the island's natural and scenic qualities by preventing fundamental changes in the present land patterns and by limiting development.

The residents of Little Cumberland Island, Georgia have long recognized the esthetic and natural values of their island, and have taken steps to protect these values by setting up a voluntary association. Development and land use are controlled by covenants and deed restrictions on individual properties, and a considerable part of the island is left undeveloped. The success of the owners and their association in maintaining the integrity of their island was acknowledged by Congress when adjacent Cumberland Island was preserved as a National Seashore in 1972.[55] Although Little Cumberland was included within the boundaries of the new seashore, section 4(d) of the Act establishing the Seashore set the policy that if the individual owners "enter into an irrevocable trust or some other irrevocable agreement for the preservation of the resources," the Secretary of Interior will not exercise his authority to purchase the properties. The private efforts of the property owners to preserve the quality of their island have therefore coincided with the national intent to preserve their larger and wilder neighbor.

Private owners have played a unique role in the preservation of Georgia's barrier islands. Early in this century it became fashionable for the extremely wealthy families of the northeast to acquire barrier islands and to build summer homes on them. The families came to love the islands and tended to preserve them largely in their natural state. Several of Georgia's loveliest undeveloped islands, such as St. Catherines, Little Cumberland, and Little St. Simons, fall into this category. Another island, Ossabaw, was purchased by the State of Georgia in May 1978.

Community Action

Community action can also contribute to the wise development of barrier islands and the preservation of their values, as illustrated by the history of Sanibel Island, Florida. The island, which is the site of the 5,000-acre "Ding" Darling National Wildlife Refuge, was connected to the mainland by a causeway in 1963. At that time, it was only slightly developed. The Lee County Commissioners approved of the rapid development that ensued, notwithstanding the serious alterations of the island's fragile environment that accompanied development. But many of the island's residents did not approve, and formed Sanibel Tomorrow, a citizen action group that promoted incorporation of the island as a solution to the problem.[56]

Their efforts paid off. In 1974, 64% of the people

[54]Donald L. Conners, "A Private Approach to Conservation: Tuckernuck Island, Massachusetts," unpublished paper.

[55]PL92-536, 86 Stat. 1067.

[56]"Islands for Our Future," Carole Kneeland, Corpus Christi Caller, Sept. 11, 1977, section B.

voted for the incorporation of the city of Sanibel. At its first meeting, the newly-elected city council declared a moratorium on building permits while awaiting the recommendations of a land use study that was being jointly prepared by The Conservation Foundation and the firm of Wallace, McHarg, Roberts and Todd. All aspects of the island were studied, and the result was a comprehensive land use plan that divided the island into ecological zones and recommended development and land use rules for each zone.[57] Hearings were held on the plan and it was adopted by the council. The plan protects the dunes, marshes, and native vegetation; it prohibits activities that would impair the precious supply of groundwater; and it establishes height limits and impermeable-area coverage limits in wetlands. Population densities are set for each ecological zone. The city council has built a legal structure of city ordinances on the foundation of the plan which will preserve the quality of life on Sanibel while allowing controlled and carefully considered development.

Acquisition for Transfer or Donation

Finally, a number of conservation-minded organizations have purchased barrier islands for transfer or resale to government agencies. The practical value of this tactic—aside from the obvious benefit to the public when such transfers are in the form of gifts to the government—is that islands can be acquired by fast-acting private parties before the islands are developed. Public agencies, which must negotiate the tedious procedures of obtaining acquisition authority and funding, are often unable to react quickly to an emergency or to an unexpected opportunity.

One group that has actively pursued the acquisition of barrier islands and adjacent marshes (among other types of areas) is the Philadelphia Conservationists. For 20 years, this organization has acquired and transferred key island habitats to such agencies as the Fish and Wildlife Service. Much of its activity has been in New Jersey, where it has contributed greatly to the State's impressive string of national wildlife refuges. It also acquired Wreck Island, Virginia, and donated it to the State's Division of Parks.

At the time of transfer, and if it meets the needs of the receiving agency, the donor conservation organization can sometimes attach special conditions to the future use and development of the island. For example, when Wassaw Island, Georgia was purchased by the Nature Conservancy in 1969 for donation to the Fish and Wildlife Service, the two parties agreed to restrictions in the deed that prevent a bridge to the island, prevent the construction of any major facilities on the island, and prohibit camping there. These special conditions ensure the Conservancy's goal of preserving the island in its natural state while permitting the FWS to carry out its functions.[58]

[57]John Clark, "The Sanibel Report: Formulation of a Comprehensive Plan Based on Natural Systems," The Conservation Foundation, 1976.

[58]Langdon Warner and David Strouss, Inventory of the Status of the Barrier Islands of the Southeast, (New York, New York: Open Space, Inst., 1976), p. 250.

Chapter 6

Federal Programs and Their Influence on Barrier Island Development

"Coastal barrier islands are a fragile buffer between the wetlands and the sea. . . Many of them are unstable and not suited for development, yet in the past the Federal Government has subsidized and insured new construction on them. Eventually, we can expect heavy economic losses from this shortsighted policy."
President Carter
May 23, 1977

Many Federal activities, while aimed at achieving important national goals, have had the effect of stimulating and subsidizing development of barrier islands. Public programs involving bridge and highway construction, coastal dredging and shoreline protection, flood insurance, and wastewater treatment facility grants have had profound effects, both direct and indirect, on barrier island development. An obvious example is that of a bridge built to connect a once-isolated island to the mainland. The island immediately becomes attractive for development, land values rise, and the natural qualities of the island may be permanently impaired.

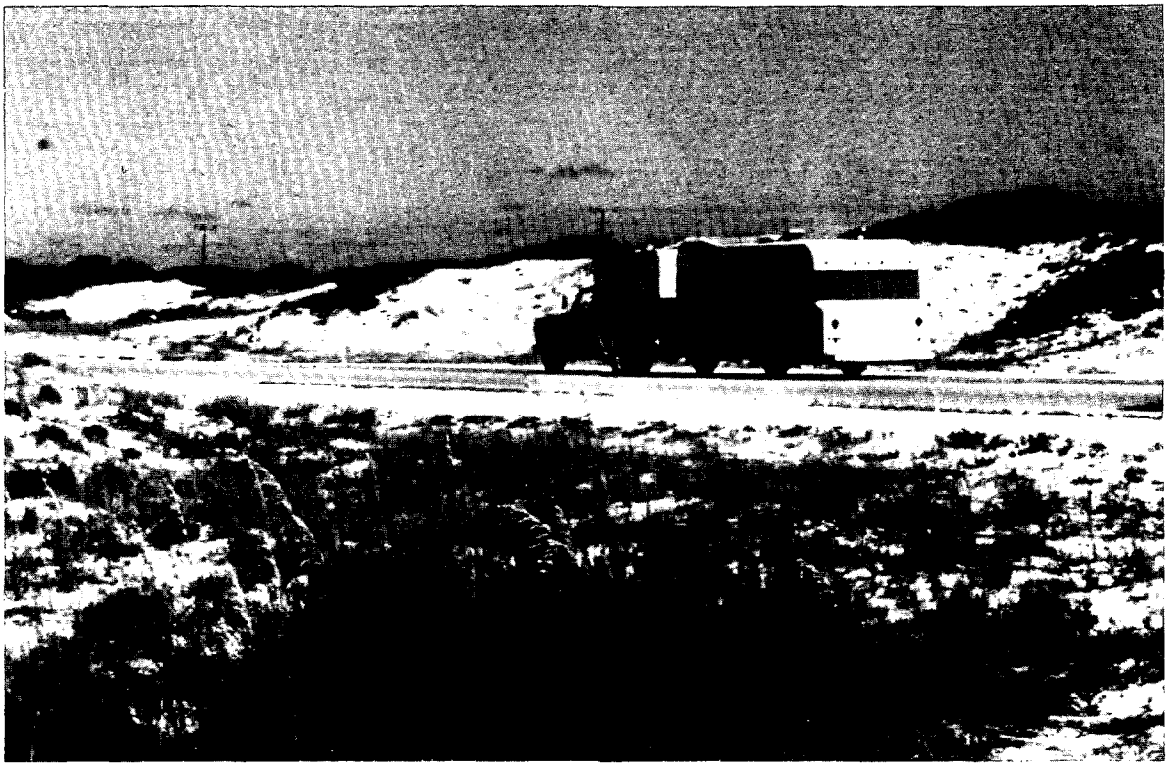
Numerous Federal programs influence the degree and extent of development on barrier islands. This can occur without regard to possible conflicts between programs. The following are short descriptions of Federal programs which may influence or more directly affect the development of barrier islands.

