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Rhode Island's Barrier Beaches: Volume I

A Report on a Management Problem and an Evaluation of Options

The Coastal Resources Center

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RHODE ISLAND's BARRIER BEACHES: VOLUME I

A Report on a Management Problem
and an Evaluation of Options

by
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The fly leaf: an aerial view of Green Hill Beach, South Kingstown, Rhode Island, shows dune leveling on a low-profile barrier beach during construction. The photograph was made by Robert Izzo, University of Rhode Island staff photographer.

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Location maps identifying the 30 barrier beaches surveyed by the staff of the Coastal Resources Center appear in both Volume I and Volume II. Individual area maps can be found at the end of pertinent sections in Volume II. Figures have been used in several places in Volume I to illustrate natural processes.

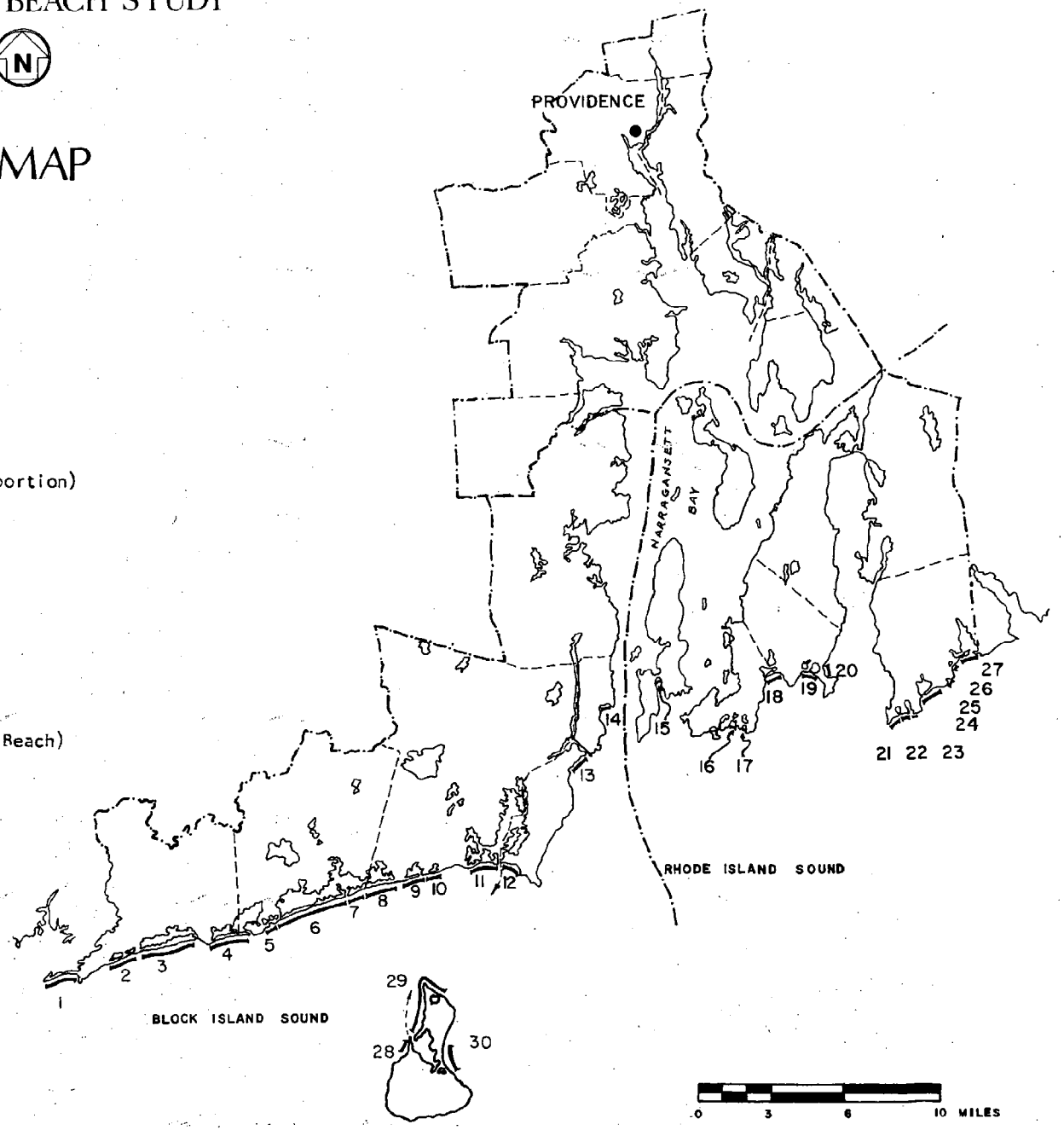
RHODE ISLAND BARRIER BEACH STUDY

COASTAL RESOURCES CENTER
UNIVERSITY OF RHODE ISLAND
JANUARY 1973

LOCATION MAP

Key:

1. Napatree Point Barrier
2. Mashaug Ponds Barrier
3. Winnapaug Pond Barrier (Atlantic Beach)
4. Quonochontaug Pond Barrier
5. Michel, Garden and East Ponds Barrier
6. Ninigret Pond Barrier (East Beach portion)
7. Ninigret Pond Barrier (Charlestown Beach portion)
8. Green Hill Pond Barrier
9. Trustom Pond Barrier
10. Card Ponds Barrier
11. East Matunuck and Jerusalem Barrier
12. Point Judith Pond Barrier
13. Narragansett Beach Barrier
14. Bonnet Shores Barrier
15. Mackerel Cove Barrier
16. Lily Pond Barrier (Hazard's Beach)
17. Almy Pond Barrier (Bailey's Beach)
18. Easton Pond Barrier (First Beach)
19. Nelson and Gardiner Ponds Barrier (Second Beach)
20. Third Beach Barrier
21. Watch House Pond Barrier
22. Round Pond Barrier
23. Long Pond Barrier (Tappen's Beach)
24. Briggs Marsh Barrier
25. Ship Pond Barrier
26. Round Meadow Pond Barrier
27. Tunipus and Quicksand Ponds Barrier
28. Coast Guard Beach Barrier
29. Sandy Point and West Beach Barrier
30. Crescent Beach Barrier



VOLUME I

ERRATA

Location Map: *Mashaug Ponds* should read *Maschaug Ponds.*

Page 2, line 5: *beneth* should read *beneath.*

Page 3, line 16: *60% of 30 miles* should read *65% of 27.4 miles.* Preliminary estimates were subsequently revised.

Page 3, line 17: *Green Bill Beach* should read *Green Hill Beach.*

Page 8, last line: *lifetimes.* should read *lifetimes, .*

Page 12, final two lines: reference to *and the heights of the present dune crests of the various barriers are shown in Figure 4* should be deleted. This information is included in the individual beach data presented in Volume II.

Page 31, line 12: *Unstabilized, it* should read *Unstabilized sand.*

Page 54, line 25: *(see p.)* should read *(see pp. 55-6).*

Page 72, line 2: *conservating* should read *conservation.*
Page 73, line 2: *distinguised* should read *distinguished.*
Page 82, last line: *In-Liew* should read *In-Lieu.*

Page 90, line 3: delete reference to *Coastal Resources Center* and add *Department of Community Planning and Area Development.*

Page 90, line 19: delete reference to *Coastal Resources Center.*

Page 90, line 22: delete reference to *Coastal Resources Center.*

OFFICIAL USE ONLY

Report No. 12

Week ending

May 30, 1973

Subject: Administrator's Weekly Report

From : Office of Sea Grant

Robert B. Abel

1. On May 22 and 23, Dr. McLellan and Dr. Attaway participated in a site visit to the University of Delaware.

2. Mr. Greenwald visited the Oceanographic and Limnological Research Company of Haifa, Israel on May 13 and 14. He met with the Director General, Admiral Yohay Ben-Nun, and discussed the oceanographic efforts currently underway in Israel. A memorandum on this subject is currently being prepared for Dr. Abel.

3. Rhode Island's Barrier Beaches: Vol. I - A Report on a Management Problem and an Evaluation of Options, available from the University of Rhode Island, is an attempt to assemble and assess the natural features of barrier beaches, their importance in ecological terms, techniques for management, and recommendations for development of a statewide management plan. In Rhode Island's Barrier Beaches: Vol. II - Reports and Recommendations at the Community Level, individual beaches are examined on a community-by-community basis. Both documents are elements in a study prepared for the State Coastal Resources Management Council by the University of Rhode Island's Coastal Resources Center.

4. Juvenile hormone mimics have a disruptive effect on the life cycle of barnacles, members of the same phylum as insects (Arthropoda). Edgardo D. Gomez, a marine biology student at Scripps Institution of Oceanography, University of California, San Diego, and Dr. D. John Faulkner, assistant professor of marine chemistry, have discovered in laboratory tests that by applying juvenile hormone mimic ZR-512 to Balanus galeatus, the barnacle can be induced to metamorphose from free-swimming cyprid larva into sessile adult before it settles on a suitable substrate. The adult, which must attach itself to a substrate in order to feed, therefore dies.

5. Columbia University was awarded an $84,000 grant for a 12-month period beginning 5/1/73. The title of the grant is "Use of Deep-Sea Ocean Water for Aquaculture, etc." and it will be supplemented by $216,000 in FY '74.

6. The NOAA Marine Advisory Service is planning to hold a one-day workshop to assist local program personnel with a number of problems that they are facing because of Great Lakes' flooding and high water levels. The meeting is planned for June 19, 1973, and will be held at the Hilton Inn near the Detroit Airport. Resource persons from NOAA, Lake Survey Center, National Weather Service, Corps of Engineers, and possibly other groups will be asked to advise marine advisory personnel on the potential for help to local citizens. This will include general information about high water problems, in addition to the possibilities for engineering applications and financial or economical assistance relative to disaster loans.

The purpose of the meeting is to pass information along to advisory agents so that they can be more effective with their own clientele. It is not intended that this particular meeting will be attended by local property owners, citizen groups, etc.

7. A Marine Communications Workshop, co-hosted by Texas A&M University and the University of Wisconsin, will be held on the University of Wisconsin's Madison campus on June 25-29, 1973. The Workshop will cover many aspects of scientific journalism, with a marine focus. Participants will meet with professionals from the print media, radio and television; and they will work on individual and group projects in aquaculture, coastal zone management and ports and shipping. For further information please contact Marine Communications Workshop, Sea Grant College Program, University of Wisconsin, 1225 W. Dayton Street, Madison, Wisc. 53706.

VOLUME II

ERRATA

Location Map: *Mashaug Ponds* should read *Maschaug Ponds*.

Page 3, line 2: delete period between *barriers* and *it*. Read as single sentence.

Page 41, Title: *South Kingston* should read *South Kingstown*.

Page 60, line 16: *Naural* should read *Natural*.

Page 62, line 16: *LEESEES* should read *LESSEES*.

Maps following page 88: *SACHUET* should read *SACHUEST*.

Page 108, lines 16, 17: *Sachem Pond Barrier (Sandy Point, West and Coast Guard Beach)* should read *Sandy Point, West and Coast Guard Beach Barriers*. Reference to Sachem Pond should be dropped.

Maps following page 112. The southern most barrier beach indicated on the maps (lower right hand corner) is not labeled. It should read *COAST GUARD BEACH*.

Map following page 52. Industrial and Governmental area around Card Pond should appear as *Light Residential*.

CHAPTER ONE

INTRODUCTION

This report is an attempt to assemble and assess the available information on the barrier beaches along Rhode Island's ocean coast. The report has been prepared at the request of the Coastal Resources Management Council to assist it in developing a plan for the future use and management of a fragile and valuable natural resource.

A barrier beach is a narrow strip of land made of unconsolidated material that extends roughly parallel to the general coastal trend and is separated from the mainland by a relatively narrow body of water. In the great majority of cases Rhode Island barriers are the seaward boundaries of coastal ponds, many of which are salt or brackish. The barriers have been formed by longshore currents and waves that have deposited sediments, chiefly sand and pebbles, across shallow embayments. The barriers are low in profile and are highly vulnerable to hurricane damage. This study attempts to evaluate the many demands that are now being put upon these areas while considering what they can withstand and what policies will be of the greatest benefit to the people of Rhode Island.

Reasons for the Coastal Resources Management Council's Involvement: In 1971 the Rhode Island General Assembly created the Coastal Resources Management Council to "... *preserve, protect, develop, and where possible,*

restore the coastal resources of the state for this and succeeding generations through comprehensive and coordinated long-range planning and management designed to produce the maximum benefit for society..." The Council has jurisdiction over *"any development or operation within, above or beneth the tidal water below the mean high water mark."* In order to "carry out effective management plans" the Council was also given regulatory jurisdiction over a number of activities and areas above mean high water. These include *"shoreline protection facilities and physiographic features," and "intertidal salt marshes."* Barrier beaches are clearly both coastal physiographic features and shoreline protection features.

The Coastal Council had been in existence for little more than a year when it had to decide whether or not residential development should be permitted on the Green Hill Barrier Beach in South Kingstown. This barrier had been extensively developed by the turn of the century. The 1938 hurricane completely destroyed all the houses on the barrier and 48 lives were lost. Several houses were rebuilt and these were swept away by the 1954 hurricane. No lives were lost in the second storm but property damages were over a quarter of a million dollars. After the 1954 hurricane the Town of South Kingstown zoned Green Hill Beach as a flood danger zone and prohibited construction on it. In 1966, however, when South Kingstown revised its zoning ordinances the flood danger classification was dropped and Green Hill Beach was zoned residential with a minimum lot size of one half acre. Many platted lots were bought up and resold. Construction began in the summer of 1972. Since South Kingstown had by then entered the National Flood Insurance Program the houses were designed to meet its building requirements. Construction on the barrier caused great public controversy, and two lengthy and very

well attended public meetings were held to discuss a building moratorium. After some delay and confusion over jurisdictions between the South Kingstown Town Council and the Coastal Management Council, the latter ruled that anyone building on Green Hill Beach must obtain a permit from the Coastal Resources Management Council. The Coastal Council would grant or deny permits in reference to a plan for all the state's barrier beaches which the Council in accordance with the Administrative Procedures Act, had seven months to produce.

Why a Plan for the Barrier Beaches is Needed: Rhode Island is a portion of what has been described as an Atlantic seaboard megalopolis stretching from Boston to Washington, D. C. At present half acre residential lots with access to the shore may sell for from ten to fifty thousand dollars. Beaches and barriers are becoming more crowded each year. All indications are that these trends will continue and that pressures to develop the remaining stretches of undeveloped coast will increase. Approximately 60 percent of Rhode Island's 30 miles of barrier beaches are undeveloped. The present development of Green Bill Beach suggests that policies controlling their future use and management are necessary. The barriers, while fragile, are valuable as storm buffers protecting ponds, marshes and stretches of low lying mainland from wave erosion and damage during hurricanes. Because so many barriers are undeveloped they are also of the greatest value as open space of great natural beauty in an increasingly developed region.

Barriers are most effective as storm buffers when their dunes are well formed and protected from wind erosion by beachgrass. Beachgrass not only prevents the wind from eroding the dunes but, by trapping blowing

sand, builds up the dunes. Beachgrass cannot tolerate trampling by walkers or vehicles and the natural growth of many of the state's barrier dunes is presently being prevented by excessive foot and vehicular traffic.

The value of the undeveloped barriers as open space or as conservation areas calls for careful management plans. Problems of public access and adequate policing must be solved. The majority of the barriers are in private ownership and few are completely safe from future development including those presently owned by organizations and individuals that favor conservation. Should additional protection be given to these areas? If their development is prohibited how should the owners be compensated? Should people be permitted to build on barriers which are clearly vulnerable to hurricane damage? These are some of the questions which this report attempts to clarify. It is hoped that this study will help the Coastal Resources Management Council, the municipalities and concerned citizens understand the choices they now have in deciding the future of the state's barrier beaches. The results of the decisions made now will be of great consequence in the future.

CHAPTER TWO

THE GEOLOGY OF BARRIER BEACHES AND PONDS

The Evolution of Rhode Island's Barriers: New England is a part of one of the oldest continuously surviving land masses on the earth. Some five hundred million years ago, the ancestors of the Berkshires and the Green Mountains formed as a chain of islands. Since then the land has been thrust up and eroded many times. Over geologic time sea level is constantly changing though the rate of change varies. One of the more dramatic drops in sea level occurred almost two million years ago when changes in the earth's climate caused the polar icecaps to grow and sea level to fall. The ice migrated as far as about 40 miles south of Rhode Island's present shore. Some 15,000 years ago the ice sheet began its retreat and passed north of Charlestown Pond some 3,000 years later.[3] As the glacier retreated it deposited quantities of sediment, known as glacial till. When it paused long enough the till piled up into steep irregular hills called moraines. One series of moraines can be seen along the northern side of Route 1 in South County.

As the icecaps melted large volumes of water were released into the ocean basins and this caused sea level to rise. Studies of the bedrock beneath Block Island and Rhode Island Sounds[1] reveal that what is now sea floor was at several times crossed by a number of rivers. As sea level rose a series of coastlines not unlike the one we see today were formed and then drowned. Barrier beaches similar to those seen

today along the south shore are preserved in much of their original detail on the sea floor of Block Island Sound. The present coastline is relatively recent. Dillon[3] estimates that a mere 3,500 years ago sea level along the Rhode Island shore was some 15 feet below its present level and the barriers and salt ponds were considerably further seaward than they are today.

The glaciers transformed the landscape. Valleys were filled with till and high points eroded. In places glacial till was blanketed with a layer of outwash sediments deposited by the streams that carried the water released by the melting ice. The new shoreline was irregular and changed rapidly. A developing shoreline will tend to straighten its irregularities because the erosive force of waves is concentrated on headlands and because sediments accumulate in protected waters in bays and between headlands. Given sufficient time and sand, long wide barriers like those seen along southern Long Island and the Carolinas will form across shallow embayments. A series of small barriers have developed along Rhode Island's relatively young shoreline. These barriers are slowly migrating inland. As sea level rises waves erode the barriers on their ocean side and, during storms, wash sand into the ponds. Slowly the barriers move shorewards and the ponds, as their relative level increases, flood the low lying mainland. In Rhode Island, this migratory process is sustained by two factors; rising sea level and a small supply of sand.

Measurements made in Newport since 1930 show that relative sea level is gradually rising in this region at an average rate of .0096 feet per year or about one foot every century.[7] The reasons for this increase are not fully understood. A verticle rise of one foot a century

may not at first glance appear to be any cause for concern. However, since the slope of Rhode Island's south shore beaches to 12 ft. above mean sea level is roughly 1:30, the horizontal encroachment per century is between 30 and 50 ft.[6] An advance of this magnitude must be considered when planning the management of these areas.

Rhode Island's barrier beaches are formed and governed by marine processes. Changes in sea level, wave action, nearshore currents and sediment supply all combine to control the evolution of barriers and their present natural processes. Furthermore the barriers are the dikes upon which the existance of the salt ponds depends. They are also the mainland's principle protection from the forces of the open ocean.

Seasonal Processes: A cross section of a beach and a barrier shows a number of definable features. These are illustrated in Figure 1. If there are no big storms the dunes may be relatively stable for several years. The beaches, however, are in a state of continual change. During the summer small waves transport sand up onto the beach and build a wide flat terrace. In the winter larger waves cut back the beach, carry the sand offshore, and deposit it in one or more bars parallel to the beach. In the winter the beach is therefore narrower and steeper and rocks that are covered with sand during the summer may be exposed (Fig. 2).