Bridge and Highway Construction Programs

The Federal Government authorizes the construction of bridges for access to barrier islands and authorizes the development of road systems on barrier islands. If the bridge or road is part of a planned primary or secondary highway system, the government may contribute financially to its construction. The determining factor is often simply whether or not the bridge or road is part of an approved State or county plan. Both the bridge and highway construction programs, which are administered by the Department of Transportation (DOT), may facilitate development of the islands by permitting improved access to the islands.

The bridge permit program is administered by the U.S. Coast Guard (USCG) and the highway construction grant program by the Federal Highway Administration (FHWA). With specific reference to the barrier islands, DOT programs will be involved more frequently in cases where the islands are already developed or partially developed. In these cases, transportation facilities are considered necessary to serve the needs of residents as well as to permit expanded development. However, decisions regarding access and transportation facilities are of special importance in cases where an island is undeveloped and unprotected, and where the owners or local public agencies are seeking improved access in order to facilitate development.

The applicable controls that are administered vary extensively from case to case. Grants and bridge permits generally require preparation of appropriate environmental documentation. Where a significant impact is anticipated, a full environmental impact statement (EIS) ordinarily will be processed. In such cases, appropriate environmental terms and controls may be imposed as a condition of the grant or permit. For example, DOT actions in the past have sometimes been conditioned upon the requirement that facilities be constructed on structure rather than on fill to minimize the impact on wetland or tidal areas. There is nothing within the administrative procedures, however, that would allow programs on barrier islands to be



treated in a different manner than those on any mainland area.

Bridge Construction Permits

Bridges can be considered essential to barrier island development, because without the easy access they provide, development costs would be extremely high, if not prohibitive. The Coast Guard has had statutory authority for reviewing proposals to build bridges over navigable waters, including those to barrier islands, since 1966. During the past five years, the Coast Guard has granted 24 bridge permits for barrier island-related projects (not all new bridges) and has six applications pending (February 1978). Bridge permit applications are processed and approved in accordance with the bridge statutes, Code of Federal Regulations, and case law. According to the Coast Guard, the issuance or denial of a bridge permit depends upon whether or not the proposed work will provide for the reasonable needs of navigation, subject to the provisions of specific statutes governing environmental impacts such as the Fish and Wildlife Coordination Act, the National Historic Preservation Act, and the Federal Water Pollution Control Act amendments of 1972. The National Environmental Policy Act requires the Coast Guard to consider the potential impact of a proposal on the future development of an island, and to seek public comment and expert testimony from Federal, State, and local agencies. These comments are formally obtained through the EIS review process.

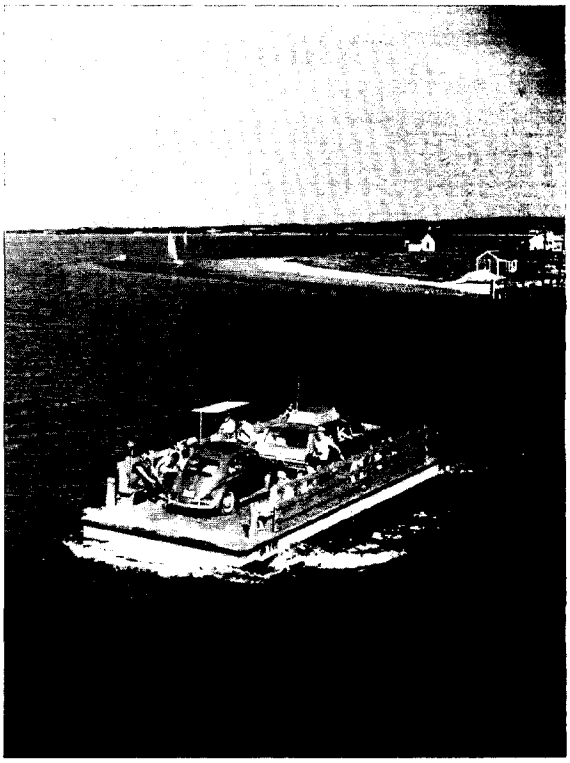
Notwithstanding these statutes, it seems that the Coast Guard has never denied a bridge permit on environmental grounds. It should be noted, however, that bridges to barrier islands have not been a controversial issue until recently, and that the agency may, therefore not have had an opportunity to deal with the issue. Furthermore, the Coast Guard has no current regulations that spell out the regulatory test which will be applied in evaluating the effect of a bridge proposal on future barrier island development, or that set forth the burden of proof that a bridge permit applicant must satisfy in order to qualify for a permit. Although some (perhaps including the agency itself), may protest that authority over bridges should not entitle the Coast Guard to make decisions on the merits of barrier island development, such considerations

must be taken into account if the agency is to fulfill its mandate of protecting the public interest in terms of environmental resources. Limiting consideration to the primary impacts of a bridge would be meaningless because it would fail to recognize the proximate secondary impacts of granting the permit. Furthermore, NEPA requires examination of these impacts, which include the development of the islands, with its profound effects on coastal ecosystems and public safety. In some cases, the Coast Guard has been preparing environmental impact statements that outline the impacts of development that will follow bridge construction, but it is uncertain whether these impacts will be considered the basis for decisionmaking.

Coast Guard policies with respect to the administration of other statutory requirements and considerations are likewise unclear. For example, the Department of Transportation has a wetlands protection policy, and although wetlands are usually found in association with barrier islands, the Coast Guard has yet to decide how it will apply the DOT policy to bridge permits and construction of bridges. Similarly, Section 4(f) of the DOT Act of 1966 forbids the agency from sponsoring or approving projects that would use publicly-owned land that is important for wildlife, recreation, and historic preservation, unless there are no feasible alternatives and all planning measures have been established to reduce the impact of the project on publicly-owned wildlife refuges, and on recreational and historic resources. Section 4(f) is often overlooked in cases of *de facto* wildlife sanctuaries or recreation areas (e.g., publicly-owned wetlands, or important natural fisheries).