The movement of beach sand is not limited to a seasonal onshore-offshore migration. Longshore currents are set up by waves striking the beach at an angle. Each breaking wave produces a slight longshore

impulse and these combine to form a current (Fig. 3). Sand that is put into suspension by breaking waves is transported either way along the shore by the current. This movement is called longshore drift. Over a long period of time waves dominate from a given direction and a net current up or down the beach is produced. McMaster[8] found that the longshore drift patterns along Rhode Island's shore from Point Judith to Watch Hill appear to converge towards the center of this section of shoreline. Where groins or jetties have been built the direction of longshore drift can be seen by the accumulation of sand on the upstream side of the obstacle.

Along a coastline where sand is predominant, it is useful to think of sand movements in terms of a budget. Sources and losses can be identified and even quantified over time. Little detailed information is presently available for the Rhode Island shoreline but some general observations can be made.

The supply of sand along the Rhode Island shore is small. Offshore, however, large deposits exist. Surveys made by the Corps of Engineers 'Sand Inventory Program'[5] have shown that an estimated 141 million cubic yards of sand lie in a belt one to four miles off Rhode Island's south shore. Only rarely, however, does the turbulence of storm waves move significant amounts of this sand onshore.

Sand is lost from the budget through a number of processes. Dry sand, unprotected by vegetation, is blown off the beaches and dunes out to sea or inland. More dramatic losses occur when waves wash over the barriers and transport large volumes of sand into the ponds. Over geologic time, and so long as the barriers are migrating shoreward, this sand is only temporarily lost to the system. In terms of our lifetimes.

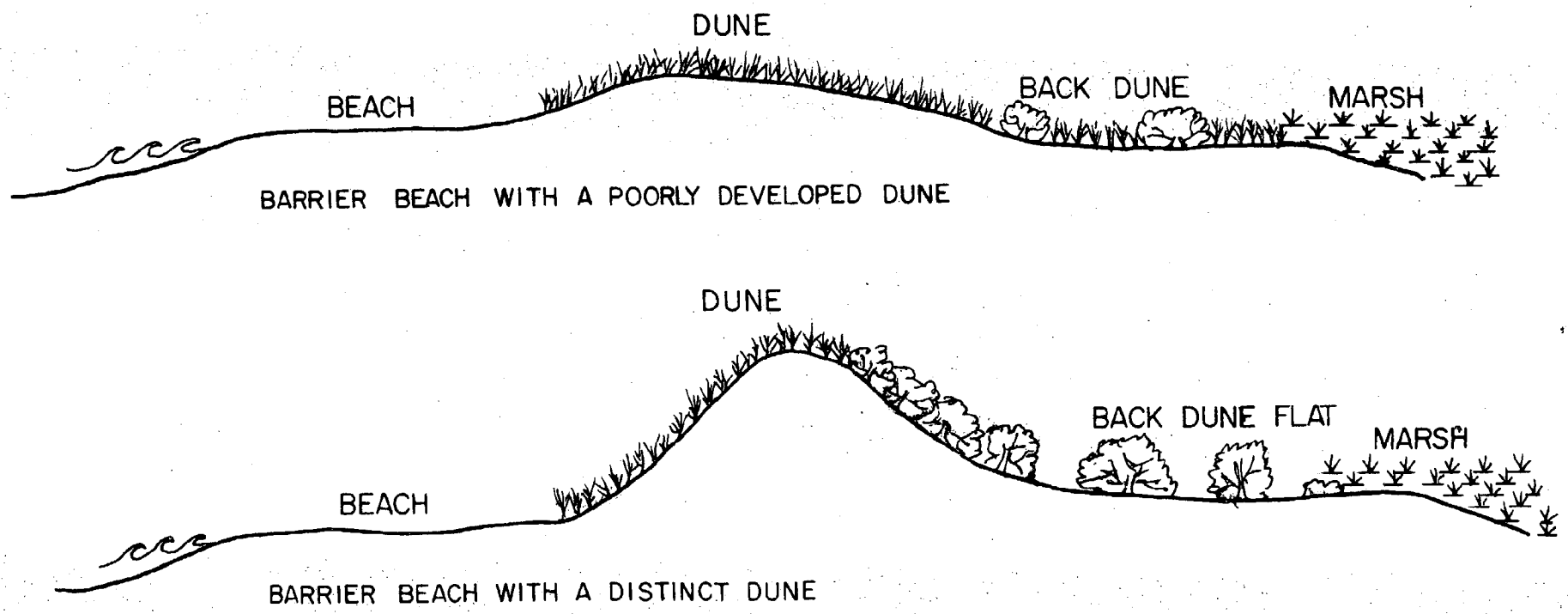


Figure 1. Cross sections of typical Rhode Island barriers showing the beach, undeveloped and developed dunes, the back dune and the marsh. Developed dunes are usually densely vegetated by shrubs and small trees on the pond side. Only barriers with a developed dune have a distinct back dune zone. The primary dune vegetation is American beachgrass.

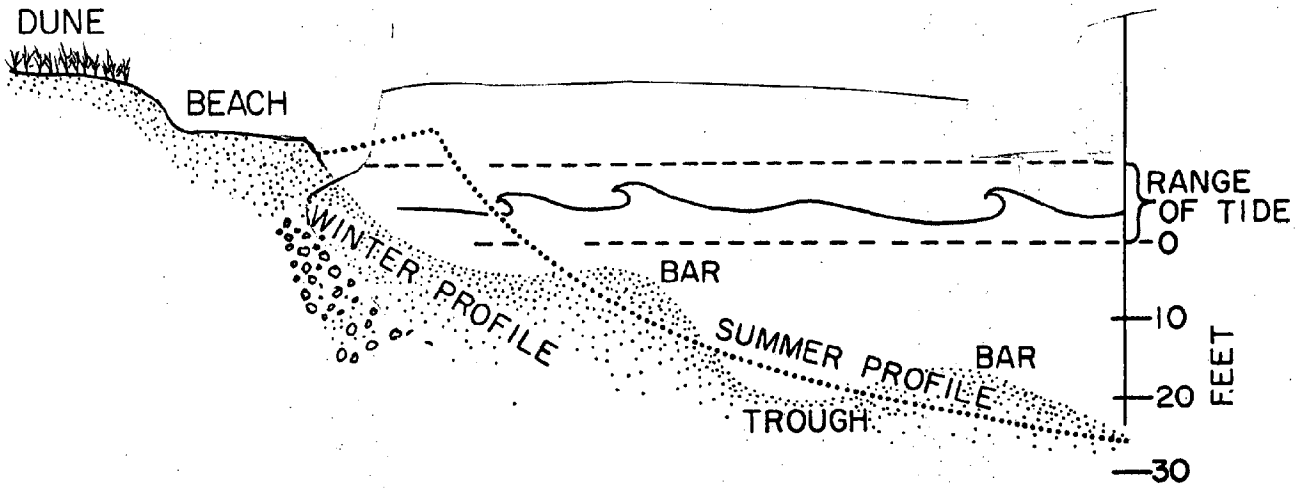


Figure 2. Winter and summer beach profiles.

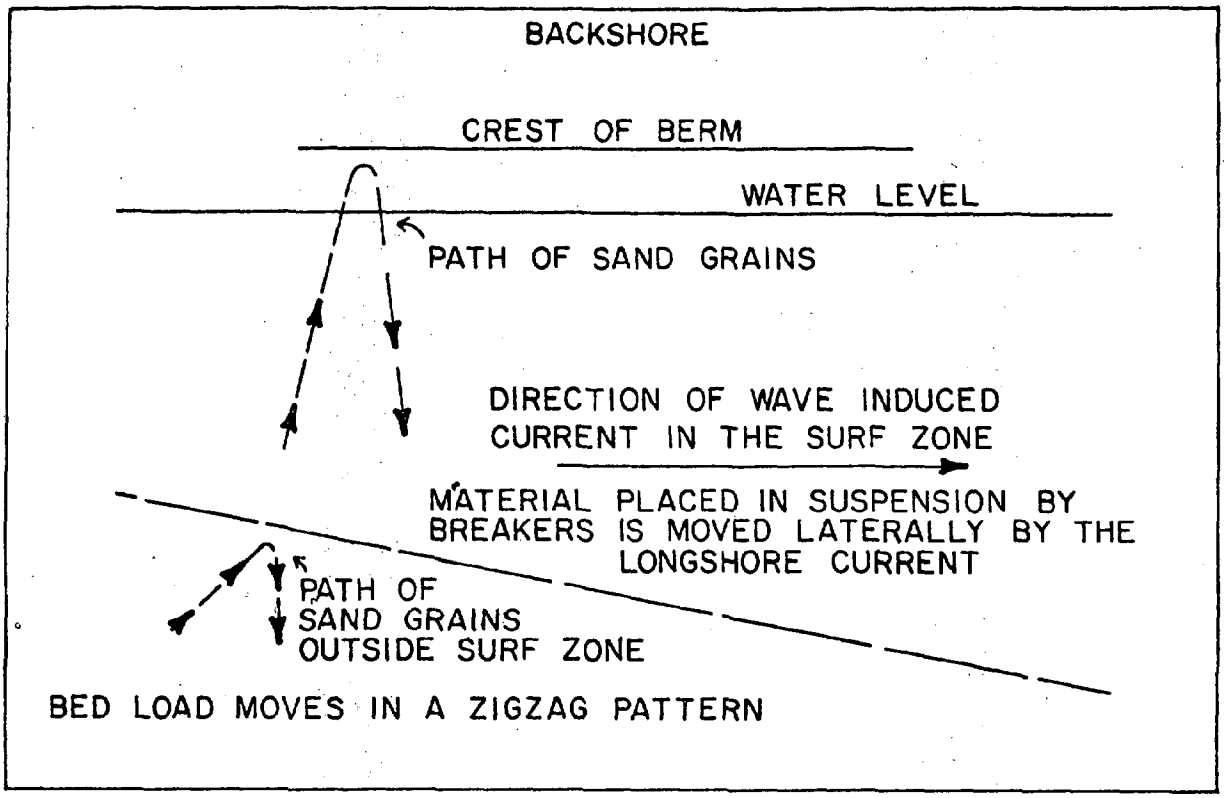


Figure 3. The longshore drift of sand. Reprinted from Bascom, Willard. "Beaches", August 1967, *Oceanography: Readings from Scientific American*. San Francisco: W. H. Freeman & Co., 1971.

however, sand washed into the ponds is lost to the beaches and the active sand budget.

Barrier Dune Formation, Stabilization and Erosion: On a barrier or on a low-lying sandy coast dunes may develop when sand is blown off the beach and accumulates behind it. Wind-borne sand accumulates rapidly around semipermeable objects, and this makes beachgrass very effective in building and stabilizing dunes. The blades and stems of the grass reduce the wind velocity so that blowing sand drops down and is trapped. Other semipermeable barriers such as snow fences or dead Christmas trees accumulate sand in a similar manner. Where sufficient sand is available and conditions are relatively stable a parallel dune may form seaward of the first dune and the older dune may become permanently stabilized with secondary vegetation, principally shrubs but including some low trees. Most of Rhode Island's barriers support only one low dune line that, in its natural state, is well vegetated with beachgrass and a few shrubs. Areas such as the eastern end of Atlantic beach in Westerly and Quonochontaug in Charlestown support high dunes that are densely vegetated by shrubs and small trees on the landward side.

Sand dunes, because they are made of an unconsolidated and light material, are very vulnerable to wind and wave erosion. If the stabilizing cover of beachgrass is destroyed the sand particles are no longer protected from the wind. When the grass is destroyed on the foredune and dune crest the wind will erode a cut into the dune. This is known as a blowout and looks like a footpath stretching from the dune crest to the beach. If beachgrass does not recolonize the exposed sand erosion will continue and the cut will deepen and widen out at the sides. Under natural

conditions blowouts are usually recolonized but on heavily used beaches blowouts are often used as footpaths. Beachgrass is an extraordinarily hardy and well adapted plant but it will not tolerate trampling. Unless a blowout is protected from vehicular and human traffic, recolonization may be delayed or prevented and erosion may be severe.

Wave erosion of dunes is generally more dramatic than wind erosion. During storms waves may wash over the barrier and erode what is known as a washover. These are similar to blowouts and differ in that they are formed by waves rather than the wind, and are generally wider and deeper than blowouts. In a washover waves frequently erode the dune to the height of the beach and transport sand into the pond where it forms a delta-shaped deposit. The dune is repaired by the recolonization of beachgrass and the natural process of dune growth may be assisted if snow fences are placed across the breach to accelerate the accumulation of sand. A washover may develop into a permanent or seasonal breachway.

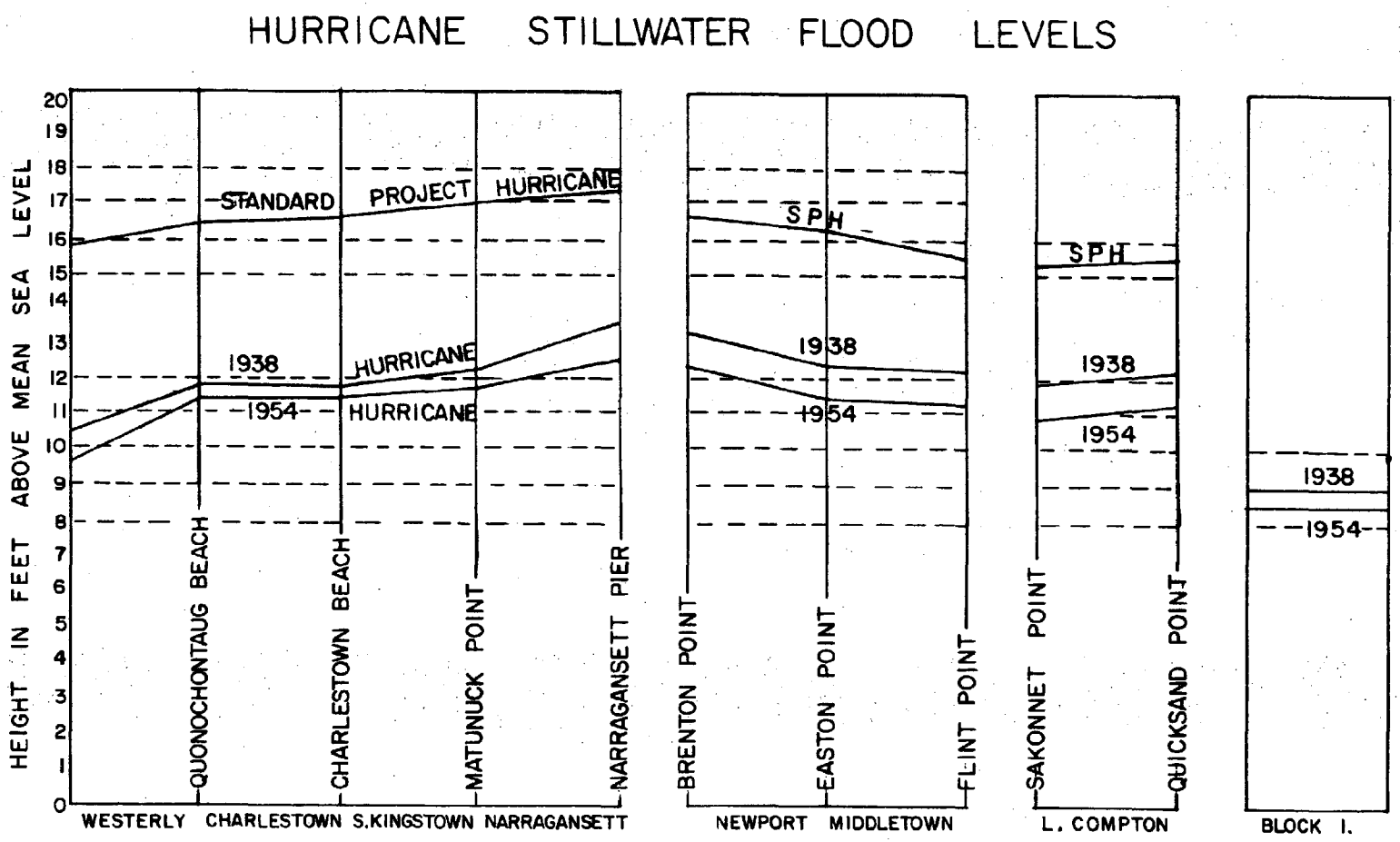
Hurricanes: During hurricanes barriers may be breached along their entire length and dunes may be completely destroyed. This happened on many south shore barriers during the hurricanes of 1938 and 1954. Before the 1938 hurricane the dunes on the south shore barriers were considerably higher than they are today. Remnants of these old dunes may be seen at the eastern end of the Quonochontaug and Weekapaug barriers. In their natural state barriers respond to severe wave erosion in a unique and efficient manner. In a big storm waves quickly erode the foredune and carry the sand seaward thus extending shallow water further out from the dunes. Waves therefore break, and lose much of their energy, progressively further away from the barrier. If, however, the barrier has been

developed and artificially stabilized by seawalls the self-sacrificing process cannot take place and the force of the waves will remain concentrated upon the barrier. As a result erosion during a severe storm may be worse. In North Carolina the extensive dune fields around Cape Hatteras were artificially stabilized and extended by sand bagging and massive plantings of beachgrass. There is presently some controversy over whether or not this has caused overstabilization that is aggravating wave erosion rather than preventing it.[4]

Rhode Island has been threatened by 71 hurricanes since 1635 of which 13 caused severe tidal flooding, 25 caused moderate flooding and 33 caused scares with little or no flooding.[2] Barrier beaches are particularly vulnerable to hurricane damage. They are the first line of defense against the sea and they are presently low in profile. By 1938 extensive development had taken place on the south shore beaches. With a few isolated exceptions, the hurricane swept all structures off all the barrier beaches in the state. Many of these areas were again built up when in 1954 another hurricane swept them clean for the second time. In 1938 two hundred and sixty two lives were lost and the statewide property damage was about 100 million dollars. In 1954 nineteen lives were lost and property damage was in excess of 200 million dollars. The destruction of buildings on the barriers greatly increased the damage to properties on the mainland side of the ponds. Large quantities of debris, including whole houses, were swept across the ponds. This debris battered and in some cases destroyed houses on the mainland shore and after the storm its removal was a major problem and a great expense.

During such severe hurricanes as these it is the storm surge which causes such extensive damage. Low atmospheric pressure and the piling

up of waves along the coast causes sea level to rise dramatically. During the 1938 hurricane, sea level rose between 10 and 14 ft. along the state's ocean shoreline. The amount of increase depends upon the shape of the coast and therefore varies significantly within a relatively small area. A long narrow indentation such as Narragansett Bay tends to funnel the waves and concentrate them upon a small area. The storm surge height in Providence is, therefore, greater than it is along the south shore. The majority of Rhode Island's barriers are presently so low that the dune crest is below the still water height of the 1938 and 1954 hurricanes. The Corps of Engineers designs coastal protection features in reference to a Standard Project Hurricane. This is defined as *"a storm that may be expected from the most severe combination of meteorological conditions that are considered reasonably characteristic of the region involved, excluding rare combinations."* Neither the 1938 nor the 1954 hurricanes reached the SPH level. The levels of still water during the storm surge for the SPH, the 1938 and the 1954 hurricanes and the heights of the present dune crests of the various barriers are shown in Figure 4.


HURRICANE STILLWATER FLOOD LEVELS
HEIGHT IN FEET ABOVE MEAN SEA LEVEL
0
1
2
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STANDARD PROJECT HURRICANE
1938 HURRICANE
1954 HURRICANE
QUONOCHONTAUG BEACH
CHARLESTOWN BEACH
MATUNUCK POINT
NARRAGANSETT PIER
WESTERLY
CHARLESTOWN
S.KINGSTOWN
NARRAGANSETT
SPH
1938
1954
BRENTON POINT
EASTON POINT
FLINT POINT
NEWPORT
MIDDLETOWN
SPH
1938
1954
SAKONNET POINT
QUICKSAND POINT
L. COMPTON
1938
1954
BLOCK I.

Figure 4.

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7. Hicks, S. D. 1970. Changes in Sea Level on Rhode Island's Coast. Maritimes, 16 (4).

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CHAPTER THREE

THE ECOLOGY OF BARRIER BEACHES AND PONDS

Introduction: Rhode Island's barriers and salt ponds are fragile, valuable and limited. The barriers are a rigorous environment for living things. There is little shelter from the elements, the substrate is a loose unconsolidated sand and fresh water is scarce. One therefore finds the barriers inhabited by a few well adapted species of plants and animals. The barriers are valuable because they provide us with some of our finest beaches. They are also a first line of defense against the sea and protect a low lying mainland and a series of extremely valuable ponds and marshes. Unlike the barriers, the ponds and their marshes are rich in plant and animal life. In the salt ponds the balance between nutrients, salinity, and circulation patterns is delicate and they are therefore highly vulnerable to disruption by man.

The Barriers: American beachgrass, Ammophila breviligulata, protects dry sand from wind erosion and is essential in building and protecting dunes. Beachgrass is an excellent example of highly specialized adaptation to a rigorous environment. It grows luxuriantly in a soil holding very little water and almost no nutrients. It withstands frequent wetting by sea spray and, perhaps most remarkable of all, it flourishes best when it is being buried by wind-blown sand.

Sand grains blown by the wind accumulate in stands of beachgrass.

The leaves of the plants reduce the wind speed and cause the sand grains to settle and build up around the grass. As the sand rises the grass develops new root systems and sends up new shoots. If you dig into a dune and expose a vertical cut several feet high you will probably see a series of root systems showing former heights of the dune. On the back side of a well-developed dune sand does not accumulate as rapidly. Here the beachgrass may die off and if sufficient water is available it may be replaced by secondary vegetation. Beachgrass is essential to the stability of sand barriers. It builds up the dunes and stabilizes sand that would otherwise be blown away by the wind.

From man's viewpoint however, beachgrass has one serious limitation; it will not tolerate trampling. In Holland, where large sand barriers stabilized by beachgrass are essential to the country's defenses against the sea only authorized scientists may walk on the barriers. In Rhode Island, where the value of beaches is seen primarily as recreational, beachgrass is seldom protected and as a result many of our dunes are badly eroded.

Dispersed with the beachgrass, but never as abundant, a number of other perennial plants are found, most notably seaside goldenrod and beach pea. In relatively well-stabilized areas thickets of wild rose are common and in protected places, such as the pond side of an old high dune, the growth of shrubs and small trees may be very dense.

The Value of Salt Ponds and Marshes: Salt marshes, which are extensive in several of the salt ponds, are beds of intertidal rooted vegetation which are alternately inundated by the rise and fall of the tide. They show a distinct pattern of zonation. Along the creeks and channels in

the intertidal zone grow pure stands of tall cord grass Spartina alterniflora. Behind grow meadows of salt grass, Spartina patens. These two species of Spartina are the most valuable constituents of the marsh because they are responsible for the bulk of its primary productivity. Above the Spartina and the reach of normal tides grows a band of black rush, Juncus gerardi. Beyond this grow salt-tolerant shrubs and then whatever terrestrial species are adapted to the soil of the surrounding land.

The productivity of salt marshes was first studied by Odum and his co-workers in Georgia about a decade ago. They found[7] that the net primary productivity of a salt marsh is extremely high, and that this is due in greatest part to the two species of Spartina. Net primary productivity is a measurement of the amount of food produced by plants in a given area over time after the amount used for their own respiration has been subtracted. Since all consumer organisms (all living things with mouths) ultimately depend upon plants for their food, net primary productivity is a good measure of an area's fertility and the number of consumers it can support. Net primary productivity may be measured in a number of ways. The terms that can be visualized most easily are tons per square meter per year (tons/m^2/yr). The weight is calculated from the above ground portion of the plant when dried. In a Georgia salt marsh production is about 10 tons/m^2/yr.[7] This is 25% greater than the production of a field of hybrid wheat and nearly 10 times the production of the average world wheat field. Levels of production as high as those found naturally in a Georgia salt marsh are only rivaled by some forms of intensive agriculture, for example high yield sugar cane plantations and rice paddies. It was largely because of the

work done by Odum and his associates in Georgia that the value of salt marshes became generally recognized and many states passed legislation protecting them. Later work in North Carolina and New England has shown that salt marshes in temperate regions are less productive than the ones in Georgia. Scott Nixon and Candace Oviatt,[6] in an extensive study of Bissel's Cove in North Kingstown, calculate that net primary production there is about two thirds of what Odum found in Georgia. This difference is due to a long dormant period during the winter months and the lower heights of the Spartina alterniflora and Spartina patens.

Why are salt marshes so productive? First of all salt marshes grow in areas where salt water and fresh water are mixed and valuable nutrients circulate rapidly between organisms, water and the bottom sediments. The tides maintain a constant supply of oxygen and nutrients and remove waste products. To quote Odum, *"other things being equal, a flowing system will be more productive than a standing system."*[7] A second major reason for the fertility of salt marshes is that the primary productivity is dependent in great part on rooted vegetation, most importantly Spartina. The abundance of the plant material supports the animals that make the marshes so valuable to man. This is well stated in Nixon and Oviatt's paper "The Ecology of a New England Salt Marsh":[6]

> *... the results from Bissel Cove indicate that even in the less extensive marshes of New England, the development of large populations of shrimp and fish in the marsh area can be documented, and that the maintenance of the system necessary for the culture of these large populations depends on inputs of organic matter from the productive meadows of Spartina.*

Though the meadows of Spartina are the most productive, algae growing on the mud and free-floating plants (phytoplankton) are also important

in producing organic material from nutrients and the sun's energy. Teal,[8] one of the scientists who worked with Odum in Georgia, estimated that about 60% of the primary production in a salt marsh comes from Spartina, 30% from the mud algae and about 10% from the phytoplankton.

After Spartina, one of the most common plants in salt ponds is eel grass, Zostera marina. Originally a terrestrial grass that has evolved into an aquatic species, eel grass forms dense meadows in shallow protected waters. Eel grass beds are directly linked to the productivity of coastal fisheries. Though fish do not graze these submerged meadows the detritus they produce is a food source for fish food organisms. The dense growth of these submerged meadows also provide protection to the juveniles of several commercially important fish species. Many species of wildfowl feed on eel grass.

Dr. Saul Saila has studied[9] the populations of juvenile blackback flounder in Charlestown and Green Hill ponds in Charlestown and South Kingstown. He found that 25% of the juvenile blackbacks necessary to maintain the (1961) commercial and sport fisheries in Block Island Sound are reared in the state's shallow coastal embayments and salt ponds. If this proportion of the blackback flounder catch is still provided by these areas, their value to the Rhode Island commercial fisherman in 1972 was about $162,000 and the income they provided to the industry as a whole (processing, retail, etc.) was about $400,000.

Nixon and Oviatt's study of Bissel Cove[6] showed that a small marsh supports very large seasonal populations of grass shrimp and fish. Grass shrimp are an important food for many larger fish, including bluefish and striped bass.

Salt ponds also support large populations of shellfish, most notably,

scallops, oysters, soft shell clams and quahogs. Green Hill pond is well known for its oysters but the population has been much reduced by a migration of marine oyster predators into the pond made possible by the increase in the salinity of the pond. This increase in salinity was brought about by the construction of an enlarged breachway into the pond. Charlestown Pond, however, still produces some oysters for the local market. The soft-shelled clam population of Green Hill pond was surveyed in 1964.[5] Maximal densities of 360 clams/m^2 were found and the average for the pond as a whole was calculated to be 20/m^2. No estimates are available for densities or harvest of scallops and quahogs.

Salt marshes have frequently been described as "food factories" for the animals that live in coastal waters. Nixon and Oviatt[6] estimate that 10% to 30% of the grass grown each year in Bissel Cove is transported out of the marsh. This dead grass may be a significant food source in nearby coastal waters. Salt ponds also export quantities of fish and crustacea which are important foods for larger species.

Salt ponds also support a plentiful and varied population of wildfowl. Thirty-five species of waterfowl, which include ducks, swans, and geese, can be found in Rhode Island in a normal year.[2] Since 1900 the waterfowl population has decreased drastically along the northeastern coast. In Rhode Island a group of three or four hunters at the turn of the century easily bagged a hundred birds in a day. In Boston markets bluebills sold for about twenty cents each. Today the number of waterfowl that are killed in a season is controlled and overhunting is no longer a critical problem. The most critical factor limiting waterfowl populations today is the lack of suitable habitats. The majority of Rhode Island's wetlands are of the scrub brush and swamp type that are

of little value to waterfowl.[3] In several locations throughout the state dams have been built to form ponds suitable for waterfowl, but little thought has been given to ensuring a supply of food. Dabbling ducks, which include the black duck and baldplate, depend on shallow rooted aquatic vegetation and diving ducks feed on small fish. A study made in 1968 of the stomach contents of Rhode Island waterfowl[3] showed that a high proportion of their food came from terrestrial plants. This was due to the shortage of the more nutritive marsh plants. Salt ponds are highly valuable to waterfowl. They are rich in marsh lands and since they do not freeze over as often as inland ponds they can be used by waterfowl when other areas are iced over.

There are no mammals that are specific to the barrier beaches. All mammal species that can be found along the shoreline may inhabit or visit the barriers. Some species of birds however, are found almost exclusively in the barriers. These include horned larks, pipits and snow buntings.

Factors Influencing the Management of Salt Ponds and Barriers: The most important point that must be remembered by those trying to manage such a small delicately balanced area as a barrier beach, marsh and pond is that it must be considered as one unit. An apparently small change, such as an increase in the volume of freshwater (increased drainage from a developed shoreline) or seawater (building a permanent breachway) entering the pond, can radically change the environmental conditions and greatly affect the animal and plant populations.

Without the barriers there would be no salt ponds. The ability of the barriers to withstand the forces of the ocean is determined by the

height and stability of the dunes. On a poorly vegetated low barrier storm waves frequently wash quantities of sand into the ponds and the losses of sand from wind erosion are great. The pond behind a poorly vegetated low barrier will therefore be filled in more rapidly than one protected by well developed and stabilized barrier dunes. Marshes behind rapidly eroding barriers may be buried and the productivity of the pond reduced. To build dunes and to protect them we must protect the beachgrass, and this means controlling construction and vehicular and human traffic. Preliminary studies made on the National Seashore dunes on Cape Cod show that as few as 10 to 15 people walking along the same route through beachgrass in a week will kill off the grass.[4] The wheels of vehicles destroy the grass even more quickly. Public education and the policing of barriers are necessary if the use of the dunes is to be controlled. To assist the rebuilding of eroded and poorly vegetated areas snow fences can be erected and beachgrass planted.

A salt pond is particularly vulnerable to man because he can so easily alter its controlling parameters. The parameters that govern the characteristics of a salt pond may be summarized as follows:

I Characteristics of Flow: volume and variation of fresh and salt water flows into the pond; circulation patterns; turbulence; flushing time (the rate at which pond water is replaced by new fresh and salt water).

II Water Properties: salinity, temperature, transparency, nutrients, pollutants and dissolved oxygen.

III The Form of the Pond: shape, size and topography and character of the bottom.

One of the most critical problems facing us today is the modification of the quality or volume of fresh and salt water flowing into the ponds. A permanent breachway and an increased flow of seawater will have

a number of effects. The most obvious change will be that the salinity in the pond will increase. The salinity of a pond determines what species of plants and animals will be present. In some brackish ponds an increase in salinity may be desirable because the phosphate found in seawater will improve a pond's productivity. In other cases more seawater will destroy a delicately balanced system.

A breachway will also cause the deposition of sand in the pond to increase. In the case of Charlestown Pond, the water flowing into the pond on each flood tide carries suspended sand which is deposited inside the breachway. Ebb currents are not strong enough to carry it out again and as a result, the volume of the pond decreases steadily.

The numbers of houses on the barriers and around many of Rhode Island's salt ponds is increasing and the great majority of these houses have their own septic systems. No data are presently available on the effects upon salt ponds of leachings from septic systems, but studies made in similar environments elsewhere, including Nixon and Oviatt's study of Bissel Cove,[6] suggest that increasing the number of leach fields around a pond or marsh will adversely effect the environment. The nutrients contained in sewage wastes, if in sufficient quantity, will cause populations of some species of plants and animals, to increase enormously. Oxygen levels may become too low for many of the more desirable species of fish and shellfish which therefore die or are forced to migrate. A dramatic example of extreme eutrophication (overfertilization) is Lake Erie.

One of the greatest threats to Rhode Island's salt ponds is the continuing destruction of salt marshes by dredging and filling. There are no records of the total lost since the first settlers but the

destruction has been enormous.[1] Forty-five thousand acres of marsh were destroyed from Delaware to Maine between 1954 and 1964. It was estimated that 40% of Connecticut's salt marshes were gone by 1959. Ten percent of Rhode Island's larger salt marshes (40 acres or more) were destroyed between 1954 and 1964 and the loss of smaller but equally valuable marshes was probably greater. Laws passed in the last decade have done much to protect the marshes but their destruction and degredation continues.

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CHAPTER FOUR

DEVELOPMENT CONSEQUENCES AND MANAGEMENT POLICIES

The Task: Man's activities modify the environment. The form and magnitude (impact) of the modification will vary with the nature of the activity and the sensitivity of the environment. These environmental modifications result in further natural changes which in turn affect the human initiators of the process. Man, unfortunately, frequently ignores this simple fact. He is continually trying to escape the consequences of his own acts or to modify the natural environment to make them less onerous. In the process he frequently compounds the original problem.

The task at hand, then is to:

1. Identify the environmental consequences of man's actions.
2. Determine what effects, direct and indirect, these have on man.
3. Determine how man's actions may be modified to avoid undesirable consequences.
4. Effect the necessary modifications.

Man Modifies the Barrier Environment: Human modification of the barrier environment can be both direct and indirect, intentional and unintentional. Direct and intentional modifications would include such things as road and parking lot construction, commercial, recreational and residential development, excavation, filling, well drilling and sewage disposal. Each of these, in turn, may cause further indirect, unintentional and frequently unanticipated modifications such as erosion, ground water

depletion, pollution, destruction of wildlife habitat or increase in storm vulnerability. Indirect modifications need not, moreover, result only from conscious modification of the barrier. Unanticipated changes can result from the most apparently simple and innocent of activities. Even walking through stabilizing beachgrass cover, for example, can have dramatic effects on the underlying dune.

Variables Determining Impact: Each activity will impose stresses on the environment. The magnitude of these will vary with:

1. The type of activity, or use
2. The number of activities (similar or dissimilar) or uses
3. The density of activities (similar or dissimilar) or uses
4. The frequency of use
5. The duration of use
6. The intensity of use

The response of the stressed environment will vary in proportion to its capacity for absorbing this stress. The barrier consists of at least five distinct but integrated environments:

1. The beach
2. The dune field
3. The back dune flat
4. The marsh
5. The barrier pond

Each of these varies in the amount of natural stress to which it is exposed and in the amount of additional human stress which it can sustain.

The following discussion will concentrate on the most frequently observed or probable consequences of common human uses of the barrier.

There is, however, no "typical" Rhode Island barrier and observations should be interpreted with an awareness of the many variables involved. They will not be equally applicable to all barriers.

THE BEACH

1. BUILDING

Problem: The beach is a hostile environment for the location of buildings. Normal tidal fluctuations and periodic storm and hurricane flooding and wave damage threaten even the most substantial structures. The few buildings presently located on the beach proper appear to have found themselves stranded there as the dunes in which they had been built eroded back around them. Whether elevated on piles or stabilized by riprapping, they remain vulnerable to serious storm damage and increasingly isolated from and unprotected by the dune.

Solutions:

1. Prohibit further construction on the beach itself.
2. Remove existing violators to behind the dune.
3. Require public beach facilities built behind or on beaches without a dune to be elevated above 100 year flood levels and protected by a seawall.

2. VEHICULAR USE

Problem: Off road vehicular (ORV...beach buggies, dune buggies, motorcycles) use of the beach for fishing, camping and pleasure riding is becoming increasingly popular. ORV use results in substantial disturbance of the beach surface by tire tracks and may endanger bathers and walkers. For this reason it is prohibited by most Rhode Island coastal

communities from May through September. ORV's do not harm the beach. Most tracks are erased by the rising tide.

ORV traffic creates problems:

1. When it becomes so heavy as to interfere with others' uses of the beach.

2. When vehicles traverse the dune base, undercut and destroy stabilizing beachgrass.

3. When vehicles indiscriminately cross the dune to get to the beach, thereby destroying stabilizing vegetation.

Solutions:

1. Establish a uniform season during which ORV traffic is prohibited by the state and coastal communities.

2. Monitor and limit the numbers of vehicles allowed on the beach.

3. Restrict cross dune access to designated routes.

4. Prohibit transit along dune base.

5. Establish fines for violation of 3 and 4.

6. Educate the vehicle owner as to his responsibilities towards the environment and other recreators.

7. Enforce all of above or if not possible prohibit ORV use altogether.

8. Require registration of or permits for ORV use of the beach. This could involve fees for application to dune restoration projects and enforcement costs.

3. FOOT TRAFFIC, PICNICKING AND BATHING

Problem: Many of Rhode Island's barrier beaches are attractive for bathing, picnicking and walking. These activities need not interfere with other uses nor harm the barrier environment. Problems arise, however, when the public abuses open use of the beach. Common abuses are:

1. Illegal parking in beach areas.

2. Trespassing on private property and interfering with riparian rights.

3. Littering.

4. Indiscriminate crossing of the dune with consequent destruction of stabilizing beachgrass.

Solutions:

1. Prosecute illegal parking, trespassing and littering.

2. Identify, open and mark existing public rights-of-way to the shore. Prosecute private owners who close these rights-of-way.

3. Provide adequate parking, disposal and sanitary facilities at heavily used rights-of-way.

4. Acquire additional rights-of-way where found desirable.

5. Restrict foot access to the beach to designated routes. Fine violators.

6. Provide sufficient routes to handle public demand.

7. Educate the public to the natural vulnerability of the barrier to human abuse and to the rights of shore front property owners.