The Coast Guard position is that Section 4(f) protection should be given to wetlands, in certain limited circumstances, if the following conditions are met:

- The wetlands must be publicly-owned.
- The wetlands must have special characteristics that distinguish them as a public park, recreation area, or wildlife and waterfowl refuge. In applying this criterion, the Coast Guard would examine the physical characteristics of the land, the actual present use of the land, and the plans of the officials with jurisdiction over the land regarding future management and use of the land.



- The property must be of national, State, or local significance as determined by the Federal, State, or local officials with jurisdiction.

However, approval would still be granted if there is no feasible and prudent alternative for locating the bridge and if the proposal includes all possible planning to minimize harm.

Highway Construction Permits

The Federal Highway Administration, with its multi-billion dollar per annum highway construction program, plays an important role in determining land use patterns in the country. A new road may result not only in concreting over the rural, undeveloped areas, but also in development, which greatly multiplies the loss of open space. The availability of Federal financial assistance for transportation improvements also makes it practical and more economically rewarding to convert from low- to high-density developments. Construction of a major access road or highway on portions of a barrier island may result in serious alteration of the natural

features. Roads improve accessibility and increase pressures for residential, recreational, commercial and industrial uses.

There are, however, environmental constraints on all federally-funded highway building. When important resources such as barrier islands are involved, environmental impact statements must be prepared under NEPA and applicable FHWA regulations. In this case, Section 4(f) of the DOT statute is once again particularly important. Since barrier islands often feature national or State wildlife refuges, parks, or recreation areas that would be affected by the new highway (the road does not necessarily have to cross the refuge, park, or recreation area; it could have a significant impact from noise, air pollution, or esthetic disturbance) Section 4(f) will often be applicable to a federally-funded highway on a barrier island.

However, as with the USCG bridge permit program, Section 4(f) is frequently overlooked or viewed very narrowly in cases of *de facto* wildlife sanctuaries or recreation areas (e.g., publicly-owned wetlands, forests, or important natural fisheries). Federal Highway Administration figures show that during fiscal years 1976, 1977, and 1978, over $37 million in 70% Federal- 30% State or local matching grant monies were provided to State and local agencies for development of roads and highways on barrier islands.

Coastal Dredging and Shoreline Protection Programs

Three programs administered by the U.S. Army Corps of Engineers greatly influence barrier island development and use. These include: dredge and fill permits, navigational dredging, and shoreline protection. Authority for these programs is found in the Rivers and Harbors Act of 1899 and the Flood Control Act of 1941.

Dredge-and-Fill Permits

Under Section 404 of the Federal Water Pollution Control Act Amendments of 1972, and the Rivers and Harbors Act of 1899, the Corps has jurisdiction over any modification of traditionally navigable waters and over the discharges of dredged and fill material into all waters of the United States, including wetlands. Although there is controversy over the scope of the Corps' jurisdiction above mean high water, the agency has consistently been using its authority to protect coastal wetland ecosystems. The Corps has the power to encourage sound barrier island development by exercising its wetlands protection policy, which states that dredge-and-fill permits in wetlands will not be issued if there is another way to achieve desired ends, including upland development. Environmental impact statements are frequently prepared on such permit applications, and the Corps routinely uses them to help make its "public interest" determinations under its regulations.

Wetlands associated with barrier beaches and islands that are significant in shielding other areas from wave action, erosion, or storm damage are considered vital areas that constitute a productive and valuable public resource. The unnecessary alteration or destruction of these areas is discouraged as being contrary to the public interest. Where wetlands are identified as important, the applicant must provide sufficient information on the need to locate the dredge-and-fill activity in the wetland and must provide data which can be used to evaluate the availability and feasibility of alternative sites. With respect to its evaluations, the depth of the Corps' review often depends on public comment and expert testimony from Federal, State, and local agencies knowledgeable in the management of wetlands and other resources.

Navigational Dredging

The main impact of navigational dredging on barrier islands results from the deposition of spoil material on the islands. In addition, the placement of channels along the accreting edges of migrating barrier islands results in the eventual loss of the island as it migrates into the channel and is dredged out. Petit Bois Island, off the coast of Mississippi, is an example.

The Corps maintains the Atlantic and Gulf Intracoastal Waterways, small craft navigation channels dredged through the shallow bays that separate the barrier islands from the coastal mainland. The need to constantly remove sediment from the channel creates dredge material, which is disposed of in the least expensive manner that is environmentally sound. The practice has been to dump much of the dredged material in tidal marshes along the water-

way route. It is not the maintenance policy of the Corps to keep all projects at their full, authorized project dimensions, but to provide depths consistent with the reasonable needs of existing traffic. Thus, unnecessary dredging and dredged material disposal does not occur with projects where full project depths are not being used. In some instances on troublesome shoal areas, the Corps has found it to be economical to dredge overdepth as advanced maintenance to prevent the requirement of returning to the same project two or more times in the same dredging season.

The depth of the Intracoastal Waterway channels in most sections is maintained at -12 feet mean sea level (MSL) under congressional mandate. However, it does not appear that the question of the most advantageous depth has been studied. A 9-foot channel, such as that on the upper Mississippi River, might be sufficient to carry a large percentage of the normal traffic now using the channel. Such a move would greatly reduce spoil requirements, make it less expensive to dredge and dispose of spoil, and allow the remaining spoil to be disposed of in a more environmentally acceptable manner. This problem deserves study.

Shoreline Protection

Research and practical experience have demonstrated that the most effective type of shoreline protection is a broad beach and a well-developed dune system. The Corps provides assistance to Federal, State, and local agencies by replenishing sand on eroded beaches and by keeping navigation inlets stable. The conditions these activities were designed to correct may have resulted from man-made changes in the island's geologic processes and, when corrected, can lead to further changes. For example, beaches sometimes erode because buildings were built on or in front of the dunes. Replenishing the beach may only induce further unwise development.

Protection methods include:

1. Artificial Fill and Nourishment. Restoration with sand imported from another source and subsequent periodic nourishment is one frequently employed method of rebuilding an eroded beach. This method requires obtaining sand with suitable characteristics from nearby bays, inlets, or inland borrow areas without disrupting the ecological integrity of the borrow area. Research is needed to determine the long-term effects of beach restoration and nourishment on not only the restored beach and downdrift areas but on the borrow areas as well.
2. Groins. Groins are structures constructed generally perpendicular to the shoreline. They extend across the beach and into the water. Used individually or in a series, they interrupt the sand moving into the area and widen the beach on the updrift side. This method is effective only when large amounts of sand are in transit. After sand has accumulated updrift of a groin, it no longer represents a total barrier to the movement of sand along the shore. However, long-term patterns of erosion and deposition may be created when a number of groins are deployed in series. The accelerated erosion downdrift that usually results from construction of groins can be reduced when sand is added to the system by means of artificial fill and nourishment or by construction of sand bypass systems.
3. Seawalls. Seawalls are massive, rigid structures, constructed parallel to the beachline, which may be used to prevent flooding, protect against direct wave attack, and control erosion. Seawalls have been used successfully to reduce flooding over long periods of time. However, by preventing erosion of areas that added sand to the supply in motion, seawalls may accelerate erosion of the fronting beaches and nearby areas. The major drawback to this type of shore protection is the extremely high construction cost.
4. Revetments. Revetments are blankets of nonerodible material placed on a bank, bluff, or escarpment to prevent erosion. Stone or concrete blocks are commonly used. They are similar in function to seawalls, but are more flexible, generally of lighter construction, and less expensive.
5. Breakwaters. Breakwaters for shore protection are usually massive stone structures located in the sea and parallel to the shore. They interrupt the wave before it reaches the shore and reduce the energy expended on the beach. This interruption of wave action causes a calm landward of the breakwater, which slows the alongshore currents and causes sand to be impounded behind the structure. This impoundment,