THE DUNE

4. THE DUNE AS A STORM BUFFER

Problem: The barrier beach and its sand dune are delicate natural features, the latter in particular is vulnerable to human damage. Damage is undesirable for more than aesthetic reasons. The beach-dune acts as a buffer to the fury of storm seas.[1,2,8] As the dune is attacked by storm waves eroded material is carried out and deposited offshore where it alters the beach's underwater configuration.[9,10] Accumulating sand decreases the offshore beach slope (makes it more nearly horizontal)

thereby presenting a broader bottom surface to storm wave action.[9,10] This surface absorbs or dissipates through friction an increasingly large amount of destructive wave energy which would otherwise be focused on the shoreline behind the barrier.[3,6]

The dune's capacity for absorbing and moderating wave energy is not dependent on any ability to completely prevent breaching or flooding. Even in the process of being inundated and destroyed, as many are by hurricanes, the dune moderates back barrier storm damage.[2,3] This effect is less pronounced for low dunes, but nevertheless persists. Since storm resistance increases with dune height, however, all human uses of the barrier which devegetate, erode or lower the dune expose the shoreline behind the barrier to increased storm damage.[1,3]

Solutions:

1. Discourage or prohibit all activities which weaken even the lowest of dunes.
2. Encourage all activities (private and public) which contribute to dune stabilization and natural regeneration.

5. *BUILDING ON THE DUNE, IN THE DUNE FIELD*

Introduction: Most of Rhode Island's barrier beaches have a single line of low dunes running parallel to the shoreline. In many areas these dunes are so low as to be nearly undetectable; most others are of very modest height. Management of the barrier dune will be complicated by the frequent difficulty of defining its extent. The back (pond side) slope of many of the lower dunes is so gentle and continuous as to prevent precise definition of a base. It may, therefore, prove

necessary to arbitrarily establish this base from engineering survey data.

Rhode Island's barrier beaches are coming under heavy developmental pressure. Increasing numbers of commercial, recreational and, above all, residential structures are being built, many on the dune. A developmental pattern common before the state's low lying beaches were swept clean by the 1938 and 1954 hurricanes is once again establishing itself.

6. *SITE PREPARATION*

Problem: Construction typically requires that a level building platform be prepared on the dune. The dune crest is frequently lowered to provide such a platform and to improve the view.[2] Vegetative cover is often destroyed by site preparation. Unstabilized, it is then exposed to wind erosion which in conjunction with lowering of the dune crest may encourage the formation of blowouts. These, in turn, increase the dune's vulnerability to storm damage and decrease its value as a storm buffer.

Solutions:

1. Prohibit lowering of the dune crest to provide building sites.
2. Restrict construction to areas behind the dune line as defined by engineering surveys.
3. Prohibit all construction on the dune.
4. Where construction is permitted or already exists, require replanting of devegetated areas.
5. Provide technical assistance and a convenient source of beachgrass plantings to property owners.
6. Encourage additional stabilization through such methods as installation of snow fencing.

7. CONSTRUCTION

Problem: Barrier buildings fall into two broad categories; those built on conventional solid foundations and those elevated on stilts or pilings. Wind blown sand is accumulated by porous barriers such as snow fencing and beachgrass. Solid objects, however, cause minor accumulation on the upwind side and erosive scour on the downwind side.[10] Downwind erosion may, therefore, be expected when solid foundation structures are built on a dune.

Solutions:

1. Prohibit all construction on the dune.
2. If construction is permitted, discourage or prohibit solid foundations.
3. Require vegetative stabilization to trap moving sand.
4. Prohibit solid barriers or enclosures under elevated structures.

8. WATER SUPPLY

Problem: Most structures will require a dependable freshwater supply. This may be provided by an on site well or by a pipeline from an external source. A pipeline, however, will be vulnerable to shifting sands and storm damage and may prove prohibitively expensive to maintain.

Barrier ground water supplies are limited and respond to fluctuations in the level of the salt water on which they float.[8] Well depletion may encourage salt water intrusion and consequent salt contamination of freshwater supplies. If ground water levels are reduced below a critical point stabilizing beachgrass will sicken and die,[8] exposing the dune to increased wind erosion and storm damage.

Solutions:

1. Provide piped water where possible. Towns should, however, be aware of the potential cost involved and may wish to charge barrier users for installation and maintenance.

2. The minimum water table level necessary to sustain covering vegetation should be determined and withdrawal of water limited accordingly. This may require limiting of building densities.

9. SEWAGE DISPOSAL

Problem: There is no conclusive evidence that the disposal of domestic wastes through conventional septic systems now required by state and local health codes has any adverse effect on the dune itself. It might, indeed, be expected to provide additional nutrients to dune vegetation. Where sufficient volumes of septic system effluent are introduced into the barrier marsh and pond, however, eutrophication may become a problem. Domestic wastes, if introduced in sufficient volumes, may additionally contaminate the limited ground water supply and thus pollute wells.[8]

Solutions:

1. The construction of municipal sewer lines and treatment facilities is desirable. Lines may be vulnerable to storm damage, however.

2. Existing Health Department regulations should be rigidly enforced.

3. Additional treatment techniques such as aeration should be considered.

4. Residential density should be controlled where sewers are not provided.

10. *ACCESS AND EGRESS*

Problem: Safe, reliable and convenient access routes must be provided to businesses, recreational facilities and, most especially, homes located on Rhode Island's barrier beaches. Access is usually provided by a gravelled or paved road open to conventional vehicles running the length of the barrier. Where the access road is located behind the dune it creates few natural problems. Even where unstabilized material is exposed it is normally protected from wind and water erosion by the dune. Where the dune is low, unstabilized or blown out, however, the access road is vulnerable to drifting sand and storm washovers. Washovers may temporarily flood or completely wash out considerable lengths of road and thereby prevent escape during storm emergencies. Many of the deaths caused by the 1938 hurricane resulted from people being isolated in low lying areas. Improved storm warning systems may prevent many such deaths, although residential use of areas subject to isolation and flooding remains undesirable.

Solutions: The access road must be protected from storm damage if a safe emergency escape route is to be provided barrier residents. Safe exit should be mandatory. It can be provided by:

1. Elevating the road grade above hurricane flood levels.
2. Protecting exposed sections with riprapping or seawalls.
3. Preserving a vigorous natural dune.
4. Restricting or prohibiting outright development of areas subject to isolation during extreme flood conditions.
5. Requiring mandatory evacuation of endangered areas during storm alerts.

11. VEHICULAR AND FOOT TRAFFIC

Problem: Foot traffic across the dune is associated with the presence and use of homes, recreational facilities or readily accessable open space. Vehicular traffic is common at public rights-of-way and along many stretches of undeveloped barrier, including conservation areas administered by the state and private groups.

Any access route across the dune line will become unstabilized and consequently vulnerable to erosion if it receives even occasional traffic.[5,6,8] The natural vegetative cover of Rhode Island dunes is American beachgrass. It is the primary stabilizing agent and is highly intolerant of foot and vehicular traffic. One or two passages by a vehicle or a dozen or so by foot over the same route in a week's time will destroy most if not all of the grass along that route.[5] Unless artificially stabilized, therefore, routes across the dune will be exposed to erosion.[6,8]

Solutions:

1. Access across the dune should be restricted to stabilized paths or roadways. All other routes should be blocked off.
2. Foot traffic should be serviced by wood walkways, preferably elevated.
3. Vehicular traffic should be serviced by corduroy (wood) or paved roads.
4. Fines should be levied for cross dune travel on other than designated routes.
5. All restrictions should be strictly enforced.
6. The public should be educated as to the value of the dunes and the need for any restrictions that are imposed.

THE BACK DUNE FLAT

Problem: The relatively flat area sloping gradually down from the back dune base to the pond fringing marsh represents the most stable area on the barrier.[8] Where the dune is low and its back slope gentle, however, it is frequently difficult to establish where, if at all, dune ends and flat begins. Arbitrary determination through engineering survey may prove necessary, although in many cases distinctions will be academic, the entire barrier width being so low, exposed and/or vulnerable as to make development of any part of it undesirable.

Where the dune provides even limited protection from storm flooding and wave damage the flat will usually be moderately too well vegetated, often in secondary growth (bushes and scrub). The protection afforded by the dune will increase the flat's ability to tolerate human use and development. Most uses and forms of development will, nevertheless, require some modifications along lines already suggested (see references to use of the dune).

Solutions:

1. See recommendations for dune use and development. A less restrictive application of many of these may be desirable.

2. Promote safe development by applying flood hazard zoning and building code criteria to permitted development.

3. Prohibit all development of barrier beaches so low and exposed as to be endangered by normal storm flooding and wave damage. Total restriction of this sort will, in many cases, require public acquisition and should not, therefore, be lightly recommended.

4. Controls short of complete prohibition should be considered wherever possible.

THE MARSH AND POND

The barrier marsh is not heavily exploited as a recreational resource. It is ill-suited for the more conventional forms of outdoor recreation and remains largely unmodified by casual human use. The major threat to the marsh's (and indirectly the pond's) continued vitality is rather residential or commercial development, both requiring substantial alteration of the marsh environment.

13. FILLING

Problem: Construction in the marsh requires that an access route and a construction site be filled to provide a suitably stable and elevated building platform.[7,8] Filling buries and consequently destroys the productive capability of the underlying mud flats and vegetation. It reduces the flood water storage capacity of the marsh by reducing its surface area. It destroys the natural habitats and nursery areas of birds, mammals and commercially and recreationally valuable fish and shellfish species. It may contribute to erosion, siltation and altered circulation patterns in the pond. Filling further reduces the already dwindling supply of a unique and valuable natural resource.

The marsh and ponds make a substantial contribution to Rhode Island's commercial and sports fishery. The marsh's ability to store flood waters moderates the impact of storm surges on low lying developments behind the barrier pond.

Solutions:

1. Filling of the marsh should be prohibited.

2. Prohibition should extend to both fresh and intertidal salt marshes and mixtures of the two, irregardless of size.

3. Existing restrictions should be strictly enforced.

14. SEWAGE DISPOSAL

Problem: The marsh is particularly ill-suited for sewage disposal.[8] Conventional treatment techniques function poorly or not at all because of the naturally high water table and the consequent difficulty of providing adequate drainage.[7,8] Concentrations of pollutants may result where domestic wastes are introduced into the marsh.[7] These may find their way into the pond.

Solutions:

1. Prohibit the installation of sewage disposal and treatment systems in the marsh. This would include filled areas.

2. Where construction is permitted or already exists provide sewage lines to an external treatment facility.

RESOLVING USE CONFLICTS

Uncontrolled development has in the past demonstrated a high probability of creating unnecessary conflicts between users of the barrier environment. The beach is well suited for swimming, fishing and light recreational use; for scenic vistas, aesthetic enjoyment and open space; for commercial, private residential and public recreational development. Many of these are or can be made compatible with each other. The competitive ability of the various legitimate barrier uses is not equal, however, and they therefore cannot be expected to manage themselves.

15. RESIDENTIAL DEVELOPMENT

Problem: Residential development in particular demonstrates a high probability of precluding other legitimate uses. Demand increases daily. The individual buyer requires only a small area for which he is willing to pay a premium price. He seems willing to live in close proximity to his neighbors. He jealously protects his private property rights.

Solutions:

1. Residential development should not prevent public access to the beach. Public rights-of-way should be provided at frequent intervals.

2. Residential density should be regulated with an awareness of the environmental capacity and the natural scenic beauty of an area.

3. Development of especially unique or valuable natural areas, wildlife habitats or fragile natural environments should be prohibited.

16. RECREATIONAL DEVELOPMENT

Problem: The impact of recreational facilities on the barrier environment and on other human activities is becoming of increasing concern. While neither the state nor the towns are able to compete on a widespread basis with the residential developer, they have the power and sometimes the money to supplant existing or other desirable uses of areas they determine suitable for recreational development. Recreation is a necessary and valuable use of the shoreline. The state in particular, however, has not always exercised its stewardship over public shore lands in a responsible manner. Management and maintenance are frequently inadequate, damage to natural features unacceptably and unnecessarily severe

and interference with other legitimate activities high. The communities in which state beaches are located have often faced heavy and sometimes unnecessary drains on their services for which they have not been adequately compensated.

Solutions:

1. Continued public acquisition of barrier shorefront should be conditional upon more efficient use and adequate management of existing areas and facilities.

2. Recreators should not be allowed free use of delicate natural features such as dunes. Access to these should be limited and only via stabilized trails.

3. Enforce existing regulations at all public recreational areas (developed and undeveloped). Fine violators. Provide adequate policing.

4. Cooperate with towns in determining most efficient traffic flow patterns, parking arrangements, policing requirements in areas adjacent to state beaches.

5. Compensate communities for the drain on town services created by the presence of state facilities. The amount should be negotiated.

6. Consider techniques for achieving more efficient use of existing facilities:

    a. Public service radio reports of swimming conditions, traffic and crowds at various state facilities.

    b. Statewide coordination of beach use. When a given beach is full to capacity, recreators should be intercepted at the nearest major access point and rerouted to less crowded facilities.

    c. Consider removal of parking lots to inland sites and an expansion of usable beach back over the existing parking lots. Provide bus service from inland lot to the beach.

7. Assess user fees at <u>all</u> state recreational facilities. This will be a key requirement for other desirable reforms and for funding of acquisition programs.

17. COMMERCIAL DEVELOPMENT

Problem: Commercial development of the barrier follows the pattern of recreational development. Restaurants, concession and souvenir stands, taverns and motels establish themselves around state beaches in particular. Commercial development need not be objectionable. Where it becomes so concentrated as to preclude other activities which require a beach front location and where it does not require such a location itself, it may, however, create problems.

Solutions:

1. Commercial uses of the barrier which do not require or are not substantially enhanced by a beach front location should be discouraged.
2. Zoning restrictions should be imposed to control and direct commercial development.

18. LIGHT RECREATION

Problem: Light recreation has a substantial impact on the barrier environment. This impact will continue to increase as the demand for recreational access and use grows. Impact and possible controlling techniques have already been treated at length in earlier discussions of vehicular and foot traffic, camping and picnicking in the dunes and on the beach. The reader is asked to refer back to these.

19. CONSERVATION

Problem: Conservation of unique or fragile natural features, valuable wildlife habitats and scenic open space is one of the most desirable uses of limited barrier lands. As urbanization of the state

and the region progresses the need for unmodified open space will become increasingly apparent. Too often we do not recognize our need for natural beauty until we have destroyed it. Too often also when we have the foresight to acquire natural areas we do not have the foresight to manage them properly. We either destroy them physically by irresponsible and unrestricted use or destroy their human value by closing them to all use.

Solutions:

1. State conservation areas should provide a model for sound management of human use:

   a. Activities compatible with preservation of an unmodified natural environment should be encouraged.

   b. Activities which harm natural features, vegetation or wildlife should be prohibited.

   c. Restrictions on human use should be clearly posted and enforced through adequate policing and fines.

   d. Numbers of recreators and duration of use should be limited to the environment's ability to sustain the stresses imposed.

2. The state should encourage and support private reservation of barrier land for conservation purposes subject to the following conditions:

   a. Adequate management as in 1, above, is provided.

   b. Total prohibition of use is restricted to those features such as dunes and areas such as nesting grounds which cannot tolerate any human use.

   c. Limited public access is allowed to other areas.

   d. Conservation restriction is not imposed for the sole purpose of preventing public access or reducing taxable land values.

3. It is essential that the public be educated as to:

   a. The value of open space.

b. The sensitivity of natural areas to human use.

c. The public's responsibility for preservation of natural areas through responsible use.

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CHAPTER FIVE

TOOLS AT HAND: CONTROLLING USE OF THE LAND RESOURCE

Introduction: There are two basic mechanisms for public supervision of land use. These are regulation and acquisition. Regulation is based on the government's exercise of the police power, i.e., the obligation to protect the public health, safety and welfare. Acquisition involves the voluntary or compulsory purchase of complete or partial title to private land for a public purpose. These mechanisms shall be examined in turn for their relevance to controlling land use on the barriers.

Regulation--The Police Power

The right of private property is not absolute. When its use has a potential to injure the public interest it may be regulated without compensation as an exercise of the state's police power.[12,15] Legal exercise of the police power requires that several conditions be met. These are:

1. A duly authorized government agency or legislative body must find a need for the exercise and must specify required restrictions in detail.[4,6]
2. The need must be found to bear a substantial relationship to the public health, safety and welfare.[4,12]
3. Restrictions must not be arbitrary or unreasonable.[4,12]

A restriction is arbitrary if it is not required for the public health, safety or welfare or is discriminatory in its application.[6] It is unreasonable if the public good to be served by regulation is not

sufficient to justify the loss imposed on the property owner; or if the regulation, irregardless of the public good served, is so restrictive as to deprive the owner of all profitable or beneficial use of his property (a "taking"). Three observations need to be made at this point. One, the "public" includes the regulated property owner himself. He can, therefore, be legally restricted from compromising his own as well as others' health, safety or welfare. Two, the mere fact that regulation results in a decrease in property value does not constitute a taking.[4,12] The amount of restriction which the courts will tolerate as reasonable will vary considerably with each situation. A substantial reduction in property value is defensible where a clear and sufficient public benefit is established. The owner must, however, retain some "profitable and beneficial use" of his property. Three, in the absence of evidence to the contrary, the courts are likely to accept the state's definition of the public purpose to be served by regulation. Regulations will, however, be struck down as unconstitutional where the public purpose is not sufficiently compelling or the deprivation of use is too severe.[4]

The major advantage of the police power is that it allows the regulation of private property in the public interest without requiring expenditure of public funds for compensation. Where applied with an eye to the constitutional limits on its use it is an altogether justifiable and reasonable expression of the community's interest in the management of its land resources. The major disadvantage is that it is frequently difficult to establish sufficient public purpose or avoid a taking where substantial restrictions are deemed necessary. Such restrictions may, furthermore, prove politically untenable. Regulated interests are commonly organized and vocal. The public's commitment to its "interest"

is frequently ill-defined and poorly articulated. In the absence of public support, defense of the public interest can become a lonesome and uncomfortable task. This suggests that the police power must be exercised with some caution and may by itself provide insufficient authority to control development of environmentally fragile areas. The fiscal "facts-of-life," however, dictate a heavy reliance on uncompensated regulation and necessitate a careful examination of its application alone and in conjunction with other control devices.

The Police Power--Conventional Zoning: Zoning as it is typically applied in the state of Rhode Island is an exercise of the police power designed to guide land development by spatially separating incompatible uses (heavy industry and housing, for instance). Its primary objective is the preservation of property values through the protection of best ($) use in each zoning district. Its practical consequence, however, is often the pursuit of rigid uniformity within districts. While preservation of property values can be one legitimate objective of barrier land management, it would not appear to be a primary one. Rigid application of "best" single use zoning principles runs counter to the Council's charge *"to produce the maximum benefit for society from (the state's) coastal resources."* It reduces the flexibility necessary to promote multiple use of coastal resources consistent with environmental integrity.

A major problem of single-use zoning, in coastal areas perhaps even more so than others, is the termination of nonconforming uses.[3] These must be eliminated if the desired separation of incompatible uses is to be achieved. Termination can be an extremely delicate operation. Any semblance of a "taking" must be avoided if the zoning ordinance is

not to be struck down by the courts and compensation required.[12] Three techniques have evolved for removing nonconforming uses. The conventional approach is to impose restrictions on the use, alteration and repair of nonconforming structures. A less tested technique, amortization, establishes a time period estimated to be the time required for an owner to recoup his investiment after which the nonconforming use must be discontinued.[3] Both techniques attempt to phase out nonconforming uses with time and are frequently unsuccessful in doing so. The most direct approach requires public acquisition of the offending use. It costs more, but provides immediate termination. Its application will be discussed in a later section of this chapter.