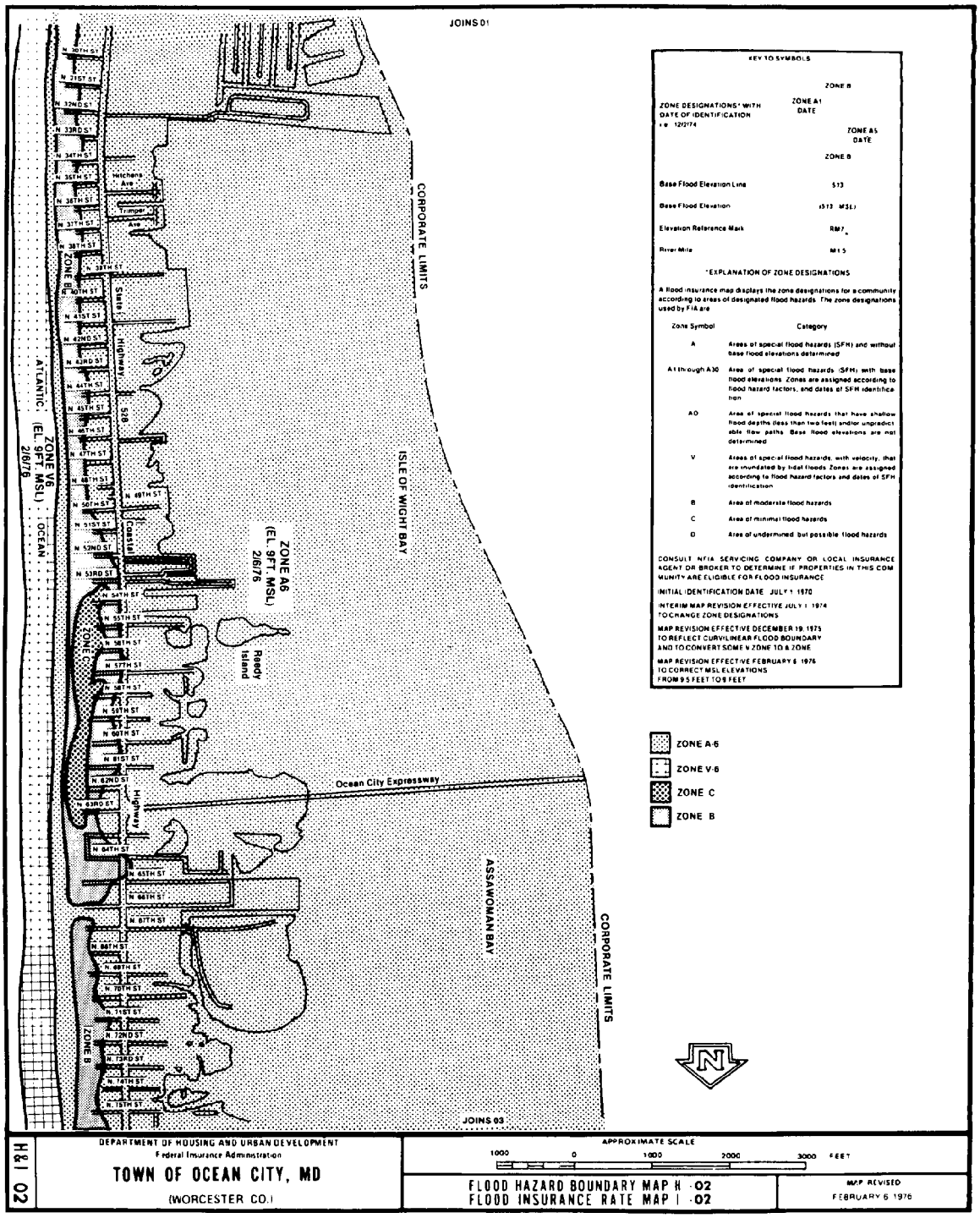
however, occurs at the expense of downdrift beaches, which are subsequently eroded. As in the case of groins, breakwaters may present only a temporary obstacle to longshore sand movement.

6. Jetties. A jetty is a structure extending into a body of water. It is designed to prevent shoaling of a navigation channel by littoral materials and to direct and confine the stream of tidal flow. Jetties are built at the mouth of a river or tidal inlet to help deepen and stabilize a channel. Most navigable inlets in the coastal United States are maintained by jetties. In general, sand trapped updrift of these structures is transported downdrift by mechanical means—a process termed "sand bypassing." In certain cases, such as Ocean City, Maryland, sand is not bypassed. This creates a sand deficiency downdrift of the jetty and subsequent erosion. The trapped sand at Ocean City is used to form recreational beaches along the City's waterfront.
7. Other Methods. Sand fences can be an effective method of trapping sand and helping to develop new dune lines, which then form a new first line of defense against storm waves. Vegetation serves a similar purpose in stabilizing dunes or beach areas that are not used intensively for recreation. Vegetation is also effective in reducing erosion of shorelines in bays and estuaries.

Studies by the Army Corps of Engineers of potential beach protection projects consider the degree of existing development and probable development to determine the benefits of constructing the project. The major category of benefits provided by beach protection concerns the prevention of losses by storm-wave erosion of the land and developments on the land. Beaches and dunes provide a natural means of defense against waves directly attacking structures, and against storm tides or storm surges inundating the structures and facilities landward of the dune line. Roads, bridges, and public utilities on barrier islands may be vulnerable to damage during storms. The decision to construct a project to prevent damage is based on existing development and the amount of normal growth expected without the project.

Enhancement of recreation is a second category of benefits. The enhanced value of recreational use associated with the proposed project compared to that associated with normal growth patterns for the

Figure 11. Town of Ocean City, Maryland
Flood Insurance Rate Map



area may be claimed as a project benefit if the beach is either publicly owned or open to public use. In fact, the Federal government cannot participate in any shore protection project without the guarantee that the public will have access to the shoreline in the project area. In this way, Federal projects often create public access to areas where access was previously denied. However, the project to rebuild the beach may not increase its dimensions beyond its historical limits.

The consequences of some of the structural solutions to coastal development are apparent in places such as Miami Beach, Florida, where the beach has virtually been lost, and Ocean City, Maryland, where channel jetties have accelerated the erosion of the north end of Assateague Island. Cost is another issue to consider. The Army Corps of Engineers has spent nearly $33.5 million for shoreline stabilization on barrier islands during the past three fiscal years. This figure does not reflect long-term commitments such as that to reestablish the beach at Miami Beach or the high annual maintenance cost once a beach has been reconstructed. Additionally, information on Corps hurricane protection and beach erosion control programs for fiscal years 1978 and 1979 indicates a total of 33 projects in various stages of advance design or construction involving barrier islands in 12 of the 18 Atlantic and Gulf Coast States.

Insurance & Disaster Relief

As a result of the President's Reorganization Plan Number 3 of 1978, transmitted to the Congress on June 19, 1978, the Federal Emergency Management Agency (FEMA) has been established as an independent agency in the Executive Branch.

The Federal Disaster Assistance Administration (FDAA) was abolished by Executive Order 12148 effective July 15, 1979, and FEMA has now assumed the FDAA responsibilities. The Federal Insurance Administration (FIA) was transferred to FEMA by Executive Order 12127 on April 1, 1979. However, FIA retains its identity as an agency within FEMA.

The program objectives of FEMA are to provide assistance to States, local government, individuals, and owners of selected non-profit facilities "in expediting the rendering of aid, assistance, and emergency services, and the reconstruction and rehabilitation of devastated areas..." and "to alleviate the suffering and damage which result from such disasters..."

Section 201 of the Disaster Relief Act of 1974 authorizes the establishment of disaster preparedness plans, utilizing all appropriate agencies. It provides for technical assistance and grants to the States in developing comprehensive disaster plans and programs, to include hazard reduction, avoidance, and mitigation. All States have already completed a $250,000 maximum one-time "development" grant. Remaining funds provide 50/50 matching grants up to $25,000 annually for updating

and improving their preparedness plans and capabilities.

Section 401 of the Act authorizes the repair, reconstruction, restoration or replacement of any facility owned by the United States which is damaged or destroyed by any major disaster if it is determined that such a facility is necessary. In implementing the section, the appropriate Federal agency is responsible for evaluating the natural hazards to which the facility is exposed and is required to take the necessary action to mitigate such hazards. However, it should be noted that this section has not yet been delegated by the President.

Section 406 also has important relevance to barrier island situations. This section requires, as a condition for any loan or grant made under the provisions of the Act, that the State or local government agree that the natural hazards of the area in which the loan or grant is to be used will be evaluated and appropriate action taken to mitigate those hazards.

Under Title V of the Act, Recovery Planning Councils may be authorized and established following a major disaster. These Councils are responsible for determining when and under what conditions recovery investment plans should be prepared. The responsibility for this section was delegated by the President (in Executive Order 12148) to the Director of FEMA. However, it has not been funded or implemented.

Council membership consists of, among others, locally elected officials and private citizens. Public participation in Council deliberations is to be provided for and encouraged. This provision generally has been interpreted to be a vehicle to get a maximum amount of recovery assistance into a devastated area as quickly as possible.

Flood Insurance Program

Under the provisions of the Flood Disaster Protection Act of 1973, communities having one or more identified special flood hazard areas must enter into the National Flood Insurance Program or be denied Federal or federally-related financial assistance for acquisition or construction purposes within those areas.

The National Flood Insurance Program is administered by the Federal Insurance Administration (FIA). The program's stated goals are: "To... encourage State and local governments to make appropriate land use adjustments to constrict the development of land which is exposed to flood damage and minimize damage caused by flood losses," and "to...guide the development of proposed future construction, where practicable, away from locations which are threatened by flood hazards."[59] There is evidence that neither of these goals are being met.

There are, however, different opinions as to the effect of the Federal flood insurance program on development of the barrier islands. According to a report prepared by H. Crane Miller for FIA,[60] the availability of flood insurance tends to increase the pressure for development on some flood-prone barrier islands. This has happened in states such as Rhode Island, where the availability of Federal flood insurance has led banks to reverse their previous policy of denying loans for construction in hazardous areas. Nevertheless, it does not appear to be a widespread phenomenon. The main issue is not whether the flood insurance program increases or does not increase the pressures for development. More important is the fact that Federal tax dollars support the process of insuring and redeveloping structures in hazardous and ecologically fragile areas.

Although FIA structural requirements have encouraged developers to construct buildings in such a way as to reduce their vulnerability to flood damage, these requirements do not reflect a total awareness of the nature or the seriousness of the hazards of building on barrier islands. For example, the 100-year flood levels used to determine minimum floor elevations are based on still-water levels. Wave height and runup, which considerably increase storm water elevations and potential damage, are not included. Further, the requirements are more concerned with design than location. Thus, buildings can be designed to meet the structural requirements but at the same time can be clustered in highly exposed or hazardous areas.

North Carolina's experience may be the best example of this. The North Carolina Coastal Area Management Plans developed under Federal enabling legislation (Coastal Zone Management Act of 1972) resulted in the designation of Areas of En-

[59] 42 USC Sec. 4002(e).

[60] H. Crane Miller, "Coastal Flood Hazards and the National Flood Insurance Program," June 1977.

vironmental Concerns (AECs). Three categories of these designations (ocean erodible, inlet hazards, and estuarine shoreline) sometimes contain lands with elevations equal to, or greater than, the 100-year flood level. Even though some of these lands may be expected to be eroded away in a relatively short time, flood protection insurance may still be available under the Federal program. Efforts are underway by the North Carolina Coastal Resources Commission and the FIA to make the two policies more consistent by instigating necessary changes in the policy of the FIA.

There are provisions in the flood insurance program that will, in the future, restrict development to some degree. Communities participating in the program will be required to adopt floodplain management or land use restraints. However, it may not be until 1991 that all participating communities are obliged to adopt these restraints, due to the nature of the program. As it is set up, communities do not have to adopt these restraints until they enter the late ("regular") phase of the flood program. This takes place after receipt from the Federal Insurance Administration of flood plain data, in the form of a Flood Insurance Rate Map (see Figure 10). Until this rate map has been published, and until a detailed rate study has been completed, the community normally remains in the initial or "emergency" phase of the flood insurance program. Congress has mandated completion of all of these rate studies by 1983, but at the current rate of progress, there may be a delay of up to 8 years, hence the 1991 date.

When the study is completed and the rate map published, actuarial rates apply to all new construction and substantial improvements. To date (Feb. 1978), however, only 1,500 communities have received this data and entered the "regular" program. Less than 500 additional communities per year will make the transition. The result of the delay is that 90% of the 15,000 flood-prone communities participating in the program are still in the initial ("emergency") phase, where only normal requirements are made, such as for building permits for construction. The current rate of entry into the regular program could be accelerated for barrier islands by making it a priority to provide data to them.

According to Miller,[61] "Half of the program's total limits of flood insurance coverage are available under the emergency program and sold at federally subsidized rates; subsidies have ranged as high as 90 percent of the cost of the flood insurance, and are currently about 60 percent."

In addition to the slow rate of entry into the regular program, a further limitation of the program is that communities may choose not to participate, thereby escaping the need to adopt floodplain management or land use restraints. Nonparticipation or withdrawal may increase in the future as more communities discover the obligations of the program's regular phase and as a result of Congress' passage of the Housing Act of 1977, which removed a key sanction of the program. The sanction was the condition in Section 202(b) of the Flood Disaster Protection Act of 1973 which made the availability of mortgage loans to would-be floodplain residents contingent upon community participation in the program. Participation would still be encouraged, however, because it would remain a requirement for receiving Federal flood insurance and Federal aid for floodplain construction.