Another key zoning problem is the heavy reliance of municipal governments on the property tax to finance public services. This source alone accounted for 65.06% of total 1970 municipal revenues in the state of Rhode Island.[13] Increasingly heavy demands on public services and heavy competition for public revenues has created an understandable pressure to administer zoning ordinances with an eye on the till. "Fiscal zoning" provides powerful incentives to encourage tax generating development, often at the expense of fragile natural areas, local and state open space and recreation needs. These incentives are augmented by assessment practices which tax property on the basis of its "highest and best" or potentially most profitable use rather than its existing use,[14] thereby making it increasingly expensive for the private land owner to leave developable land in an undeveloped condition.[6] Tax pressures are felt particularly keenly in shore areas where heavy demands for residential, industrial and private recreational development have resulted in skyrocketing land values and increased tax burdens.

Conventional zoning is not well suited to barrier land management. It may be of limited value for guiding development of currently undeveloped or lightly developed shore areas. Even here, however, its usefulness will be compromised by an inability to relate growth rate to the availability of necessary public services. In all shore areas, moreover, conventional zoning will exhibit common shortcomings. One, it relies on spatial separation to remove use conflicts. This is not always possible or even desirable in shore areas subject to heavy and differing user demands. Two, it characteristically defines the "best use" of a zoning district in dollar terms. The "best" use(s) of the shoreline is (are) quite frequently not the most profitable. Conservation, recreation, aesthetics have values which are only partially expressed in dollars. Three, its practical consequence frequently is the pursuit of uniform use within zoning districts. Again, the multiplicity of demands for shore use suggests that uniform use is neither a desirable nor realistic objective. Four, it is seldom possible to terminate nonconforming uses quickly. The barrier is a delicately balanced natural system. Undesirable activities can cause irreversible damage in the time required to force their termination. Five, conforming and nonconforming uses are defined inflexibly. They are consistent within districts. The desirability of and compatibility between uses on the barriers is variable. Inflexible definitions don't work. A use will be tolerable if it does not have an adverse effect on the barrier environment and does not prevent other desirable uses. The barrier environment varies with the physical condition of the barrier and its natural features. Desirable uses vary with location and compatibility with other desirable uses. A flexible approach to conformity and nonconformity is required for effective

management. Six, zoning is subject to revenue generating pressures. A natural bias towards tax producing development is built into the system. Delicate natural features such as barriers are not always tolerant of the type and density of development which produces high tax revenues. Even where they are, it may prove desirable to provide for other uses whose tax value is less.

The usefulness of zoning as a guide to barrier development will be enhanced by consideration of multiple-use possibilities. A more flexible and hence workable application of zoning techniques may be possible if increasing the number of uses a given shore area can support becomes a recognized objective. Mixed (multiple-use) development where modified by consideration for compatibility between uses and by sensitivity to environmental limitations represents the most desirable allocation of limited shore areas. Zoning can be one means of encouraging multiple-use. Substantial modification of existing municipal ordinances may be required, however, before zoning can effectively realize this objective. The Council has no authority to cause such modifications. Local cooperation will be necessary.

The Council's Authority Over Land Areas: There are a number of land areas whose use it would appear the Council can control under the provisions of Section 46-23-6 of the General Laws:

> The authority of the council over land areas (those areas above the mean high water mark) shall be limited to that necessary to carry out effective resources management programs. This shall be limited to the *authority to approve, modify, set conditions for, or reject the design, location, construction, alteration, and operation of specified activities or land uses when these are related to a water area under the agency's jurisdiction,* regardless of their actual location. The Council's authority over these land

> uses and activities shall be limited to situations in which there is a reasonable probability of conflict with a plan or program for resources management or damage to the coastal environment. These uses and activities are [among a total of six specified]:
>
> 1. Shoreline protection facilities and physiographic features.
>
> 2. Intertidal salt marshes.

Assuming that a legally defensible case has been made for the barrier beach-dune complex's status as (1) a coastal physiographic feature and (2) a shoreline protection feature, and that the existence of pond fringing salt marshes (as defined in existing intertidal salt marsh and coastal wetlands statutes) can be established, there seems to be adequate authority and justification for the Council to exercise use controls in these areas. These might be exercized at two levels and the consequences of each are worthy of some consideration

Possible Expressions of Council Authority: At the first level the Council might assume direct administrative control over land use in the designated barrier areas through either a permit or zoning system. Such an approach would superimpose state over local controls. While access to this approach may prove desirable for the protection of extremely sensitive areas of overriding value to the state, its general application to the barriers poses several problems:

1. It is politically unfeasible. Complete abrogation of local control will create municipal opposition and hostility which will reflect itself in the Legislature.

2. It is practically unfeasible. The Council has neither the time nor the staff to administer a direct permit or zoning system on the necessary scale.

3. It is socially unfeasible. The reservoirs of public good will and community cooperation necessary to effective management are unlikely to survive such a drastic challenge.

4. It is legally suspect. Municipalities are protected, as are individuals, from abuses of the state's exercise of the police power. A complete assumption of state control, except under very limited circumstances, might well be struck down by the courts. The matter would be there very quickly.

At the second level the Council might exercise its authority through the municipal zoning and permit system. This would be accomplished by the Council's establishing zoning (use) standards for barrier development. Minimum levels of local compliance would be established and enforceable under the Council's legislatively delegated authority. The Council would retain the option to regulate directly where local ordinances did not exist or did not meet minimum standards. This approach to zoning as a control technique presents several advantages and, additionally, reflects Council policy of ruling on coastal development only after the community has considered and approved it. State-local cooperative zoning of critical coastal areas (with the emphasis on local initiative and administration), does not necessarily address itself to the inadequacies of zoning as a land use control technique. It does, however, provide a tool sufficiently useful to justify further consideration.

State-Local Cooperative Zoning: Although the power to zone constitutionally belongs to the state, it has long been delegated to municipalities. They with good reason, see it to be one of their most basic and necessary administrative controls. They are unlikely to suffer infringement of their zoning powers without substantial opposition. A notable advantage offered by "cooperative" zoning is that it provides for the minimum disruption of local land use controls consistent with protection of overriding state interests. Municipal controls having a local impact only are not affected. Such state supervision as exists is in the form of

broad guidelines and minimum standards within which continued local initiative is protected. Cooperation is encouraged by mutual consultation and negotiation. Inherent in the state's reassertion of even limited zoning controls as an exercise of its police power, however, is the presumption that the greater (state-wide) public interest must prevail when irreconcilable differences arise between it and the narrower interests of the municipality. In other words, where compromise acceptable to the state is not possible, its position must prevail.

Enforcement of minimum standards requires that the state impose controls where towns fail to implement adequate regulations within a reasonable period of time. Protection of local interests is provided through public hearings, administrative review and judicial proceedings. Although the "cooperative zoning" approach provides for minimum disruption of local control, it nevertheless represents an infringement of traditional powers. It will be regarded with suspicion. It may, however, provide an attractive alternative to complete assumption of state control in land areas subject to Council regulation.

The successful application of "cooperative" zoning principles to use control of the barriers will be conditional upon resolving several difficulties:

1. Removing nonconforming uses without violating the due process clause ("taking").

2. Minimizing community opposition while providing necessary controls.

3. Encouraging desirable multiple uses through an instrument essentially directed to single-use zoning.

4. Providing the best balance between overall flexibility and firm control of undesirable activities.

5. Establishing a legally defensible, politically acceptable and

administratively feasible review and appeal system without undermining effective control.

Flood Hazard Zoning: Flood hazard zoning is an exercise of the police power justified by the state's obligation to protect the safety of its citizens in areas subject to seasonal or periodic flooding and storm damage.[12] This obligation extends both to the residents of the hazard area itself and to those of adjacent areas which might be affected by activities in the hazard area. Regulation normally includes:[12]

1. Restrictions on the filling of marsh land (salt, fresh or mixed) because it decreases the natural storage capacity and, hence, flood resistance of the watershed.

2. Building code regulation of minimum floor elevation, construction specifications and sewage disposal systems--to protect the lives and investments of residents.

3. Standards to guarantee safe access to and egress from home sites in emergency situations.

4. Prohibitions of development which is liable to impose inordinantly heavy burdens on the community in the areas of public services and flood protection.

Under Rhode Island law (Chapter 54-24, General Laws) communities may restrict the use of land subject to flooding. They don't have to, however, and under existing law there is nothing the state can do to make them.[14] Previous state efforts to encourage adoption of flood zoning ordinances have met with very limited success. The National Flood Insurance Program (see p.) may, however, provide the necessary incentive.

Since the Council does not have authority to force local adoption of flood hazard zoning the implementation of this particular device would require that the Council take direct action. Under existing legislation the Council does not have authority to do so for the whole flood plain

although it would appear that it does for those areas specified in Section 46-23-6 of its enabling legislation. Intertidal salt marshes are among these areas as are barrier beach-dune complexes (as shoreline physiographic features).

While flood hazard zoning would provide the Council with a rationale for restricting development of barriers and marshes to alleviate flooding and promote public safety, its application would still be subject to the general limitations of zoning, direct and indirect (cooperative), as a control technique. Effective flood zoning would additionally require voluntary cooperation from coastal communities to extend protective restrictions throughout the flood basin. The Council itself does not have sufficient jurisdictional authority to implement a flood zoning program. It is unlikely that local cooperation would be forthcoming in sufficient time to forestall continued unsafe development. If, however, flood hazard zoning is found to be a useful control technique for all or some of the state's barriers, every effort should be made to encourage local participation and cooperation. Numerous models exist for establishing necessary controls. Particularly relevant material may be found in The Rhode Island Shore, Appendix B by the Rhode Island Development Council (1956), in Flood Hazard Area Management for New England, by the New England River Basins Commission (1970), and in Regulation of Flood Hazard Areas to Reduce Flood Losses, by the U.S. Water Resources Council (1971).

Federal Flood Insurance Program: Recent federal and state efforts to enroll flood prone communities in the National Flood Insurance Program

(1968) (25 Rhode Island communities are now in the program) have raised a great deal of enthusiasm among proponents of flood zoning. The stated goal of the program is to encourage state and local governments to restrict development of flood prone areas through implementation of land use controls. The incentive offered is federally subsidized flood insurance. The administrative requirements of the program and especially its emergency provisions, however, do not live up to its ambitious goals. It is possible under the emergency provision to qualify for substantially reduced insurance rates (for existing structures) by doing nothing more than determining the general extent of the flood plain. Modification of existing controls or implementation of new ones is not required. Final operational provisions require only that new construction be protected from flood damage by building code modifications to qualify for subsidized insurance. The problem of nonconforming use is handled through imposition of conventional restrictions such as prohibitions of expansion and major modification. Speedy termination of undesirable uses is not provided for and no effort is made to encourage comprehensive zoning per se. For these reasons the Council should not anticipate any great assistance from the National Flood Insurance Act in achieving its own objectives. It should certainly not regard the existence of the Act as a convincing argument in favor of flood hazard zoning.

Conservation Zoning: The exercise of zoning type restrictions on land use for the express purpose of conserving valuable and fragile natural resources is a relatively new and expanded expression of the police power. It is justified, however, under a 1970 amendment of the state constitution which expanded Article 1, Section 17 to emphasize the

public's right to enjoy and the state's duty to preserve natural resources. While many expressions of the public benefit inherent in the conservation of natural resources have been recognized by the courts, the Council should expect to be held strictly accountable for its interpretation of its charge to preserve, protect and restore the coastal resources of the state (46-23-1). There are many legitimate ways to realize this objective and each should be pursued vigorously, but an overly expansive or inadequately defended interpretation is unlikely to survive judicial review.

Subject to the due process clause of the federal and state constitutions (deprivation of use without just compensation, or "taking"), the following conservation concerns have generally been recognized as legitimate by the courts:[12]

1. Preservation and maintenance of the groundwater table.
2. Protection of the community from costs which may be incurred due to unsuitable development of areas subject to flooding.
3. Protection of salt marshes.
4. Conservation of natural conditions, wildlife and open spaces for purposes of public education, recreation and general welfare.
5. Preservation of unique natural areas or features.

The following objectives have generally been struck down as unconstitutional expressions of the police power:[12]

1. Regulation of property for aesthetic reasons alone. Aesthetic objectives will be upheld, however, in conjunction with other legitimate expressions of the police power concern for "conservation."
2. Restrictions which provide free open space or conservation areas for unspecified or vague reasons.

The numerous legitimate applications of the police power conservation

objectives suggests that it should be of great use to the Council in promoting responsible land use in fragile and vulnerable areas such as barrier beaches, dune fields and salt marshes. Here again, however, the private land owner's constitutional protection from "takings" will necessitate a very careful application of controls. An excellent example of the use of conservation restrictions can be found in the coastal wetlands statutes of several states. Rhode Island's Coastal Wetlands Act (1965) exhibits both the strengths and weaknesses of this approach. It will be of value as a model for conservation protection of other delicate natural areas and as a tool (with some modification) for marsh conservation.

Coastal Wetlands Controls: Restrictions on use of the marsh are justified on the basis of its great value as a fish and wildlife habitat and food source and on its ability to store flood waters and hence reduce flood hazards to adjacent settled areas.[18] Protection of the public safety and welfare is guaranteed by restrictions on developments of the marsh which would cause erosion or necessitate excavation or filling. Controls take precedence over local zoning regulations, although more restrictive ordinances are not preempted.

The land owner's constitutional rights and the law's validity are protected by a number of provisions which the Council might wish to consider when applying conservation controls to areas under its jurisdiction:[12]

1. Criteria for delineating the area subject to regulation are clearly established and uniformly applied.

2. Permissable uses, uses subject to qualification and uses permissable by special permit only are specified.

3. Public hearings on both 1 and 2 are held.

4. Restrictions apply to the entire designated area equally. Application is not selective.

5. All private property rights not subject to restriction are retained. Control does not imply any right of public use or trespass.

6. The individual's right to administrative and judicial review is clearly spelled out.

The law does not work because it provides the state with no alternative to paying compensatory damages if an order is found by the courts to constitute a "taking." Since only limited funds are available for wetlands acquisition, the Department of Natural Resources has not issued any orders under the Coastal Wetlands Act and is unlikely to do so. It has instead relied on less comprehensive legislation (The Intertidal Salt Marsh Act [1969]) which provides financial penalties for ecological disruption caused by dumping, excavation or filling without a Department of Natural Resources permit.

As the Coastal Wetlands Act is not now enforced, the Council cannot avail itself of what could be a useful and effective management tool. If the present law were amended to allow a more flexible response to court rulings on individual orders, it is likely that the Act would be applied and enforced. As is the case with the Massachusetts Coastal Wetlands Act, the Department of Natural Resources should be provided the option to buy (through eminent domain proceedings if necessary) the property affected by an order, to modify that order or to drop it entirely. Amendment of existing legislation to provide these options has been proposed by the Statewide Planning Program (Protection and Control of the Salt Water Shore Area, Technical Paper #21, 1972, page 35). Enforcement of the Coastal Wetlands Act would be to the Council's definite advantage and

it might wish, therefore, to support amendment. It should in any event try to retain for itself as many options as possible when and if it chooses to apply conservation restrictions to vulnerable natural areas under its jurisdiction.

Strengthening of the Coastal Wetlands Act along the lines suggested would provide the Council (through the Department of Natural Resources) with a means of controlling development of tidal salt marsh and contiguous uplands within fifty yards. Direct exercise of similar powers over other sensitive coastal areas may well be justifiable under expanded judicial interpretations of the police power protection of conservation objectives. Wholesale application of conservation zoning to the state's barrier beaches does not appear feasible, however, as:

1. It is unlikely that desirable restrictions can be placed on the many existing uses without violating due process (taking) clauses in the state constitution.

2. Conservation restrictions may not be desirable or workable for all barrier areas. The Council should retain for itself flexibility in multiple use development of suitable (tolerant) areas.

3. It may prove difficult to justify uniform restrictions for all barriers when individual barriers and subsystems (dunes, marshes, etc.) require different levels and types of controls.

Uniform restrictions can, however, be applied to clearly defined barrier units and subunits and should be legally defensible so long as the six criteria previously mentioned are met. This technique may prove particularly useful for controlling development of sensitive areas which are either presently unimproved or which are narrowly enough defined to allow for reasonable use of abutting areas. The latter application may prove appropriate to dune fields.

Additional Expressions of the Zoning Power: Minimum Lot Size: Zoning ordinances establish maximum tolerable building densities for defined zoning districts by manipulating the minimum lot size required for construction. This is a legitimate application of the police power when it is based on such considerations as groundwater depletion, sewage disposal problems, or inordinantly heavy demands on community services.[10] It is not a legitimate application when lot requirements are aimed only at the preservation of open space and has been struck down as discriminatory when applied for this purpose.[10] The general application of this technique by the Council or municipal governments may not be feasible. Most of the state's barrier beaches have been platted under or even prior to existing municipal zoning codes and many lots will be substandard if minimum lot size is increased. Many nonconforming lots will, therefore, be created and the whole problem of discontinuing their use will be introduced.

Setbacks: The right to control the location of structures by establishing minimum widths for front, side and back yards has long been upheld as a legitimate expression of the police power obligation to protect the public from fire and traffic dangers and to promote the public health and welfare by providing adequate light and air circulation.[10] Similar controls have recently been applied to shoreline construction in several states and justified by the state's obligation to protect the developer from exposure to storm dangers and the public from exposure to similar dangers caused by modification of such natural storm barriers as dunes.[1,7] Shoreline setbacks are defined by survey lines based on minimum distances from either the shoreline or features to be protected. Development seaward

of the survey line is subject to stringent control.

There is some question whether Rhode Island courts would uphold the establishment of setback lines as a legitimate expression of the Council's land control authority. It is further debatable whether they provide any useful protection which is not better served by more flexible controls under the conservation zoning power as previously discussed.

Cluster Zoning: Cluster zoning is a relatively new zoning technique which allows for concentrated development on smaller lots than would be otherwise permitted provided that substantial amounts of surrounding land are permanently preserved as open space with use restricted to recreation.[12] Overall population density is not increased and presumably reflects the capacity of the location to support a given number of users.[12] The advantages of this approach are that it encourages flexible siting to take advantage of the terrain and to preserve attractive natural features and that it offers savings on site preparation and on the installation and maintenance of public services such as roads, sewers, treatment facilities and water mains. Cluster zoning provides numerous benefits for guiding residential development of coastal areas. It would certainly help prevent the sprawling development which is currently swallowing up enormous amounts of valuable shoreline. Cluster zoning is already permitted in one coastal community (North Kingstown). The Council may wish to encourage other municipalities to examine this technique for application to their coastal areas. It may not, however, be appropriate to barrier beaches as they cannot (with the possible exception of Narragansett Pier) support the concentrations of development required to make clustering financially attractive to the developer.

Shoreline Zoning: The application of zoning techniques to the barrier beach appears to be a legitimate exercise of Council powers--subject to conditions already discussed. Zoning as to permit only those uses of the shore area which derive "maximum benefit" from such a location, however, may be ruled unconstitutionally vague. Encouraging only those uses which are substantially enhanced by location in coastal areas is, of course, a desirable Council objective, but it cannot be achieved by exercise of the police power alone.

Subdivision Regulation: Subdivision regulation is an exercise of the police power which justifies restrictions on how large parcels may be divided for residential development and how they may be subsequently developed. Sewage, water and road standards may be established, minimum lot size enforced and reservation of open space for parks and recreation required.[6] Restrictions must be equally applicable to all subdivisions under the zoning jurisdiction although they need not be (and typically aren't) the same as those applied to individual residences. Subdivision regulation of barrier development should not be an immediate concern of the Council as beaches currently under strongest development pressures consist of numerous small parcels in individual ownership. Owners could develop these parcels without exposing themselves to subdivision controls. If larger holdings which are more common on the Little Compton beaches were ever opened to development, (which appears unlikely) subdivision regulation might prove a useful management tool. There would not seem to be any legal impediment to its applications to land areas subject to Council authority.