According to Miller, one impact of the change is fairly predictable—it will be increasingly difficult

[61] Ibid.

for both the Federal Insurance Administration and for local communities to strengthen their floodplain management regulations beyond the minimum requirements now in force. These standards need to be strengthened through the adoption of more definitive setback requirements. A 30-year erosion setback (for the average life of a mortgage), or a 67-year erosion setback (for the average life of a building), could provide substantial protection to barrier islands.

Of the nearly 300 study units identified in this study, 188 are in communities covered by the National Flood Insurance Program. As of May 4, 1979, 130 of these communities already were in the regular phase of the program; 55 still were in the emergency phase of the program; and three were not participating in the program.

Of the 58 (55 + 3):

- 36 have mapping studies underway
- 14 have mapping studies scheduled to start in FY '79
- 6 have no studies scheduled
- 2 have studies completed and are scheduled to convert to the regular program before the end of calendar year 1979

Wastewater Treatment Facilities Grants

Wastewater treatment facilities are under construction on many barrier islands. Alternatives to this construction should be carefully evaluated—particularly that of clustered septic systems, where water table levels, pollution control, water supply, etc., permit this approach. This evaluation must be carefully and objectively conducted since soil scientists have confirmed that a relatively small percentage of the Outer Banks possesses soil characteristics suitable for septic systems. On the Outer Banks of North Carolina, less than 20% of the land is considered suitable for the proper filtration functioning of conventional septic systems. Even these high, sandy areas are potentially troublesome because of high permeability and low filtration characteristics that allow contaminants to enter the valuable and limited groundwater supplies. Most of the remaining 80% of the Banks have characteristically high water tables during extremely high tides and during periods of heavy rainfall.

Construction of wastewater treatment facilities is primarily funded by grants from Federal agencies, such as the Environmental Protection Agency (EPA), the Department of Housing and Urban Development (HUD), the Farmers Home Administration in the Department of Agriculture (FmHA), and the Economic Development Administration in the Department of Commerce (EDA).

Under Section 201 of the Federal Water Pollution Control Act Amendments of 1972,[62] EPA is authorized to grant up to 75% of the construction costs of new wastewater treatment facilities. For the period 1971 through 1978, State and local areawide water quality management agencies whose territories include the barrier islands covered by this study received nearly $395 million in grants under Section 201 of the Federal Water Pollution Control Act.

One of the problems with EPA's facilities grants program (201) is the fact that inadequate areawide planning has typically preceded construction of treatment facilities. Therefore, 201 projects often contribute to growth without adequate controls and conditions and may lead to unplanned and unwanted residential and commercial growth on barrier islands.

EPA regulations do not specifically designate barrier islands as geographic areas of environmental concern. Because EPA concentrates more on the adequacy of the justification and engineering design of the facilities, environmental assessments of proposed projects are prepared under contract by engineering firms, which may or may not be aware of the specific conditions on barrier islands.

The EPA Regional Administrator has the authority to make a negative declaration on a project proposal. When made, the decision is published in the newspapers. If there is no adverse comment within 15 days, a full environmental impact statement (EIS) is not prepared.

If an EIS is required, it is usually done under contract by an environmental planning firm. Few EIS reports are prepared by EPA staff. EPA staff carefully consider a project's potential impacts on wetlands and on floodplains and require justification for "unreasonable" 20-year estimated population growth figures which may be attributed to a project. However, there is again no special significance attached to a proposal for a wastewater treatment

[62] 33 USC Sec. 1281.

facility on or serving a barrier island community.

EPA regulations for the areawide planning grants (Section 208) do not specifically address barrier islands. As a consequence, regional plans for water quality management may not be detailed enough to permit analysis of planned or potential impacts on individual barrier islands.

Water quality management plans could have particular significance for barrier islands because the plans must project wastewater treatment needs for the next twenty years, and consider alternatives and land treatment needs. The plans are to include regulatory programs to control all sources of water pollution identified by the State or designated local agency. For exxmple, a building permit may be required for any construction in fragile ecological areas. This permit would require an erosion and sedimentation control plan and special monitoring by State officials. Water quality management plans were originally due by November 1, 1978. However, Congress provided additional funding for Section 208 and extended the deadline for plan submissions to June 1979. The influence of other agencies providing wastewater grants—HUD, FmHA, and EDA—is similar to that of EPA. As one might expect, HUD's emphasis is urban while FmHA's is primarily rural. EDA's waste treatment program is small (in comparison to the others) and mixed.

The HUD figures for fiscal year 1975 Community Development Block Grant (CDBG) program expenditures indicate that over $3.5 million in water and sewer grants were made available to communities on barrier islands. Over $54 million was made available to coastal counties that contain barrier islands and to coastal communities in the 18 States involved in the study. The CDBG program finances all activities previously eligible under urban renewal, neighborhood development, model cities, water and sewer, neighborhood facilities, public facilities, rehabilitation, open space, urban beautification and historic preservation grant programs.

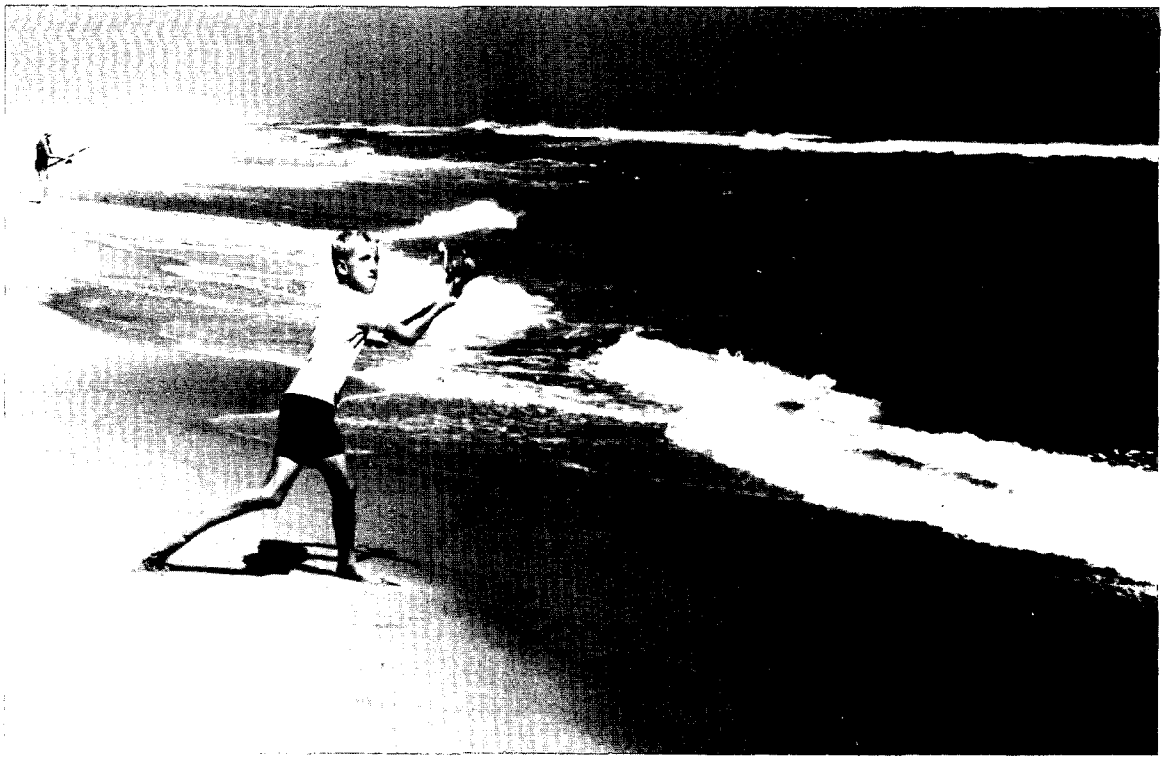
Although the law does enumerate general objectives which the block grants are designed to fulfill, spending priorities are determined at the local level. Metropolitan cities and urban counties (having populations of at least 50,000 and 20,000 respectively) are guaranteed an amount called an "entitlement" which is based on a number of population, poverty, and housing factors. Smaller communities compete for the remaining "discretionary" funds on the same basis. The discretionary fund amounts to about 2% of the annual appropriation for CDBG purposes. As with most other Federal financial assistance programs, the CDBG guidelines do not differentiate between barrier islands or uplands. Of the activities eligible for fund assistance under CDBG, water and sewer grants probably have the greatest impact on barrier island development.