Building Codes: The enforcement of building code requirements is an exercise of the police power justified by the community's obligation to protect the health and safety of the occupants and their neighbors and to protect itself from excess costs caused by poor construction. A number of building code restrictions appear relevant to construction on the barriers:[6]

1. Soils must provide adequate foundations and waste disposal.
2. Buildings must be constructed to resist wave, wind and water damage and must be securely anchored against movement by any of the above.
3. Construction must not increase erosion.
4. Basement, floors, pilings and access roads must be established at minimum elevations above flood level.

There does not appear to be serious legal question as to the Council's right to enforce building restrictions in areas subject to its land use controls (as defined under Section 46-23-6 of its enabling legislation). Minimum construction standards may, therefore, provide a useful method for establishing tolerable types of development. Building code regulation cannot, however, control the location of structures, their relationship to each other or the sequence of development. It will consequently be of little assistance in guiding the overall pattern of development on the barrier. It will likewise be of little help in preventing development of delicate natural areas as standards sufficiently strict to do so are likely to result in a "taking." Where construction is not found to be totally unacceptable, code enforcement should prove useful.

Other Expressions of the Police Power: Special Ordinances: An ordinance is a statute enacted by a town to regulate a specific activity. Several Rhode Island coastal communities enforce ordinances which protect valuable

and fragile barrier features by preventing or controlling dune access and vehicular use of the dune and beach. Since ordinances of this nature compliment the Council's own objectives their enactment by all coastal communities should be encouraged.

Acquisition

The several types and levels of public control over the use of private land through exercise of the police power can be duplicated by public purchase of partial or complete title to lands. In this way acquisition can provide a useful alternative or supplement to restriction. This may be a particularly attractive feature where necessary restrictions are likely to result in an illegal "taking."

Public acquisition may be either negotiated (voluntary) or condemned (compulsory). Negotiated purchase involves a voluntary surrender of partial or complete title for a mutually agreeable sum. It does not, therefore, differ substantially from a normal real estate transaction. Condemnation through the power of eminent domain, however, involves the public purchase of property or rights without the owner's consent. It is compulsory.

Conditions: The state's right of acquisition is subject to legal conditions which guard against its abuse. Conditions which apply equally to voluntary and compulsory purchase are:[14]

1. Agencies of government must be specifically delegated the right to purchase property by the legislature.
2. Acquisition must be for a public purpose.
3. Just compensation must be made to the property owner.

Public purpose is generally taken to mean that the taking must result in a benefit to the public. Three observations should be made at this point:[4,10]

1. A legislative declaration of public use has a strong presumption of validity (is presumed legitimate by the courts). Questions of necessity (the need for taking the land and adopting a particular plan for it) are considered matters of discretion of the legislature or its appointed administrative body.

2. Acquisition of land for park and recreational purposes and for aesthetic and conservation reasons has been held to meet the public test.

3. Free public access need not be provided as a condition of public purpose. Scenic control, elimination of undesirable conditions and preservation of valuable resources all justify acquisition without requiring access.

Just compensation is not an important consideration in the negotiated purchase of title as the negotiation process presumably safeguards the seller's financial interests. In the seizure of title through compulsory proceedings (condemnation by eminent domain), however, the private owner's interests are not so clearly protected. The courts, therefore, have established standards for what constitutes "just compensation." These are usually expressed in terms of "fair market value"--or the price which the property would bring if offered by a willing seller who is not obliged to sell to a willing buyer who is not obliged to buy.[4] Judicial interpretations of fair market value suggest that:[5]

1. The property owner is entitled to compensation for the value of his property at its highest and best use as this would normally be considered by a purchaser.

2. He is not entitled to compensation for any increases in his property value caused by the state wanting to purchase it.

3. He is not entitled to compensation for relocation costs or profits and business opportunities lost by displacement even though these would normally be considered in a negotiated transaction.

Analysis: The obvious general shortcoming of land use control through acquisition is the cost involved. While the constitutional requirements for its legal application are more easily met than those for police power regulation, its high price tag prevents its widespread use. Assuming that adequate funding can be arranged, acquisition provides a useful technique for controlling land areas valuable for public recreation or conservation or which require immediate and highly restrictive controls.

The shortcoming of acquisition which is most immediately relevant to the Council is, of course, that it has no legislatively delegated authority to acquire land other than through gifts. It cannot negotiate or condemn purchase of land or rights. This will seriously undermine any effort to manage land areas under the Council's jurisdiction and may additionally disqualify the state for financial aid under the new federal coastal zone management act (which requires access to the power of eminent domain). It is hoped that the Legislature will see the wisdom of granting the Council acquisition powers in areas subject to its jurisdiction. In the interim, however, the Council may have limited access to acquisition powers through the Department of Natural Resources. Access would be indirect and tenuous at best. It would undoubtably come under immediate legal fire from regulated interests and might additionally be subjected to legislative scrutiny. This in itself should not discourage the examination of indirect techniques by legal counsel.

The possibility of indirect access exists under Chapter 37-6 and 17 of the General Laws and Section 46-23-10 of the Council's enabling legislation. Chapter 37-6 authorizes the head of a state agency to acquire property for public use subject to the availability of funds and review by the State Properties Committee. 37-17 authorizes the transfer of state

owned properties from one agency to another subject to approval of the governor. 46-23-10 directs "all other departments and agencies and bodies of state government" to cooperate with the Council.

The Department of Natural Resources has the power to acquire property, by condemnation if necessary, for public purposes under its jurisdiction.[17] The Green Acres Acquisition Act of 1964 (Chapter 32-4) defines applicable public purposes as including recreation and conservation and allows acquisition of land and water, rights of way, easements and other interests by the state or its municipalities. The original $5.5 million bond issue (matched by an equal amount of federal funds) has all been spent or pledged. A new bond issue for $1.1 million was approved in November 1972 and it too is pledged with matching funds to existing or proposed recreational projects.

Council access to acquisition controls through the Department of Natural Resources depends, therefore, on a rather lengthy list of interdependent conditions:

1. The Department must agree to cooperate. No effort should be made to force it to.

2. Green Acres acquisition funds would have to be made available. This would require either a reordering of present programs to free funds or a new bond issue.

3. The State Properties Commission would have to approve any proposed acquisition.

4. The governor would have to approve any transfer of properties between the Department and the Council. It is doubtful, however, whether outright transfer would be necessary or even desirable in which case this step might not be required.

The Council's present access to acquisition powers, if it exists at all, is obviously undesirably indirect and subject to legal challenge and funding shortages. Every effort should be made, however, to gain even

limited use of purchase powers as they provide many additional and valuable management tools.

Funding Sources and Techniques--Federal Government

Several federal agencies administer cost sharing (matching funds) and grant programs whose purpose is to encourage state and municipal pursuit of objectives seen to be in the national interest. Objectives include erosion control, conservation, preservation of open space and recreational development. Programs of particular relevance to barrier land use control include:

Bureau of Outdoor Recreation--Land and Water Conservation Fund: This program provides grants covering 50% of the total cost for planning, acquisition and development of state and municipal recreational areas and facilities. Matching funds are required. The Rhode Island program is administered through the Department of Natural Resources.[9,12]

Department of Housing and Urban Development (HUD)--Open Space Land Grants: Grants cover up to 50% of the cost of acquisition and development of land in urban areas for permanent open space use (recreation, conservation, scenic value). Purchase may be of full or partial title in easements. Matching funds are required.[9] Application to barrier beaches will depend on how liberally HUD defines "urban areas."

HUD--Advance Acquisition of Land Grants: Grants cover interest on debts incurred for the municipal purchase of land for recreational

development within five years.[19]

HUD--Urban Beautification and Improvement Grants: Grants cover 50% of the cost of improving parks and other public lands. Matching funds are required and a comprehensive local beautification program must be adopted.[9] NOTE: Many HUD grant programs have been indefinately suspended through recent administration (federal) budget cuts.

Bureau of Sport Fisheries and Wildlife--Fish Restoration Aid: Grants cover up to 75% of the cost of acquisition, development, restoration and rehabilitation of fish hatching, feeding or breeding areas. 25% matching funds are required.[9] This program is administered through the Department of Natural Resources and is applicable to salt ponds and marshes.

National Wildlife Refuge System: The Bureau of Sports Fisheries and Wildlife can acquire and manage in perpetuity areas valuable as wildlife sanctuaries. These may be administered as federal conservation areas with only wildlife oriented recreation allowed.[9]

Soil Conservation Service--Small Watershed Projects: Matching grants for 50% of state or local costs of acquiring land, access rights or facilities for recreation, conservation or flood protection in small watersheds (less than 250,000 acres and unnavigable). This program would probably not be applicable to the barriers themselves, but might apply to the watershed draining into the barrier ponds.[11,12]

Soil Conservation Service--Resource Conservation and Development Projects: The Soil Conservation Service provides technical assistance for land use planning, soil analysis and resource inventorying in rural areas. Matching funds for up to 50% of certain conservation projects are also available.[9,12]

National Oceanic and Atmospheric Administration (NOAA), Office of Coastal Zone Management--Federal Coastal Zone Management Act: The new federal Coastal Zone Management Act provides for 2/3 federal 1/3 state matching grants for both management program development and administration. Guidelines for eligibility have not been finalized as yet and no money has actually been appropriated by Congress. Rhode Island may not qualify for either type of grant unless the Office of Coastal Zone Management liberally construes a legal requirement that approved agencies have eminent domain powers. If the Council met minimum requirements, however, it would be eligible for a minimum of $90,000 for program development, provided state matching funds could be raised.

Analysis: While a number of federal programs exist which may be of some interest, the federal government is by no means likely to inundate the state with largesse. The availability of federal funds will be restricted by federal spending ceilings and administration withholding of appropriated funds. Competition for remaining funds is intense and likely to get worse. A further restriction will be the state's ability to raise the necessary matching funds. This may severely limit participation in matching grant programs.

Private Funding Sources

A limited number of private conservating foundations exist which purchase or assist others in the purchase of land for open space use or eventual public acquisition. Three such foundations are active in Rhode Island.

The Audubon Society of Rhode Island: The Audubon Society acquires limited land areas by purchase or gift.[8] It generally restricts their use to only those few activities consistent with strict conservation. Lands acquired by the Audubon Society enjoy a permanent property tax exemption. The Society is not in a position to acquire significant amounts of barrier beach except through gifts. Municipalities are unlikely to encourage Society purchase of beach areas under their control because of the effect on their tax base. Society acquisition of limited amounts of ecologically fragile or unique areas would appear to be in the public's interest, but reservation of large areas of shoreline for strict conservation purposes may, in fact, run counter to that interest. The Council may expect firm support from the Society in promoting conservation of barriers, ponds and salt marshes. Equally firm opposition will greet active or defacto promotion of most types and levels of development.

Rhode Island Heritage Foundation: This group is primarily oriented towards the preservation of historical areas and structures.[8] Its charter allows for the tax free acquisition of unique natural areas, however. With a much more limited scope than the Audubon Society and no history of natural area conservation it is unlikely to become active in barrier preservation.

The Nature Conservency: The Nature Conservency has a long and distinguised nationwide reputation in conservation and recreational land acquisition.[8] The Conservency prefers to acquire property by gift or at token cost, although it raises funds from private (usually local) and foundation sources to acquire especially desirable parcels at market value. Where possible, the Conservency prefers to delegate management of its holdings to government agencies or private trusts upon satisfaction that they will preserve natural conditions. It is possible for the state or town to buy back title to land purchased from private owners by the Conservency, although no substantial savings in acquisition costs should be anticipated. As with the Audubon Society, the Nature Conservency can be expected to provide support for coastal conservation efforts. It may also be of help through the actual purchase of threatened areas.

Funding Techniques: User Charges: The federal government, most state and most Rhode Island municipal governments charge entrance fees for the use of developed public recreation facilities. These facilities are supported by all citizens through income and property taxes. However, the high cost of developing, maintaining and expanding recreational facilities is seen to justify supplemental levies on those who benefit most directly from their existence, namely, their users. Thus, the general public pays a nominal sum to provide itself with the opportunity to recreate; the recreator pays an additional sum to actually do so. The primary objective of this dual funding approach is to allow facilities to pay their own way while more equitably distributing the financial burden of doing so. It is central to the objectives of charging user fees that revenues generated be earmarked for recreational development. Where no such guarantee exists,

the imposition of fees becomes a legally suspect method of augmenting the general treasury at the expense of the recreator. Present Rhode Island administrative procedure does not encourage the earmarking of state funds from any source, although one half of the revenues generated by parking fees at Misquamicut State Beach and by concession and bathhouse rentals at other state parks is placed in the Recreational Development Fund administered by the Department of Natural Resources. Since no state park or beach actually charges an entrance fee, the contributions to the Recreational Development Fund are minor, only $200,000 in 1972. This amount would be increased substantially if even a small entrance fee was levied at all state recreational facilities.

Numerous objections can be, and often are, made to the continued complete absence of entrance fees:

1. Essentially free state beaches present unfair competition to town and private beaches which charge fees.

2. The heavy use of state beaches imposes costs (police protection, traffic control) on local communities for which they are not compensated.

3. Unlimited free access provides the recreator with what is essentially a publically subsidized experience. This can be objectionable, especially when he is from out of state and hence contributing nothing in taxes himself.

4. Free access removes a useful rationing technique. Heavy use by some elements is, again, in effect subsidized by the general public.

5. Free beaches cannot pay for themselves, let alone contribute towards the acquisition and development of needed additional facilities. Recreation is, furthermore, a weak competitor for unappropriated funds and its development is consequently handicapped.

The Council, of course, has no authority to impose entry fees for any of the state's beaches. It should,however, receive a sympathetic hearing from the Department of Natural Resources if it recommends that

they be levied. Legislative support may also be forthcoming if the advantages of meeting the above five objections to the present situation can be demonstrated.

A fee system need not impose disproportionately heavy burdens on repeat users. Discounted season passes as are common on the municipal level encourage regular use at a modest cost, while higher day charges are tolerable to the infrequent or one-time user.

The application of fee generated revenue to recreational development and acquisition (through the Green Acres Acquisition Program perhaps) would definately contribute to the realization of Council objectives. The state's ocean beaches, many of them barriers, are one of its most valuable, certainly its most plentiful, marine recreational resource. The application of user fees to recreational development of this area seems particularly appropriate.

Discount Bonding

The "floating" of bond issues has become a common method for funding recreational and open space land acquisition programs. Rhode Island has financed its matching funds under the Green Acres Acquisition Act through bond issues, the latest, for $1.1 million, in November 1972. Discount bonding is a useful technique for encouraging public financial support of future oriented acquisition programs because it transfers costs to the future in proportion to how much benefits will be realized in the future.[6] Open space and recreational lands for the future must be provided for in the present. As available land resources shrink, experience suggests that waiting until needs materialize often removes any possibility of ever meeting them. Discount bonding allows today's public

to provide for tomorrow's needs. It defers payment of interest and principal on borrowed funds until such time as the benefits of public acquisition can be realized.

Discount bonding is appropriate to the Council's obligation to provide for the state's long term marine recreation and open space needs. The Council cannot itself issue bonds or even present them for voter approval. There does not, however, appear to be any legal impediment to its administration of legislatively initiated and voter approved bonds as "gifts, grants or donations made for any of the purposes of its program" (46-23-8). Funds thus generated could be applied as matching funds either under the new federal Coastal Zone Management Act or through the Department of Natural Resources under the Green Acres Acquisition Act. They might also be applied directly through the Recreational Development Fund. It is doubtful whether the Council could acquire title on its own authority without specific legislative authorization. In the absence of such, acquisition under Department of Natural Resources programs presents a workable alternative so long as mutual cooperation is maintained.

The value of bonding as a revenue source will be limited by public willingness to assume future burdens. Public generosity knows very definite bounds. These should not be pressed.

Appropriations

Annual appropriation of funds for operating expenses is the normal legislative mechanism for funding agency activities. Appropriations very seldom include funds for land acquisition. Increasing interagency competition for available funds in the face of administration budget tightening suggests that acquisition funds are likely to become even scarcer.[1] It

is possible that the Legislature may appropriate matching funds under the federal Coastal Zone Management Act, although, again, it is doubtful whether very much or any of this will become available for direct acquisition. The Legislature's past record in passing appropriations for shoreline related programs is not encouraging.

Acquisition Techniques: Acquisition in Fee Simple

Acquisition in fee simple is the most direct and expensive form of public acquisition. It involves the purchase or condemnation of clear and absolute title to a piece of property.[6] This form of purchase gives the state unqualified control over the use of the property. Acquisition in fee simple is required where desired public and even minimum private use are mutually exclusive, as where a public beach is to be developed.

Acquisition in fee simple requires that the "fair market value" of the property, its improvements (buildings) and its potential best use be paid by the state. This can represent a prohibitively high cost. The application of this technique will, therefore, be limited by the availability of funds and the necessity of absolute control. Unless substantial sums (many millions of dollars) become available for acquisition, fee simple will be of limited value as a control. In the meantime it should only be contemplated where all other expessions of the police and purchase powers fall short of necessary controls and where adequate funds for the maintenance of the acquired property are available.

Conservation Easements

A conservation easement is a form of acquisition (voluntary or compulsory) which results in public title to less than absolute rights in

a piece of private property.[12] The state obtains the right to restrict the private owner to specified uses or activities in return for compensation for the resulting decrease in his property value.[4] The easement is a useful device because there are many public land use purposes which are compatible with restricted private ownership. Among those which have been upheld by the courts as legitimate expressions of the public acquisition power are preservation of:[12]

1. Natural beauty and scenic vistas.
2. Open spaces.
3. Unique, fragile or threatened resources, features or areas.

The acquisition of conservation easements is subject to the same legal restrictions as apply to other exercises of the public acquisition power:[4,10]

1. A public purpose must be shown. Physical possession is <u>not</u> a precondition for public purpose.
2. The agency acquiring the easement must have been delegated the authority to purchase or condemn land.
3. Just compensation must be made. This is usually defined as the difference between the value of the property as restricted and its value in its highest and best use.
4. The private property rights taken and those retained must be specified.

The conservation easement is of particular interest as an alternative or supplement to exercise of the police power. Where it appears likely that police power restrictions may constitute a taking a comparable level of control can be maintained through purchase or condemnation of an easement. In both cases, however, effectiveness requires that some minimal level of private use be consistent with a declared public purpose. This is most likely to occur where the restricted area comprises only

part of the owner's holding, the rest being subject to no extraordinary controls.

The easement offers definite advantages where minimum restrictions do not require outright acquisition. Where only defined rights are acquired, just compensation as a reflection of fair market value may be substantially less than for acquisition in fee simple.[6,12] The easement will represent an especially good bargain where restrictions are placed on an undeveloped parcel. If, however, the parcel is heavily developed, the cost of an easement may not be a great deal less than that of total acquisition (fee simple).

The effectiveness of the easement will depend on:

1. The appropriateness of restrictions to (a) the sought after public purpose, and (b) the land feature or area being restricted.

2. The duration of restrictions. Not all easements can be or need be in perpetuity.

3. The flexibility that is retained in applying restrictions. Termination should be possible where total acquisition (fee simple) becomes desirable.