FmHA grants and loans to barrier island communities during the past three fiscal years exceeded $26 million. More than 80% of this money is earmarked for water and waste treatment facilities. EDA statistics indicate that a total of $22 million in grants for wastewater treatment facilities was made available nationwide during the past four fiscal years. However, only a small percentage was for barrier islands.

Small Business Loans

The Small Business Administration (SBA) provides direct loans or guaranteed/insured loans to:

a. assist business concerns suffering economic injury as a result of certain designated disasters (Economic Injury Disaster Loans); and



b. restore, as nearly as possible, disaster damaged physical property to predisaster conditions. (Physical Disaster Loans).

Loans are granted for up to 30 years at a relatively low interest rate. Economic disaster loans may be used to pay certain liabilities and to continue business in operation until "normal" conditions are restored. No funds are available under this program for the repair or acquisition of equipment or for real estate purposes.

Physical disaster loans may be made to individuals, business concerns, churches, private schools, colleges and universities, and hospitals. Funds made available through this program may be used to repair or replace realty, machinery, equipment, and household or other personal property which was damaged or destroyed as a result of a disaster which occurred in an area designated as eligible for assistance because of floods and other catastrophes.

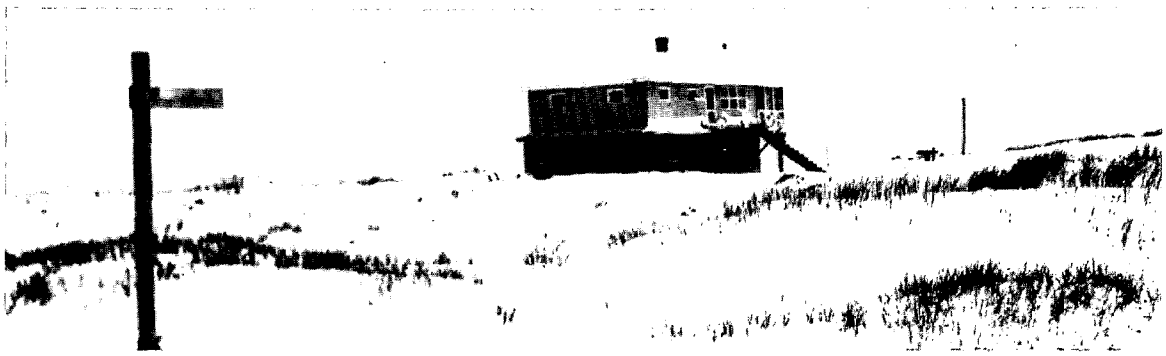
The amendment contained in the Federal Water Pollution Control Act Amendments of 1972 authorizes the SBA to provide direct loans or guaranteed/insured loans to assist small businesses to make additions to, or alterations in, equipment and facilities necessary to comply with water pollution control requirements. Funds provided can be used for construction of pretreatment facilities and interceptor sewers.

The SBA share of guaranteed loans may amount to as much as 90% of the costs.

Federal Surplus Property

The General Services Administration (GSA) also plays a role in barrier island development. GSA, under the provisions of the Federal Property and Administrative Services Act of 1949 as amended, currently leases a number of properties on barrier islands for various purposes, mostly Federal agency space needs. However, GSA is also responsible for disposal of Federal surplus property. Not all future development plans are known to GSA at the time of a disposal action. Unanticipated uses could occur with the sale or transfer of title to real property which might involve increased development on barrier islands.

Cities, counties, and States may purchase Federal surplus property for development purposes ranging from parks and recreation to economic develop-



ment (commercial and industrial) and many other uses. Although many surplus properties are converted to recreational or wildlife uses by State or local governments, many are also assigned to the Department of Health, Education, and Welfare (DHEW) for conveyance to local governments for public health or educational purposes. As with most other Federal agencies, GSA does not differentiate between barrier island and mainland sites in the administration of its programs. GSA now (December 1978) has 10 surplus property actions pending on barrier islands in seven States, involving approximately 20,000 acres.

Interstate Land Sales

The Interstate Land Sales Full Disclosure Act, administered by the Department of Housing and Urban Development (DHUD), may inadvertently contribute to the development of barrier islands. Although the Act was not designed by Congress to influence the patterns of land use or the rate or timing of development of barrier islands, neither was it designed to discourage such development. In order to meet statutory requirements, land developers (sellers) must make a property report available to each buyer, which discloses information on various aspects of the property involved. However, because of the volume and cost of printing, developers usually make the reports available to DHUD, and potential buyers must obtain the information from that agency.

The disclosure requirements apply to subdivisions without regard to the geographic location of the land. According to DHUD officials, the fact that a subdivision is located on a barrier island would not by itself be sufficient to require disclosure. However, lack of access by road or bridge would probably require disclosure. Obviously, barrier islands could be made to appear extremely attractive if it is not necessary to disclose the hazardous nature of barrier island living.

The Office of Interstate Land Sales has indicated that approximately 1,700 subdivisions, both registered and unregistered, are situated in 97 of 108 counties on the barrier island list. To determine the number of barrier islands that might be impacted by these subdivisions would require an examination of each subdivision file.

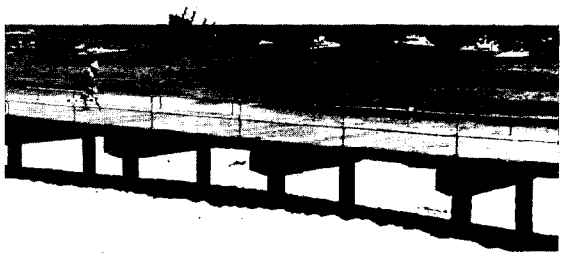
Economic Development Grants

The Economic Development Administration has primary responsibility for the Economic Development Grants program under the provisions of the Public Works and Economic Development Act of 1965. Technical assistance is provided to help distressed areas evaluate and understand their problems and economic potential. This assistance may be in the form of: (1) studies to identify area needs or solve industrial and economic problems; (2) grants-in-aid, amounting to 75 percent of the cost of planning and administering local economic development programs; and (3) management and operational guidance for private firms.