The easement could become a useful tool for controlling selected areas under the Council's authority. Its general use would be restricted by funding shortages and legal requirements. Under present legislation the Council cannot purchase or condemn easements in land. It should have access to this power as both a required acquisition technique under new federal legislation and a necessary management tool. The Council can, however, receive and administer gifts (46-23-8). It would, therefore, appear useful to examine the incentives which may be offered to encourage the donation of public conservation easements.

Donation of Easements: Incentives: Individual owners will not voluntarily surrender rights to their property unless:

1. They are convinced that their interests as well as the general public's are served by accepting certain restrictions.
2. The practical exercise of their private property rights is not significantly compromised.
3. They are offered some tangible reward for whatever sacrifices they do agree to make.

Conditions one and two suggest that it will be nearly impossible to convince an owner that he should tolerate controls which severely restrict his use of any desirable portion of his holdings or which allow for public access to and use of any part of his land. This will, of course, severely limit the types of easements which will be voluntarily assumed. The addition of tax inducements should increase the owner's willingness to compromise in the public interest and may additionally provide methods for protecting the public from his reneging on his obligation.

Taxation as an Incentive

It is important to recognize that the primary tax affecting land use is the real property tax administered on the municipal level. It is not subject to state control. Since the Council has no authority to interfere in local tax matters even where tax policy runs counter to sound land use principles, it should approach this subject with extreme caution. The forceful exercise of Council police powers over land activities and areas subject to its control will discourage sympathetic municipal receipt of suggestions in other areas (such as taxation). Some balance will have to be struck between necessary firmness and desired local cooperation.

Manipulation of taxes for land use control purposes is limited by

two legal requirements:[4]

1. A public purpose must be demonstrated.
2. Equal protection must be guaranteed; i.e., taxes cannot be discriminatory.

Rhode Island courts have recognized that a public purpose exists in allowing nonuniform tax assessment.[4] Taxes can, therefore, be levied so as to encourage preservation of open space.[4]

Four legally valid applications of tax inducements are presently in use. These are (1) reduction in fair market value, (2) unlimited deferral, (3) limited deferral and (4) in-lieu payment.

Reduction in Fair Market Value: This approach requires that the Legislature authorize (not order) municipalities to reduce the tax valuation of lands subject to conservation or open space easements. In return for agreeing to restrict activity on his property to existing use, the owner is taxed on that use and not on the basis of the normal "highest and best" criteria.[1,12] Reduced valuation requires that the community receive some assurance that existing use will be continued. This is normally accomplished through deeding of easements in perpetuity or by providing penalties for development. The Rhode Island Legislature passed legislation in 1968 authorizing communities to tax open space at existing use in return for conservation easements. Penalties are provided (Chapter 44-27, General Laws, 1968).

Unlimited Deferral: Taxes can be reduced by deferral of a portion of the normal property tax on classified open space lands as long as they remain undeveloped. Land can be withdrawn for development upon payment

of deferred or "roll back" taxes. There is unfortunately no strong incentive for any but the sincere conservationist to participate in such a program. The speculator would be unlikely to participate because of the large lump sum he would have to raise prior to withdrawal and opening of his land for development. Unlimited deferral is not provided for under existing Rhode Island legislation.

Limited Deferral: Limited deferral is provided for under the 1968 legislation previously mentioned. Classified open space is taxed at a preferential rate (existing rather than best use). Roll back taxes equal to the difference between the preferential and the best use taxes must be paid when land is taken out of open space.[17] The roll back, however, only applies to the present and any two previous tax years. It does not, therefore, provide sufficient safeguards against long term speculation, as land values are liable to increase more than a three year penalty will reflect. Communities have been reluctant to risk potential losses at the hands of speculators and much local controversy has arisen over application of the law. Its value could be enhanced by adding additional provisions:

1. A conservation easement should be deeded for a specified period. Twenty years might be reasonable. After this, all restrictions would lapse.

2. The tax rate should be more highly preferential (below existing use) to encourage participation.

3. Stronger penalties should be levied for withdrawing before the agreed upon date. Payment of a proportion of assessed evaluation high enough to exceed the amount deferred should be required. This will deter land speculation.

In-Liew Payment: In-lieu payment is an inducement offered by the state to

encourage communities to preserve open space and other areas of state interest. It provides state subsidies to replace property tax revenues lost by favorable taxation of or outright acquisition of open space. In-lieu payments are not currently made by the Rhode Island State government nor is it likely that legislation authorizing them will be enacted in the near future.

Taxation: Analysis: Rhode Island communities are hard pressed for operating revenues. The property tax is their primary source. They need to derive the maximum tax revenue from all their land and consequently look favorably upon most types of development. While they are not unresponsive to the need for open space, it is questionable whether they are in any position to resist developmental pressures on high value land. They are certainly not likely to favor further erosion of their tax base by offering preferential open space taxes. The Council may, however, wish to encourage coastal communities to investigate alternative revenue sources more consistent with conservation objectives. It should not anticipate a very positive response.

Other Acquisition Techniques

Partial Purchase and Severance: Partial purchase provides a technique midway between acquisition in fee simple and acquisition of public easements. It is appropriate where acquisition of an entire parcel is unnecessary and where easements provide insufficient restriction or are totally incompatible with private property rights.[6] In such situations sufficient control can often be obtained by acquiring only part of a land holding and paying the owner severance charges. Acquisition costs may be

less than for acquisition of the entire parcel, although if the acquired portion is developed the savings might be minor. Partial purchase will be subject to the general, legal, practical and financial limitations of other exercises of the acquisition power. It does not appear to present any unique problems of its own.

Fee Simple with Lease Back: Where a need for property in the future can be foreseen, it is sometimes possible to acquire title in fee simple and then lease the use of the developed land back to the original owner.[4] The private lease can be terminated with the owner's death, passed on to a child or sold, depending on what terms are drawn into the agreement.

Change in use is usually prohibited. The lease back approach has been applied by the National Park Service in the Cape Cod National Seashore and seems to be a useful method of reserving land for conservation or eventual development. It allows for the interim continuance of unobjectionable use while providing a source of revenue (the lease) which can be applied to the acquisition cost or held in escrow for eventual site development. Lease back provides an alternative to straight purchase where no immediate use is likely. It may, therefore, encourage early acquisition of desirable future recreation and open space sites by providing a partial financial justification. Restrictions will be practical (is existing use compatible with the natural environment and eventual need?), legal (can a future public benefit be established?), and financial (can acquisition be funded?). Since it is extremely unlikely that private owners will donate properties to the state on a lease back basis the Council will be unable to avail itself of this technique unless it is delegated the condemnation power. Lease back itself should present

no problems. The Council is authorized to lease state-owned property assigned to it (46-23-6).

Purchase of Options: Another technique for the reservation of desirable property for future public use is the negotiation of a purchase option. The owner agrees to transfer title in fee simple for a specified price at a future date.[6] The agreement implies no state control over the land until title is actually transferred. Existing use could continue until that time. Presumably, if a new use which threatened the state's interest in the property were initiated the state would exercise its purchase option at that time.

The purchase of options seems particularly appropriate where immediate public use is not required and where existing use is unobjectionable. It offers both immediate and long-term financial attractions. The cost of the option itself will be substantially less than outright purchase at fair market value, while the eventual purchase price will presumably be established at less than future market value. The final acquisition is placed in the future and can, therefore, be paid for by those who will benefit from the proposed public use--all at a savings.

The option approach is not well suited to preservation of areas presently subject to undesirable or unsound development. It provides no public control until such time as the option is exercised. Uncontrolled development could in the meantime destroy the values which made the area desirable for future acquisition.

The purchase of an option will require that a future public purpose be established.[17] This purpose should be reflected as a specific proposed use for the property being acquired. Vague and general declarations of

future public needs may not justify condemnation or purchase of private property.

The purchase of options may provide a useful tool for meeting future needs. The Council does not now have the authority to either negotiate or condemn options. It would, however, acquire such authority if it were delegated general acquisiton power by the Legislature.

Combinations: A Word of Caution

The combination of police power restriction with acquisition by condemnation is felt by some planners to offer significant advantages for land use control. Application of police power restrictions reduces the fair market value of affected properties. They are worth less than they would be under no restriction. Should the state then see a public purpose in acquiring the restricted property it can condemn it at the fair market value under restriction. Substantial savings in acquisition costs are possible through application of this technique.

Combinations of the police and acquisition powers meet numerous legal objections, however. Police power restrictions cannot be applied for the sole purpose of reducing fair market value and hence facilitating acquisition.[10] The abuse of state powers inherent in such combinations is obvious and will be struck down by even the most sympathetic court. Restrictive ordinances will not be struck down simply because they have the effect of reducing property values and, hence, potential acquisition costs.[10] A restriction which is defensible as a legitimate exercise of the police power is likely to be upheld. If, however, even legitimate exercises of the police power are combined with any but the most coincidental and occasional exercises of the acquisition power, the courts

are liable to cry foul. Under the best of circumstances combinations will be viewed with great suspicion.

Inverse Condemnation: The sole variation of combination which the courts may be expected to routinely uphold applies to inverse condemnation as reflected in modern wetlands controls (see *Coastal Wetlands Controls)*. If the state's restriction of wetlands use is found to constitute a taking of private property (without just compensation), the court can do either of two things:

1. Strike down the state's order and thereby restore the affected property to unrestricted private use.

2. Require the state to pay the property owner just compensation for continued restriction. This would normally be implemented through outright purchase under eminent domain powers.

Inverse condemnation provides the state with the option to either drop its order or purchase the property at fair market value. The important point to note, however, is that market value in this case means unrestricted value. The purchase price is not determined by the imposed restrictions and is consequently less subject to legal challenge.

Combinations: Comment: Combinations appear to create as many problems as they solve. They are legally suspect and hint of a deviousness which will be poorly received by the general public and the Legislature alike. Situations may arise where combinations present themselves naturally. These should be avoided where possible. Premediated use of this technique does not appear advisable under any circumstances.

The Question of Jurisdiction

An examination of the Rhode Island Constitution and of pertinent case law in this as well as other states suggests that the public may be entitled to limited use of the shoreline above mean high water irregardless of private title.

Article I, Section 17 of the Rhode Island Constitution guarantees the public use of the shore for fishing and other "privileges."[18] The right of access to and movement along the shore is not specifically mentioned, but is strongly implied.

Swimming has been ruled by the courts as one of the "privileges" referred to in the State Constitution (Jackvony vs. Powel, 67, R.I. 218 [1941]). Public shore rights as defined constitutionally are not conditional upon the stage of the tide. Since public passage along the shore in pursuit of fish or "privileges" can only be reasonably expected to take place above mean high water at that state of the tide, it can be inferred that the public has some right to pass over what are otherwise private lands.[18]

Whatever private rights exist in shore areas above mean high water are, thus, at best unclear. They are defined more sharply, however, under the common law doctrine of custom. Unchallenged public use of beach areas above mean high water for an extended period of time has the effect of superimposing certain minimum public rights over existing private claims.[16] The Oregon courts, for instance, have ruled that the public has acquired a customary easement to use of the state's dry sand beaches between high tide and the vegetation line. They have prohibited private owners from doing anything to interfere with free public access.[16]

Rhode Island courts have yet to rule on customary public rights to

beach areas. Until they do it would be unwise to base any management position on the belief that such rights in fact exist. Since the existence of public beach rights should be of interest to the Council, it may wish to seek judicial clarification of pertinent constitutional guarantees and common law doctrines. Where rights exist, they should be protected from private infringement.

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CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

General Conclusions:

Rhode Island's barrier beaches are a valuable natural resource in need of protection and careful management.

The barriers are made of unconsolidated sediments and are frequently altered by the forces of the ocean. Barrier dunes are stabilized by vegetation, primarily beachgrass, and are easily damaged by human activities. The barriers are low in profile and highly vulnerable to wind and wave erosion particularly during hurricanes.

The barriers protect a low lying and frequently developed mainland and a series of ponds and marsh lands. Many of the ponds provide food and nursery grounds for commercial and sport fin and shell fish species. They also support large seasonal populations of waterfowl.

The barrier ponds are especially sensitive to man's activities because their controlling parameters (characteristics of flow, water properties and physical form) all can be easily altered.

In their natural state the undeveloped barriers are uniquely beautiful and will be of increasing value as the region develops.

The barriers are a limited resource. There are 30 miles of barrier beaches in Rhode Island of which 40% are developed. Pressures to develop and increase the human use of the remainder are rapidly mounting.

The above observations suggest the following management principles:

1. Even though the barrier beach municipalities should share responsibilities with the state, a uniform management program requires a large measure of state control. For this reason the Coastal Council should maintain its present requirement that all developments whether state, local or private must

receive a permit from the Coastal Council as a final step after local and other state authorizations have been obtained. The Coastal Council should provide minimum standards to the municipalities for the future use and management of the barrier beaches.

2. No residential or commercial development should be permitted on remaining undeveloped barrier beaches, but in some areas properly designed public recreational facilities may be appropriate.
3. On developed or partially developed barrier beaches no construction, with the exception of boardwalks over dunes should be permitted on dunes or in marshes. Construction may be permissable behind well-developed dunes that will provide a measure of protection from hurricane damage.
4. Pedestrian access across dunes to the beach should be over boardwalks or similar devices designed to prevent trampling of beachgrass. Foot traffic should be prohibited in the dunes except along marked stabilized trails.
5. Vehicles should be permitted on the beaches only at specific times and seasons. No vehicles should be permitted on the dunes.
6. Adequate public right-of-ways to the shore should be established and clearly marked.
7. The Coastal Council should encourage state, local and private owners in the barrier beach zone to develop programs of erosion control and dune stabilization.
8. Funds should be secured for acquisition of barrier beach areas

important as recreation or conservation areas or for public right-of-ways to the beaches.

Responsibilities for Implementation:

Cooperation between local and state authorities and private citizens is essential if the management plan is to be successful.

It should be possible to achieve several elements of the plan by either state or local regulation, or a combination of the two. These include such things as effective control of motor vehicles and pedestrian traffic, dune erosion control and stabilization programs and public education.

From the beginning of the study it was recognized that the most difficult problem is that of private property rights. Aside from the Ninigret Conservation Area in Charlestown and a few other parcels in state or local ownership, or held in conservation trust by the Audubon Society, the barrier beaches most vulnerable to development are privately owned. Regulation which seriously affects private property values may face court challenge and some form of compensation to the owners for a loss in value should be anticipated. This means that funds should be found at the state or local levels to pay compensation when necessary.

For this reason we strongly urge consideration of a *Key Parcel Acquisition Fund financed through user fees at all state recreational facilities* and in turn matched by federal funds such as those administered by the Bureau of Outdoor Recreation. One possibility might be to amend the present state Recreational Area Development Fund Act by adding the power to use the fund for acquisition. The only other avenues for development of a substantial *Key Parcel Acquisition Fund* appear to be a direct

appropriation by the General Assembly or a special statewide bond issue. If user fees are not acceptable then the other methods should be explored. We want to emphasize that some financial resources will be needed at some point to support regulation.

At the same time, it may not be necessary to move toward full acquisition in all cases. The various options discussed in the preceding chapter such as conservation easements, sale or donation of development rights, purchase and lease-back, etc., all represent possible ways to control future development at a saving of limited acquisition funds. These should be explored.

In summary, the following steps toward implementation appear to be best among the alternatives discussed in the earlier chapters.

State Responsibilities:

1. Since all permanent building in dune fields or in salt marshes should be prohibited, the Coastal Resources Management Council in cooperation with the Department of Natural Resources should arrange for an engineering survey of all developed or partially developed barrier beaches to precisely identify remaining back-dune land on which construction might be permitted.
2. The Council should have building codes drawn up by appropriate state agencies to be followed in the back-dune areas where construction may be permitted. These should be established as state minimum standards to be met by the municipalities.
3. Similar state standards should be developed for construction of walkways crossing the dunes to the beach front.
4. A special study of all privately-owned barrier beaches should

be carried out to determine the value in terms of conservation or public recreation of privately owned parcels in order to establish a priority list for acquisition or development control. At the same time this survey should identify existing and potential public access ways needed to permit cross-over points to the beach.

5. If a *Key Parcel Acquisition Fund* is created through user fees collected at state recreational facilities a portion of the funds should be paid to cities and towns where state acquisition programs take place to compensate the communities for local services such as police, fire and public works required to support the state programs.

6. In areas where building will be permitted under minimum standards established by the state, sellers of barrier beach property, as a condition of sale, should be required to inform potential buyers that the property is in a hurricane flood hazard area. To further strengthen this provision, the necessary legislation should require a statement of the buyer's awareness of the hazard to be attached to the deed before it is accepted for filing by town and city clerks. Generally all of the barrier beaches, with the exception of a few high dunes at certain locations, are below flood levels of Standard Project Hurricanes established by Army Engineers.

7. The Department of Natural Resources should be urged to take the lead in creating an information center for dune stabilization and make available, possibly in conjunction with the University of Rhode Island, a source of beachgrass for state,

local and private use in dune-building projects.

8. The state should take the lead in dune stabilization on its own property, utilizing its beachgrass and snow fencing projects as demonstration plots of educational value to the communities and private citizens. It also should lead in protecting fragile areas from misuse.
9. The Coastal Council should make certain that regulations affecting foot and vehicular traffic on all barrier beaches are vigorously enforced both by the state or municipalities. Cross-dune foot traffic should be channeled to special cross-over points. Vehicles should be permitted on approved back-dune roadways. Vehicles should be prohibited on the beaches from June 1 to October 1 but allowed to drive on the beaches from October through May only by way of established entrances at the ends of the barriers in areas where local regulations permit. No vehicular cross-overs from back-dune roads or from the beach through the dunes should be permitted. In all other cases vehicles should be confined to approved state and municipal roads. Parking should be limited to approved parking lots that do not damage dunes. No parking should be permitted on dunes.

Local Responsibilities:

1. It is recommended that all barrier beach communities adopt flood plane zoning ordinances prohibiting all construction in dune fields and at least matching state minimum standards for back-dune construction.

2. Barrier beach communities through their building inspectors or other permit-granting agencies should make known to buyers or potential developers of barrier beach properties that in addition to local permits they must obtain a permit from the Coastal Resources Management Council.
3. While most communities now have ordinances barring vehicles from barrier beach areas from June to October it is recommended that additional ordinances be adopted prohibiting foot traffic through the dunes except over approved walkways and that such measures be vigorously enforced.
4. In their own community plans, barrier beach areas important to the communities for recreation or conservation purposes should be identified and local acquisition programs should be co-ordinated with similar state programs to prevent development.

APPENDIX I

THE REPORT OF THE CITIZENS COMMITTEE ON BARRIER BEACHES

When the study by the Coastal Resources Center reached final stages of development a 12-member citizens committee was appointed by the planning and policy committee of the Coastal Resources Management Council to contribute management recommendations.

Nine members of the Citizens Committee were appointed by the town and city councils of the communities involved. The Coastal Resources Center made available the contents of this volume and much of the information found in Volume II to the Citizens Committee which conducted four working sessions on February 7, 14, 21, and 28, 1973. The report which follows was then adopted and submitted to the planning and policy committee of the Coastal Council. This report and the recommendations of the Coastal Resources Center found primarily in Chapter VI of this volume were under study by the planning and policy committee as this volume was printed.

Introduction

The Rhode Island Coastal Resources Management Council is a state agency which was established in mid-1971 with responsibilities for planning and managing the coastal resources of the state. In response to citizen concern over a recent wave of development on barrier beaches the Council in September, 1972, in effect, called for a temporary moratorium on such development to allow it to come up with a detailed plan which is required for it to regulate and manage such areas. Since that time the Coastal Resources Center at the University of Rhode Island, working as a technical advisor to the Council, has been preparing background information and recommendations to assist in development of such a plan.

The final plan will provide the basis for regulation of development on the barrier beaches by the Coastal Resources Management Council. It also will provide information and recommendations to coordinate the efforts of private individuals, local communities and state and federal agencies in proper management of these resources.

In December, 1972, the nine ocean communities were asked by the Council's committee on planning and policy to designate members of a citizens committee to study the problem and the report by the Coastal Resources Center. In addition four "at large" members were appointed by the Council's committee on planning and policy. One of the latter was unable to participate for personal reasons and resigned. The letter from Stuart O. Hale, Acting Director of the Coastal Resources Center, to the town councils involved, follows:

"As you know, the Coastal Resources Center at the University of Rhode Island has been working closely with the state Coastal Resources Management Council on development of management plans and guidelines for our marine areas. As part of this continuing project a special study has been in progress this past fall and winter on the barrier beaches of the state.

"My group here at the University works directly with the Coastal Council's Committee on Planning and Policy headed by Mr. Alvaro Freda, vice chairman of the Council. Other members of this Council committee are Dr. William Miner of Jamestown and Mr. Joseph Turco of Westerly. Mr. Freda and his associates have asked me to put together a citizens committee to work with us on barrier beach policy recommendations. They strongly feel that the towns and the cities involved should have good representation on the citizens committee. I heartily concur. We aren't looking for a rubber stamp but rather serious, hardheaded and realistic examination of the alternatives. The Coastal Resources Center will serve as staff for the citizens committee.

"We are planning for a committee of about a dozen individuals, nine of whom would represent the coastal communities. Could I ask you to designate a member from your community who is thoroughly familiar with your local problems and the attitudes and aspirations of your citizens? I would appreciate it if I could receive the name, address and phone number of your designee as soon as possible.

"Our timetable for submission of recommendations to the Coastal Council is about March 1. This means that the report from the Coastal Resources Center and the report and recommendations of the citizens committee should be in final form by about mid-February. I would like to set up an initial meeting of the committee by mid-January and can visualize a minimum of four meetings on a weekly basis from about January 15 to February 15. It is quite possible we will need more.

"I do hope you will give this matter your immediate attention because the exercise in which we are engaged can have a most important impact on your community."

Members of the committee consisted of:

Mr. Richard E. Updegrove	Middletown
Mr. Clement A. Griscom, IV	Westerly
Mr. Kenneth R. Duhamel	Charlestown
Mrs. Nelson Cabot	Little Compton
Mr. Herbert Maack	Narragansett
Mr. Charles J. Dowling, Jr.	Jamestown
Mr. Daniel McCarthy	Newport
Mr. Joseph Frisella	Wakefield
Mr. John Gray	Block Island
Mr. Carl W. Haffenreffer member-at-large	Little Compton (resigned for personal reasons)
Mrs. Margaret Neubert member-at-large	North Kingstown
Sen. William O'Neill member-at-large	Narragansett
Dr. Scott Nixon member-at-large	University of Rhode Island

C. Conclusion

The steps we are recommending are not simple or subject to implementation by a simple directive to a single state or local agency. A combination of state, community and private cooperation is required. The goal - preservation and proper utilization of a unique and limited resource - is so important, however, that the efforts of all Rhode Islanders, whether inland or shore residents, should be exerted for effective management.

true of dunes along state beaches as it is of dunes around private homes. It is true that severe hurricanes will level even well-stabilized dunes but healthy, beach grass-protected dunes can survive ordinary storms and slow the movement of sand into the salt ponds as well as buffering storm effects on development beyond the ponds.

We feel that along many of the barrier beaches local property owners were aware of the problem, but have neither the information nor the tools to deal with it adequately. If these are provided by either the state or the municipality it is felt that voluntary cooperation would be generally secured.

Two requirements are necessary for a successful program:

-a readily available and well-advertised source of beach grass,

-education about the need for stabilization, the best means to achieve it, and technical assistance in applying such techniques.

Either the state or the federal government (Soil Conservation Service) might be called in to develop such a program. The University of Rhode Island is also a rich source of expertise in this problem.

The barrier beach plan should designate priority areas in immediate need of stabilization.

Responsibility for initial implementation and coordination of the program should be assumed by local government.

This could include mobilizing local groups such as the Boy Scouts, Girl Scouts, schools, and other organizations to assist in planting grass and erecting other barriers.

Commercial advertising signs on barrier beaches should be prohibited.

Foot Traffic: The major problem resulting from foot traffic on barrier beaches has been the destruction of beach grass which leads to blowouts and washovers. Beach grass is extremely vulnerable to destruction by foot or wheel.

We recommend that human activity directly on dunes be strictly regulated.

Access to beach areas should be appropriately marked. The use of boardwalks or other devices designed to prevent trampling of beach grass on dunes should be required.

Where practical, access to beaches over dunes should be restricted by snow fencing.

The state should provide technical advice to local governments and private individuals on the building and siting of such walks.

Local communities should be encouraged to:

-prohibit activities directly on the dunes,

-require rebuilding and stabilizing of dunes damaged through past activities such as construction of buildings,

-require that boardwalks be built to provide the property owner proper access to his beach.

Where local communities fail to take such action, the state should assume responsibility for these regulations.

Dune Stabilization: Without some stabilizing force such as beach grass, snow fencing, etc., dunes would be rapidly eroded by wind and wave action. Thus in areas where human activity has increased erosion of dunes an active program of stabilization is needed. This is as much

enforcement of on-street parking regulations.

Human activity should be restricted in such a way as to minimize ecological damage to dunes, marshes, and ponds. Stringent anti-littering regulations should be established and enforced by both state and local government.

User fees at state bathing facilities should be instituted and should be high enough to be an important source of funds for acquisition and management of state beaches. While there is already limited precedent for such application of fees, legislation is needed to broaden and strengthen the program.

Users of state beaches often place a heavy load on police and other municipal services while spending little in the community to generate tax revenues to pay for required services. We recommend that a portion of the user fees be allocated to the local community to assist in financing municipal services required by beach users.

Vehicular Traffic: We believe that vehicular use of the barrier beaches as a recreational outlet is incompatible not only with other recreational uses of these beaches, but also and perhaps more importantly, with sound natural resource management practices.

Even with local area restrictions and generally adequate surveillance and enforcement, the ecological damage that can be and has been done by even a small number of vehicles supports the need for a general management policy of exclusion of all motorized vehicles from the sand barrier beaches of Rhode Island except for service or emergency purposes.

to the public health, safety, or welfare is involved.

We also recommend that necessary legislation be passed to require that government be given options to buy land in areas designated for acquisition in a management plan or program whenever it is available for sale.

The municipalities should have the first option. Upon their refusal, the state should have a second option.

This should apply to all property in designated areas and should apply at all subsequent offerings even though options are not exercised initially.

Acquisition should be at an appraised fair market value.

In cases where land is already developed, the relocation of buildings inland (such as took place in acquisition of the Ninigret Conservation Area) should be encouraged.

The purchase or lease of conservation easements to prevent development, or the use of incentive taxation such as a variation of the current open space tax program also should be considered in cases where acquisition is not desirable or possible.

The social and economic effects of state facilities on local areas also should be considered, and a program acceptable to both worked out to deal with potential problems. These effects in the past have included serious traffic problems, police and other service costs to local government, and aesthetic deterioration.

The human capacity of public facilities should be determined and the use of such facilities limited accordingly. Techniques for limiting use include controlled pedestrian access, limited parking, and strict

In these areas the state should set minimum standards for evaluating the environmental impact of such development. Where communities adopt these or more stringent standards, precedence should be given to their findings. In cases where such regulations are inadequate, the state should assume greater responsibility.

Acquisition and Management: In areas where necessary regulations must be so stringent as to prohibit building, or make it so expensive or difficult that most property owners cannot afford it, the state or town should acquire the land.

Other areas which should be acquired include those where some public use is desired or where conservation of natural resources is important for ecological reasons.

Acquisition should not be on an unplanned basis, however, but should be carried out as the implementation of an overall program.

Such a program should include designated use of the area after acquisition, and should establish a mechanism for proper management, including the provision of adequate funding.

Too often, in our estimation, land owned by the state has deteriorated because of inadequate resource management practices i.e. poor dune conditions at Ninigret Conservation Area.

The management program should include enforcement of necessary regulations, coordination of activities between the state and municipality, signs clearly designating restricted and/or fragile areas, and educational displays. Hazardous areas should be well marked.

We recommend acquisition through the use of eminent domain, only in cases where significant destruction of a natural resource or danger

-to maintain absorption-buffering capacity of marshes for storm water levels.

At the same time we recognize that a property owner has the right to make a reasonable use of his land. Even if the state or local government intends to buy this property in the future the government should not, prohibit reasonable use or restrict it so extensively that it becomes a burden to the owner.

Areas of Particular Concern

Building on the Barriers: Building on barrier beaches is not a wise practice. However, we recognize that there are certain types and regions of barrier beaches which present fewer problems than others. For example, the Coastal Resources Center report indicates that back-dune areas may be more amenable to building than fore-dune and dune crest. Also certain areas have been built up for years and have survived major hurricanes with minor damage.

We recommend that a system of priorities for regulation and acquisition be established which recognizes the differing character of these areas. This should be carried out by the state in consultation with the local communities.

The definition of the capacity of particular areas to withstand development we prefer to leave to those with technical expertise.

In areas where building is to be allowed, initial responsibility for regulation should be left to the communities through local zoning, building, and other ordinances.

risk to their own lives and property, the damage which they are doing to a natural resource, or the importance of the beaches, dunes, marshes and ponds.

-that others using such development also are not aware of the risk.

-about destruction to property along the shores of the ponds caused by wreckage from barrier development carried inland by storms.

-about the financial condition of municipalities which depend on periodically destroyed beach development for portions of their tax base.

-about the financial burden on towns resulting from replacing storm and erosion destroyed utilities necessary to service barrier development, from efforts to evacuate barrier residents stranded by storms, and from the need to provide storm protection and beach stabilization facilities to protect such development.

Barrier beaches need to be preserved and enhanced:

-to provide recreational facilities for the public at large, such as swimming, walking, fishing, hunting, and wildlife appreciation.

-as protectors of the marshes and ponds which provide spawning grounds and nurseries for offshore fisheries, important shellfish habitats, and nesting and migratory resting grounds for wildfowl,

-to maintain and improve their buffer capacity to moderate storm waves,

The plan should establish minimum standards for evaluating the impact of barrier beach uses on the environment. Local communities should be encouraged to adopt these or more stringent standards as part of local zoning, building, or other ordinances.

Besides setting minimum standards, the state should also provide technical assistance and guidance and arrange for financial aid to the communities where necessary to help in implementation of the plan.

As in the development of the plan, public education and information should play an important role in implementation.

Permit applications and hearings at both the state and local level should play an important role in implementation.

Problems affecting implementation should be well publicized.

Technical advice should be made available to the private citizen as well as to local government.

Besides being able to assist directly in implementation, an informed public will provide a strong political base to bolster local governmental efforts.

B. Objectives and Policies

The Basis for Action

The Committee recognizes that barrier beaches are one of the greatest natural resources of the state, and that they perform various functions and provide various amenities, but they are fragile and in need of protection.

We are concerned:

-that people building on barrier beaches are not aware of the

and in such a manner create an audience receptive to programs and plans, and better equipped to evaluate them.

The need for the plan should be made clear. Public meetings, the news media, mailings, etc., should be active parts of the planning process.

Implementation of the Plan

We recommend that where the municipalities are willing and able to implement the barrier beach plan they should be encouraged to do so.

Local government is more aware of the problems and needs of its area, and is likely to be more responsive to the desires of local citizens who will be most affected by the plan.

It is only after a demonstrated inability or unwillingness on the part of a community to take the necessary steps toward implementing the plan that the state should assume the major regulatory role. A reasonable time limit should be agreed upon before this transfer takes place.

Particularly, allocation of land uses on barrier beaches through zoning should continue to be a local function.

To assist local communities in determining appropriate zoning for barrier beaches, the state should provide technical guidance and advice to communities. For example, such assistance might include information on the impact of various types of zoning on the environment, on the tax base of the community, on community facilities or on other areas of local concern. In addition, the state might design a set of model ordinances for the beaches.

Management Council. It covers those issues which the Citizens Committee feels are of particular importance to them as citizens of local communities. Except where otherwise noted, recommendations represent a consensus of the Committee members.

The Appendices of this report contain reports from those members who wished to express a particular concern. These individual reports were not edited or voted on by the Committee.

A. General Approach

Development of a State Plan

Without a continuing two-way open communication between government and citizens any government-initiated plan, no matter how well conceived, runs the risk of being viewed with suspicion as an attempt to diminish the position of local government to respond to local problems.

We believe, therefore, that any state plan for the barrier beaches must be the result of an *open planning process* which incorporate local government and citizens in each step of the process. Preparation of the plan must be accompanied by a continuous and active effort to inform and educate the public.

The importance of public education at every stage of the process cannot be overstressed. An informed public is one that we believe will respond to the problems of the barrier beaches.

The state should initiate an active program of public education to provide information on the nature and problems of barrier beaches,

They were assisted in their deliberations by the staff of the Coastal Resources Center and the Statewide Planning Program. In addition, members of the Council's committee on planning and policy attended all meetings. The committee met four times during February, 1973 prior to drafting the report which follows.

The citizens committee was not asked,nor has attempted, to prepare a plan for barrier beach management. Nor has it attempted a detailed or technical critique of the report to be made by the Coastal Resources Center to the Council. Although the Coastal Resources Center made available to the committee in the form of "working papers" sections of its report, the views which follow were arrived at in the course of discussion and debate after weighing the available technical evidence. It should also be pointed out that the recommendations presented here do not necessarily reflect those of the town governments involved since it was not possible in all cases in the time available to fully communicate with town and city councils and bring back their views.

Public hearings over proposed regulations on the building at Green Hill in South Kingstown brought out large numbers of local citizens, and consequent controversy and actions indicated that issues of deep and widespread concern were at stake, both at Green Hill and on the other barrier beaches of the state. Debates over building, beach buggies, public access and use, state beach management, etc., are not new. Such issues, however, are central to the development of a plan for management of the state's barrier beaches.

This report is a set of recommendations to the Coastal Resources

APPENDIX 2

Glossary

1. Barrier beach: a narrow strip of land made of unconsolidated material that extends roughly parallel to the general coastal trend and is separated from the mainland by a relatively narrow body of water.
2. Beach: the zone of unconsolidated material (sand, pebbles or cobble) extending landward from the mean low water line to where there is a change in material or physiographic form such as a zone of permanent vegetation, or dunes.
3. Beach face: the section of beach normally exposed to action of wave uprush.
4. Berm: the nearly horizontal portion of a beach formed by the deposition of material by wave action.
5. Beachgrass, American: Ammophila breviligulata is the natural primary dune vegetation in New England. It is a grass which grows in clumps and traps sand in its roots and between its stems.
6. Blowout: a wind eroded segment of a dune stretching from the dune crest to the dune base. Wind erosion takes place where vegetation is removed or killed and unprotected sand is exposed.
7. Culm: an individual beach grass plant including root stock and stem.
8. Dune: a ridge or mound of loose, wind-blown material, usually sand.

9. Dune field: an area where dunes are the dominant physiographic feature.

10. Mean sea level: the average height of the ocean surface for all stages of the tide.

11. Scarp, beach: an almost vertical slope along the beach or dune foot caused by wave erosion. It may vary in height from a few inches to several feet.

12. Standard Project Hurricane: a hypothetical hurricane intented to represent the most severe combination of hurricane parameters that is reasonably characteristic of a specified region, excluding extremely rare combinations, calculated by the U.S. Weather Bureau and the Corps of Engineers.

13. Still water level: the elevation that the surface of the water would assume if all wave action were absent.

14. Storm surge: a rise in sea level along the coast due to the stress of high winds on the water surface and reduced atmospheric pressure.

15. Swash: the rush of water up the beach face following the breaking of a wave.

16. Tombolo: a barrier bar or barrier spit connecting an island to the mainland or to another island.

17. Washover: the segment of a dune line that has been lowered by waves washing across the barrier.

18. Washover fan: a delta shaped feature on the landward side of a barrier formed from material eroded by waves during the formation and working of a washover.

Acknowledgments

The Report on Rhode Island's Barrier Beaches, while principally the work of Stephen B. Olsen and Malcolm J. Grant, resource analysts on the staff of the Coastal Resources Center, could not have been completed without considerable assistance from a number of individuals and agencies. George Keller, center staff member, supervised the work of George Odell, Sanford Lyne, and Mrs. Betsy Found in gathering ownership statistics about the barrier beaches. He also contributed to the basic land use planning research.

A group of University of Rhode Island faculty members served as a scientific committee and reviewed the accuracy of Chapters II and III in Volume I. The committee consisted of Dr. Robert L. McMaster, Dr. Saul B. Saila, Dr. Scott Nixon, Dr. H. Perry Jeffries, Dr. Elmer Palmatier, and Prof. John Jagschitz.

Prof. Francis Cameron of the University Marine Affairs Program contributed useful information for Chapter IV - Tools of Management. The staff of the Statewide Planning Program, in particular, Daniel Varin, Chief, Bradford Southworth and Mrs. Susan Morrison, reviewed sections of the material and consulted with the Coastal Resources Center staff on numerous occasions. Assistance also was rendered by the State Department of Natural Resources and the Army Corps of Engineers.

Special thanks should go to the town and city clerks and tax assessors of Westerly, Charlestown, South Kingstown, Narragansett, Jamestown, Newport, Middletown, Little Compton and New Shoreham for their courtesies in making municipal records available.

Basic map work was done by Ecological Associates of North Kingstown as part of a contract with the Coastal Resources Center and maps appearing in Volume II were drawn by Pedro Leitao, a student in the URI Department of Community Planning and area development.

Mrs. Alice Allen and Mrs. Anne Barrington spent many hours in typing, proofreading and collating the material.

The Coastal Resources Center at the University of Rhode Island began work in the fall and winter of 1971 on an inventory of the marine resources and coastal features of the state as a first step in the planning and management process required of the State's Coastal Resources Management Council under a law passed by the General Assembly in the summer of 1971. The natural resources phase of the inventory was partially completed by the fall of 1972 when the Coastal Council rearranged its priorities as a result of activities at Green Hill Beach, South Kingstown. With approximately five months available in working time, the Coastal Resources Center was asked to treat the barrier beaches as the first complete segment in its overall inventory and planning task. In the limited time available, we have attempted to follow this directive. Undoubtedly, there will be errors in publication. We hope there are no major errors in fact. An inexpensive form of printing has been employed to both conserve funds and save time.

The Coastal Resources Center is not an official arm of the Coastal Resources Management Council. Working in a voluntary public service capacity, it draws on a small technical staff and, as needed, the expertise of the marine science and marine affairs faculty of the University of Rhode Island. Current financial support consists primarily of University Funds, a portion of the institutional grant to the University from the Office of Sea Grant Programs, U. S. Department of Commerce, and a matching fund grant made available by former Governor Frank Licht through the Department of Natural Resources.

Stuart O. Hale

Stuart O. Hale
Acting Director
COASTAL RESOURCES CENTER

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