Grants of up to 50 percent of the development cost can be used for such public facilities as water and sewer systems, access roads to industrial parks or areas, harbor facilities, railroad sidings and spurs, public tourism facilities, vocational schools, flood control projects, and site improvements for industrial parks. Severely depressed areas that cannot match Federal funds may receive supplementary grants to bring the Federal contribution up to 80 percent of the project cost.

Loans also are available for public works and

development facility projects. Loans may pay the full cost of a project and may run for as long as 40 years, the interest being determined by government borrowing costs. A community that is not able to raise its share of the eligible project cost may receive a grant for 50 percent or more of the project's cost and a Federal loan for the remainder. Grants from the Economic Development Administration to provide public facilities on a barrier island could accelerate its development for urban use.



Urban Planning Assistance

The Department of Housing and Urban Development provides grants to assist comprehensive urban development planning programs in small communities, States, and metropolitan areas. Activities eligible for grants include: preparation of comprehensive development plans, development of capital improvement programs, coordination of intergovernmental urban planning activities, and preparation of regulatory and administrative measures (e.g., general plans, zoning, ordinances, etc.).

Certain studies for overall economic development programs under the U.S. Department of Commerce are also eligible under this program. Grants may also be made to cover the cost of studies and research to develop and improve planning methods.

Nuclear Power Plant Siting

The Power Plant Siting Act[63] provides assistance in constructing and operating nuclear power stations for the production of electrical energy and byproduct heat energy. Assistance may be provided in the form of funds, loans of fuel or heavy water, or other services not available to the user. The user should first consult with the Nuclear Regulatory Commission before developing a proposal for assistance. Construction of nuclear power facilities can destroy or impair barrier island environmental values.

Home Mortgage Insurance

Home mortgage insurance programs are administered by the Farmer's Home Administration, U.S. Department of Agriculture (USDA) and by the Federal Housing Administration (DHUD). The Federal Housing Administration (FHA), by insuring commercial lenders against loss, encourages them to invest capital in the home mortgage market. FHA insures loans made by private financial institutions for up to 97 percent of the property value for terms of up to 30 years. The loans may finance homes in both urban and rural areas (except farm homes). Less rigid construction standards are permitted in rural areas.

Farmer's Home Administration (FmHA) loans may be used to: construct, repair, or purchase housing; provide necessary and adequate sewage disposal facilities for the applicant and family; purchase or install essential equipment which, upon installation, becomes part of the real estate; or, buy a site on which to place a dwelling for the applicant's use. Housing debts may, under certain circumstances, be refinanced. Restrictions on the use of the loans are that a dwelling financed for a family with a low or moderate income must be modest in size, design, and cost. An applicant must not have adequate housing or sufficient resources to purchase the necessary housing, or related facilities. The applicant must also be unable to secure the necessary credit from other sources upon terms and conditions which he or she could reasonably be expected to fulfill.

As with most other Federal agencies, neither FHA nor FmHA differentiates between barrier island or mainland sites in the administration of these programs.

Mineral and Oil Exploration and Extraction

Ships, oil derricks, and sand dredges have been

[63]P.L. 703; 68 Stat. 919.

familiar sights to coastal inhabitants for years, but they represent only the beginning of the potential for extraction of resources along the thousands of miles of coastline. The International Convention on the Continental Shelf, which went into force in 1964, added more than 1 million square miles to the public lands of the United States.

The promise of oil and mineral resources near barrier islands and on the continental shelf has attracted increased attention as a source of economic wealth and growth. However, our understanding of the distribution, richness, and extraction costs of oil, gas, and mineral deposits on barrier islands and, particularly, on the continental shelf is still very limited. There is presently no effective mechanism to provide adequate review and resolution of conflicting interests prior to initiating leasing procedures for Federally-owned barrier island and tidal lands.

Conclusion: Program Coordination

At least 20 Federal agencies are involved in more than 30 Federal programs that influence the degree and extent of barrier island development. Insufficient coordination between agencies and their programs appear to be a major problem. For example, the Coast Guard has no clear policy on how it will administer the bridge permit program in such a way that it does not prejudice or compromise the later administrative decisionmaking of such agencies as the Corps of Engineers and the Federal Insurance Administration. The Army Corps of Engineers has jurisdiction over construction and dredge-and-fill activities in wetlands, and will often be called upon to exercise this jurisdiction over development of barrier islands. The Corps does not, however, have jurisdiction over bridge construction. Issuance of a bridge permit by the Coast Guard before the Corps has a chance to pass on the merits of dredge-and-fill proposals may tend to prejudice, if not vitiate, the ultimate decision of the Corps, by presenting that agency with the *fait accompli* of a bridge constructed at great expense. Other than informing the Corps by means of a copy of the Public Notice that a bridge permit application is open for public comment, the Coast Guard is not required to coordinate with the Corps for purposes of their responsibilities under Section 404 of the Federal Water Pollution Control Act. The Coast Guard's function is in-

dependent of the Corps' Section 404 function.

The Federal Insurance Administration has adopted regulations under the Flood Disaster Protection Act that make Federal insurance subsidies conditional upon sound construction and planning practices. However, the Coast Guard has not yet determined how it will handle these policies, which are designed to prevent unsound development in flood-prone areas such as those universally found on barrier islands.

On the one hand, there are Federal programs and policies that tend to encourage development that is incompatible with natural processes and values of barrier islands and beaches. On the other, there are Federal programs and policies designed to promote the conservation of barrier islands and their resources. These programs often work at cross purposes, resulting in confusion, wasted dollars, and lost resources.

The Federal Government should set the pace if goals of barrier island conservation are to be reached. The coordination of programs to ensure evaluation and suitable protection of barrier islands is an economical way to achieve island conservation goals. It is also a good demonstration of public policy involving efficient and coordinated efforts to attain long-range goals.

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Barrier islands are different . . . (They) contain fascinating ecosystems not found anywhere else . . . Because of their inherent beauty, they are places of great attraction, offering not just scenic land and water scapes, but also the mystery and an allure that seacoasts always have had.

We see today a pervasive disregard of the barrier islands' nature—of what ought to be their proper role. The balances are fragile, but the forces at work are not.

It is clear that we cannot continue to develop barrier islands as if they were mainland sites. Sooner or later we have to pay for our mistakes.

Robert L. Herbst
Assistant Secretary of the Interior

"The natural properties of barrier islands provide an absolutely unique combination of values. These islands are the front line of storm defense for a thousand miles of United States Atlantic and Gulf of Mexico coastline. They have scenic qualities—vividness, variety, and unity—unparalleled elsewhere in the coastal zone. They offer broad sandy beaches and a score of other recreational opportunities. They provide habitats and food for unique biotic communities—hundreds of species of coastal birds, fish, shellfish, reptiles, and mammals."

John Clark
Coastal Ecosystem Management
John Wiley & Sons, New York (1977)

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